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# AN EMPIRICAL EXAMINATION OF THE STOCK MARKET RETURNS IN SELECTED ASIA-PACIFIC ECONOMIES IN THE PRE- AND POST-FINANCIAL REFORM PERIOD*

## 1 Introduction

Together with the rapid rise in the flow of capital across countries in the Asia-Pacific region (Table 1) in the early 1990s, interests in understanding the nature of relationships among the region's capital markets also continued to rise. These markets attracted further studies as more questions emerged at the outset of the recent financial crisis in the East Asian countries. With hindsight, the spectacle of price collapses around the world during the October 1987 stock market crash provided an early warning of the risk elements embedded in integrated financial markets. The 1997-East Asian financial and currency crisis further demonstrated how powerless a group of integrated economies could become in the midst of financial market meltdowns.

Rather than looking through a global perspective, this study will focus on eight capital markets in the Asia-Pacific region: Australia, Hong Kong, Japan, Korea, Malaysia, Singapore, Taiwan and Thailand. Similar to the experience at the time of the 1987 crash, the degree of market integration among some of these economies had become sufficiently high to facilitate the worst contagion of financial crisis that these economies had ever experienced in 1997-1998. These markets will be analysed from their early development period (January 1977) to the period of the East Asian financial crisis (up to January 1998). By covering a period of more than 20 important years when reforms and rapid economic developments took place, it is hoped that a more conclusive analysis of these markets will be generated.

To understand the trends, the periods will be divided into two stages: before

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and after the wave of financial liberalisation in these countries. Key indicators of the stages of liberalisation, such as relaxation of capital and exchange controls, exchange rate arrangements, and interest rate liberalisation will be reviewed. Based on these indicators, the data sample is split into the pre-and post-liberalisation period.

The paper starts with one basic question: how integrated are the Asia-Pacific stock markets? To address that first question, the co-movements of the stock markets in those eight economies will be evaluated. Standard correlation tests will be conducted to highlight the short-run relations between the movements of the stock price indices in the Asia-Pacific region. To supplement the short-run analysis, cointegration test to examine for the long-run relationships between those stock indices will also be used.

To take the study one step further, an unrestricted vector autoregressive (VAR) variance decomposition test will be conducted. The objective here is to analyse the degree to which a change in one country's stock price exerts an influence on a change in other countries' stock price series. The variance decomposition test will show the proportion of the movements in the stock index that is due to its own shocks versus those originating from other markets. From the test, the time-span for the shock in one market to have an impact on the other market can also be analysed. Lastly, the test results will help identify the most influential market(s) in this region.

The last test employed in this study is the Granger-Causality test. This test investigates possible relationships between the movements of the stock price index and its macroeconomic fundamentals. This test allows both an examination of the role that stock markets have played in the fluctuations of the macroeconomic fundamentals and an investigation of the historical feedback of these macroeconomic variables on the stock markets in Asia-Pacific countries. If the movements in the stock price indices appear to be independent of the countries' economic fundamentals, then it could be argued that the stock markets in this region are prone to speculative bubbles — confirming the experience in the past few years of the East Asian crisis.

The next section of this study will briefly review the flows of capital/investment into this region. It will then be followed by brief discussions on the financial reforms that have taken place in these economies (section 3). Section 4

provides literature reviews. Section 5 will discuss the empirical aspects of the study (the tests and the results). The paper ends with some brief concluding remarks (section 6).

## 2 Capital Flows to the Asia-Pacific Emerging Markets

While portfolio flows in the Asia-Pacific markets were insignificant during the 1970s and 1980s, they became sizable in the early 1990s. A noticeable fact is that in 1993 net portfolio inflows into the region, excluding Japan and Australia, hit an astonishing US$23.8 billion.[1] The portfolio flows reached US$20.1 billion in 1996, or 20 times larger than their 1990 total, and hence, represented the largest component of flows between 1992 and 1996 in the Asia-Pacific region. In addition, attracting foreign portfolio investment became one of the prime goals throughout the region in the 1980s, mainly for ensuring an adequate supply of capital for long-term growth.

The capitalisation of the seven Asia-Pacific stock markets (Australia, Hong Kong, Korea, Malaysia, Singapore, Taiwan and Thailand) excluding Japan, increased from about US$ 283,283 million in 1987 to US$ 1,731,016 million by end-1996 (Table 2), before taking a nose-dive in 1997. Asia-Pacific equities, excluding Taiwan, experienced a considerable loss in their values in 1997 (Table 3). The crisis in the region led to a fall in portfolio flows to global emerging economies.[2] Nevertheless, as compared to before 1990, portfolio inflows to Asia-Pacific countries remained strong at the early stage of the 1997-crisis.

## 3 An Overview of Liberalisation and Internationalisation of Asia-Pacific Stock Markets during the 1980s till the 1990s

Asia-Pacific stock markets, prior to the 1980s, were generally underdeveloped and played a less important role in intermediating resources. Alongside the underdeveloped stock markets, capital controls in this region were generally imposed to support exchange rate arrangements, as well as to insulate domestic interest rates from foreign influences. This combination discouraged competition in the financial system, and hence, limited improvements in financial intermediation.

However, during the 1980s, changes in the external environment, such as rising international interest rates and the slowing of market growth in developed

countries, stimulated most of the Asia-Pacific countries to liberalise their financial systems. The resulting changes in the financial structures encouraged foreign direct investment and more generally the promotion of the international movement of capital.

This section will only briefly highlight the key areas of liberalisation. There are three major groups of reforms in the financial sector that have had direct influence on the development of the capital markets in most Asia-Pacific economies: relaxation of capital and exchange controls; exchange rate arrangements; and liberalisation of interest rates.

### 3.1 Relaxation of Capital Controls

As shown in Table 4, Hong Kong and Malaysia have been free from capital controls since the mid-1970s or earlier, and Singapore eliminated restrictions on capital flows in the mid-1970s. More cautious moves toward capital mobility have taken place in Australia and Japan since the early 1980s. Partially free capital movements have existed in Thailand.

Korea and Taiwan began financial deregulation relatively late and substantial barriers to international capital mobility still remain, especially in Korea. Taiwan traditionally has restricted capital outflows and did not eliminate controls on current account transactions until 1987. However, significant progress has been made since 1989 in liberalizing capital inflows and outflows in Taiwan.

### 3.2 Exchange Rate Arrangements

Most Asia-Pacific countries have deregulated their exchange controls and accompanied this deregulation with a movement toward greater flexibility in exchange rates. Hong Kong virtually abolished its exchange controls as early as December 1972. In November 1974, the Hong Kong dollar was allowed to float freely. However, since October 1983, the Hong Kong dollar has been pegged to the US dollar, the intervention currency, at the rate of HK$7.8 per US$1. By the early 1980s, all of the economies included in our study had adopted some form of managed floating exchange rate policy (except Hong Kong) (Table 5).

### 3.3 Liberalisation of interest rates

Interest rate liberalisation was a major feature of the financial reforms implemented by nearly all the Asia-Pacific countries. Nevertheless, the degree and timing of interest rate liberalisation has varied from country to country. Several countries in the Asia-Pacific region, for instance, Australia, Hong Kong, Malaysia and Singapore, have carried out extensive interest rate deregulation. Other countries, such as Japan, have adopted a gradual approach to liberalisation. A summary of interest rate liberalisation in Asian-Pacific countries is presented in Table 6.

In addition to the reform measures implemented, several direct and indirect barriers to the financial sectors were also lifted by the early- and mid- 1980s. One of the key direct barriers is on foreign ownership. Some forms of withholding taxes such as on interest, dividends, and capital gains existed in most of these economies. However, by the early 1990s, these types of direct barriers had been relaxed.

Yang and Vandenberg (2000) also found few forms of structural indirect barriers, such as on the information system, accounting standard, disclosure standard and investor protection. These obstacles continue to face some of the less-developed economies listed in our study.

However, in general, it can be concluded that by the mid-1980s, all of these Asia-Pacific economies had already initiated some form of liberalisation. Around the same period, there appears to be a significant jump in the general market capitalisation rates in these economies. Based on these observations, the years of 1986/1987 have been adopted as the breaking period for the empirical analysis. The period before 1986/1987 is treated as the pre-liberalisation period, while the period after 1987 will be considered as the post-liberalisation period, when these countries started to implement reforms.

## 4 Literature Reviews

The recent literature on finance has seen an enormous increase of interest in the activity and role of the world's stock markets, particularly regarding stock price movements. These will be reviewed as three major groups of studies:

(1) The first group of studies examined evidence of stock market integration in different parts of the world. This group is further divided into two sub-groups. The first looked at the co-movements between stock markets driven particularly by the need to push for international portfolio diversification and financial reforms. Most studies here applied correlation tests and cointegration tests to evaluate the co-movements of stock market indices around the world. The second sub-group went a little bit further and evaluated the interdependencies of the stock markets in the world. Instead of just evaluating the co-movements of the stock price index, this group of studies looked at the structure of the stock price developments and the degree to which a change in one country's stock price index exerted influence on other countries' stock price indices.

(2) The second major group of studies investigated the impact of domestic macroeconomics fundamentals on the domestic stock market.

(3) The last group of studies looked at all the above mentioned issues, but focused mostly on the Asia-Pacific markets.

## 4.1 Stock market integration: co-movements and interdependencies

### *4.1.1 Co-movement of stock markets*

#### 4.1.1.1 International diversification

The early literature on international portfolio diversification can be identified as the early stage of study on market integration. It was based on estimates of correlation coefficients between national stock markets.[3] The benefit of international risk-diversification of investment was well documented by Grubel (1968), Levy and Sarnat (1970), and Lessard (1973). These studies revealed that there were gains from international diversification. In addition, studies by Ripley (1973), Panton, Lessig, and Joy (1976), and Hilliard (1979) applied more sophisticated methodologies to investigate the co-movements of world stock markets. Despite different methodologies, all these studies found evidence of co-movements among the world's stock markets.

#### 4.1.1.2 The crash of October 1987

Several studies have examined the co-movement of the world's stock markets before and after the 1987 crash. Dwyer and Hafer (1988) employed time series analysis to examine the co-movements of the stock markets in the US, the UK, West Germany, and Japan around the time of the 1987 crash. Their results showed co-movement among the markets they examined.

Another study by Meric and Meric (1997) applied correlation analysis to compare the relationships among eighteen stock markets before and after the crash. The authors concluded that national stock markets appeared to be more closely tied to one another after the 1987 crash than before it.

A study by Bennett and Kelleher (1988), on the other hand, argued that the October 1987 crash was qualitatively similar to prior episodes in that the volatility spread from market to market and correlations among some markets strengthened. Their study indicated that stock price movements in major markets had become increasingly similar in the 1980s compared to the 1970s. However, they also showed that this increased similarity of price movements was comparatively small and did not appear to have decisively influenced how markets interacted in October 1987.

#### 4.1.1.3 Financial deregulation

The trend towards market deregulation has led to an increased focus on the greater integration of the world's capital markets. A considerable amount of work on this issue has employed time series analysis, particularly unit root tests and cointegration tests. The idea that cointegration has implications for financial market efficiency was introduced by Granger (1986). The study argued that if cointegration exists between two stock markets, it suggests that one of the markets will help predict the other since a valid error correcting representation does exist. This was clearly inconsistent with the definition of weak efficiency according to which asset prices incorporate all available information. Hence, Granger suggested that the prices of assets determined in efficient markets cannot be cointegrated.

Early studies using the cointegration method, such as Taylor and Tonks (1989) and Ma (1990), carried out tests on the integration of domestic and overseas stock markets and the impact of the abolition of exchange controls. Taylor and Tonks found

that the abolition of UK exchange controls did stimulate the integration of the UK stock market with others. Yet two studies, Ma (1990) and Andrade, Clare and Thomas (1991), challenged the cointegration model in the Taylor and Tonks' study. Both Ma (1990) and Andrade, Clare and Thomas (1991) did not find any evidence of cointegration relationships.

On the other hand, studies by Blackman, Holden, and Thomas (1994) and Lee and Jeon (1995) using the Johansen maximum likelihood procedure, supported the view that there were more cointegrating vectors in the late 1980s compared to the 1970s.

The alleged inconsistency between cointegration and efficient markets has, however, been challenged in the last few years. It has been argued that the definition of efficient markets as markets in which changes in asset prices are unpredictable did not contain much economic substance. Market efficiency could be defined more usefully as a lack of arbitrage opportunities. This was the concept adopted by Dwyer and Wallace (1992), who claimed that predictability of future stock prices did not imply inefficient markets.

Even after the publication of Dwyer and Wallace (1992), the use of cointegration technique was, however, still found in many studies.[4] A commonly held view in these studies was that cointegration tests could be usefully employed to investigate the predictability of asset prices. The absence of cointegration simply ruled out the existence of a long-run equilibrium tending relationship, but did not invalidate any short-run relationships that may arise due to profit-seeking opportunities.

### *4.1.2 Interdependencies of Stock Markets*

The above section addressed the question of market integration by examining the literature on the "co-movement" of national stock price indices. However, the use of correlation coefficients in the previous empirical studies on the co-movement of stock market price indices is questionable.[5] One reason is that the correlation coefficients do not provide information on causal relationships between variables in the model. Thus, strong positive correlations in the rates of stock price returns do not provide sufficient evidence to show whether stock markets are integrated across countries or that stock markets are segmented and responding to common international shocks.

Therefore, the primary goal of this section is to examine the literature which discusses and tests for interdependencies between the time-series of stock market price indices, in order to support or reject the proposition that the world's stock markets are becoming more integrated. The main difference and the basic aim of the study of interdependencies, rather than just "co-movement", is that the study of interdependencies moves forward the analysis to examine the structures of stock price developments and the degree to which a change in one country's stock price index exerts an influence on other countries' stock price indices.

The relationships of "interdependency" among world stock price indices have been studied extensively in a variety of contexts and using different methodologies. Most of the existing literature in this area is based on daily observations over a large number of national stock indices. They are concerned with the following two issues: (1) how much of the movement in one stock market can be explained by innovations in other markets? and (2) are there any markets whose movements are causally prior to those of other markets?

One of the commonly used methods to answer this question is the vector autoregression (VAR) model. The advantages of VAR analysis are that the VAR model is not subject to any a priori restrictions on the structural relationships among the variables, and an analysis of the pattern of innovations and responses in different markets can be precisely performed by the impulse response function (IRF) analysis and variance decomposition available in the VAR model. A number of studies have applied VAR models, including Mathur and Subrahmanyam (1992), Chowdhury (1994) and Lee and Jeon (1995).

### 4.2 The Impact of Domestic Macroeconomic Fundamentals on Domestic Stock Market

Another important recent research topic on finance is the economic role of stock market prices. Recent work has considered the notion that stock prices reflect fundamental macroeconomic variables. Therefore, stock price indices can be considered as one of the leading indicators of economic activity in business cycle analysis.

In general, studies on the linkage between stock prices and macroeconomic activity are rather inconclusive. Huang and Kracaw (1984), linked the stock market to

real economic activities in terms of productivity, GNP and unemployment, among other variables. Their results confirmed that there was a strong relationship between the stock market and economic activity.

On the other hand, studies by Shiller (1981), Brainard, Shoven and Weiss (1980) and Summers (1982), found that the stock market did not always move with fundamentals in a manner consistent with the efficient markets hypothesis. The results from Summers (1982) and Brainard et al. (1980) suggested that the low level of the stock prices could not be rationally related to economic realities.

Huang and Kracaw (1984) and Fung and Lie (1990), applied the Granger causality test to investigate the "causal" relationship between stock returns and macroeconomic variables. In the Huang and Kracaw (1984) study, two macroeconomic variables, Gross National Product (GNP) and unemployment, were examined. Their result indicated that measures of real activity, changes in the log of real GNP and unemployment, were Granger-caused by the variation of stock market returns.

### 4.3 Studies on Asia-Pacific stock markets

It was not until the late 1980s that the other Asia-Pacific stock markets, the so called 'emerging markets,' including Hong Kong, Korea, Malaysia, Singapore, Taiwan and Thailand, had grown in importance. Since then, a considerable amount of work has been done to investigate the relationship (or linkage) among the national stock markets within the region. The results from existing studies indicate that Asian-Pacific stock markets are less than fully integrated. Studies by Cheung and Ho (1991), Cheung and Mak (1992) and Allen and Macdonald (1995) all showed that there is potential benefit for international diversification.

The study by Cheung and Ho (1991) examined the benefit (if any) of diversification from developed markets to Asia-Pacific emerging markets (AEMs), and discovered that the correlation between the developed market group and the AEM group was smaller than among the developed markets. Therefore, the benefit of diversification did not exist for investors in the developed countries to invest in the Asia-Pacific emerging markets. The study by Allen and Macdonald (1995) confirmed this finding. Unit root and cointegration tests were used in both studies.

Furthermore, Cheung and Mak (1992) provided evidence that the US stock market led most of the Asia-Pacific stock markets, except Korea, Taiwan and Thailand. They suggested that the difference in results with these three markets and the other Asia-Pacific markets was the difference in the countries' external capital controls. In his study, Chowdhury (1994) indicated that the US stock market influenced, but was not influenced by the Asian markets. His result also suggested that markets such as Korea and Taiwan, with severe capital controls were not responsive to innovations in foreign markets.

In addition, an important point highlighted by Chowdhury (1999) was that markets had become more integrated in recent years due to financial deregulation. Indeed, two other studies on Asia-Pacific stock markets that included more recent data sets, — Corhay, Rad and Urbain (1995) and Sewell, Stansell, Lee and Below (1996) — provided evidence of varying levels of market integration.

One question that may arise from the above literature is if the countries' stock markets are found to be independent from others, does this mean that these markets are influenced by their own domestic factors? Fung and Lie (1990) examined the economic role of the Taiwan stock market in response to changes in economic activities, and their results indicated that the information captured in the stock market did not include changes in macroeconomic variables. Therefore, they argued that the Taiwan stock market was purely speculative.

As far as the relationship between fundamental variables and expected returns in the Japanese market is concerned, most of studies found evidence of the influence of the various fundamental variables on Japanese stock market returns. For instance, Brown and Otsuki (1988) found evidence that several macroeconomic variables were sources of risk in the Japanese equity market. Chan, Hamao and Lakonishok (1991) detected that the book to market ratio and cash flow yield had the most significant and positive impacts on expected returns in the Japanese Market.

On the other hand, by considering not only economic factors but also international factors, Kaneko and Lee (1995) found international factors such as changes in oil prices and, to a lesser degree, terms of trade and exchange rates were also significant in Japanese stock market returns.

## 5 Empirical Work

In this section, sequential testing will be conducted to address key objectives listed in the Introduction of the paper. The first set of tests will evaluate the short-and long-run co-movements among the stock exchange indices in the Asia-Pacific region by conducting a standard correlation test and cointegration test. Then, the issue of interdependencies among the same markets will be examined by employing the unrestricted VAR-Variance Decomposition test.

The second set of tests will analyse the role of macroeconomic fundamentals in explaining the volatilities of the stock exchange indices in the Asia-Pacific markets. A set of macroeconomic indicators for each country will be introduced and their Granger-Causality against the country's stock exchange index will be tested.

To analyse the impact of financial reforms in the region, the periods of this analysis will be divided into the pre and post liberalisation period. Based on the discussions on financial reforms of these economies (section 2), the first set of test will be split into two periods. The first period runs from January 3, 1977 to December 31, 1986. This period corresponds with the stage when most of the Asia-Pacific stock markets were less accessible to foreign investors. The second period covers the period from January 3, 1988 to January 30, 1998. The data set excludes the period from January 1, 1987 to December 31, 1987 to avoid the disturbance of the stock market "crash" in 1987. For the first set of tests, a daily data series is employed.

As for the second set of tests on the role of macroeconomic fundamentals, the test periods is broken into three: (1) the whole sample period of January 1973–January 1998; (2) the first sub-period of January 1973–December 1987; (3) the second sub-period of January 1988–January 1998. The data set includes monthly, quarterly and annual series depending on the macroeconomic variables that are tested. Here, the 1987 "crash" period is included to evaluate the role of the fundamentals in explaining the volatilities of the stock exchange indices in these selected economies of the Asia-Pacific region during that period.

All the data sets for the tests are gathered from Datestream for all the countries, except Taiwan. The Taiwanese data sets were gathered from the Taiwan Stock Exchange. Since the stock markets in Japan, Korea and Taiwan are open on Saturday, any Saturday entries have been dropped. To ensure that each country has an entry on a

given date, any data gaps caused by holidays and other non-working days have been adjusted. Note that the stock markets within the Asia-Pacific region operate in different time zones, but with only a small gap between them.[6] Nevertheless, the implications of using this overlapping data should be considered when interpreting the empirical results.

## 5.1 An Investigation of Short- and Long-Term Co-movements in Asia-Pacific Stock Markets

### *5.1.1 Correlation Test: Short-Term Inter-relationship*

This section uses daily stock returns[7] to examine the correlation between eight Asia-Pacific stock markets. Correlation coefficients are used to measure the extent of the association between the stock returns. The basic aims here are: to compare the relationships among the Asia-Pacific stock markets before and after financial deregulation; to determine if any short-term co-movement exists in the region; and to discuss whether there is any benefit for international diversification in the future.

To test the significance of the correlation coefficient, a t-test is used under the null hypothesis of the correlation coefficient being zero against the alternative that it is not zero. In addition, since the comparison between two sub-periods is discussed in this study, it is necessary to test the significance of equal correlation coefficients. The test statistic for equal correlation coefficients is a one-tailed t-test, under the null hypothesis that corresponding correlation coefficients are equal in the two sub-periods against the alternative that the second period is greater than first period. [8]

The test results of the correlation coefficients between the daily stock returns in eight Asia-Pacific markets indicate that there was a significant difference between sub-periods 1 and 2 in terms of the degree of association in these markets. Tables 7 and 8 show an overall improvement of both correlation coefficients and the significance for each pair from sub-period 1 to 2. Most of the correlation coefficients in sub-period 1 are not significantly different from zero for 15 of the 28 market pairs examined, with the exception of the pair of Singapore and Malaysia which has a significant correlation coefficient of 0.368 (Table 7).

In contrast, the correlation coefficients in sub-period 2 are all positive and all significantly different from zero (Table 8). Another notable fact in the second period is that the correlation coefficients between Singapore and Malaysia (0.672); Singapore and

Hong Kong (0.507); and Malaysia and Hong Kong (0.452), all yield very high correlation coefficients significant at the 5 per cent level, while Korea pairwise with country yields lower correlation coefficients. This may be due to the difference in degree of financial liberalisation among these countries, as the higher the degree of financial liberalixation, the higher the degree of openness of the market.

The above results are evaluated further by testing the hypothesis for equal correlation coefficients (Table 9). The null hypothesis of correlation coefficients being the same for the two periods is rejected in 25 out of the 28 cases. Hence, the results from correlation tests indicate that the daily stock returns are more highly correlated in the period after financial deregulation.

In addition, because of economic interdependence, Singapore and Malaysia are often considered as a single unit or twin market. The result in this study provides further evidence regarding this relationship. The pair of Singapore and Malaysia has the highest correlation coefficients at the 5 per cent significance level in both sub-period 1 (0.368) and sub-period 2 (0.672). Although these correlations are the highest, they are inadequate for us to treat Singapore and Malaysia as a single market (and it should also be noted that a test of the single market hypothesis assumes a test of the law of one price, which correlation coefficients alone cannot provide). Another interesting point here is that Singapore and Malaysia both also yield higher correlation coefficients (most are significant) with other markets. This result may be due to the fact that both markets have higher levels of financial liberalisation.

In contrast, Korea, Taiwan, and Thailand yield lower correlation coefficients with less significant pairs in sub-period 1. There are sharp increases in correlation coefficients and significance levels in sub-period 2 for both Taiwan and Thailand. Korea, albeit with an improvement in the significance level, still yields the lowest correlation coefficients in the region. This comparison may imply that the pace of financial deregulation is slower in Korea than the other two countries.

Overall, the results from the correlation coefficients may suggest some conclusions concerning short-term relations between Asia-Pacific stock markets. One is that short-term co-movements do exist after financial liberalisation as the results show an overall improvement on both correlation coefficients and their significance in the period following the deregulation. The correlation coefficients indicate there are short-term co-

movements among Asia-Pacific stock markets, which suggests that the benefits of any short-term diversification, or speculative activities, are limited within the region.

Another conclusion is that the correlation coefficients in this study suggest that not only the degree, but the pace of financial liberalisation may have an impact on the role and short-term relations between Asia-Pacific stock markets. For example, Singapore and Malaysia, with a relatively high level of financial deregulation, are closely related to each other and to other markets in the region. On the other hand, Taiwan and Thailand, with lower stages of financial reforms but faster rates of reforms, show a sharp and significant increase in their correlation coefficients during the second period. In contrast, Korea, with a lower stage and a slower pace of financial deregulation, is very isolated and seems to play a less important role in the region.

### *5.1.2 Unit Root and Cointegration Tests: Long-Term Inter-relationship*

#### 5.1.2.1 Unit Root Tests

The unit root issue arises in the presence of non-stationary variables. The major problem associated with regression on non-stationary variables is 'spurious regression' resulting from non-stationarity of time series.[9] Therefore, to avoid the problem of spurious regression, it is necessary to test the order of integration of each variable in a model, to establish whether it is non-stationary and how many times the variable needs to be differenced to obtain a stationary series. Given the large sample sets that we have, the Phillips-Perron unit-root test will be employed here.

Following Phillips and Perron (1988), three regression models are used to test for the unit roots. They are:

Model 1: with constant and trend

$$Y_t = \hat{u} + \beta (t - (T/2)) + \hat{a} Y_{t-1} + e_t \qquad \text{Ho: } \hat{a} = 1 \qquad [1]$$

Model 2: with constant but not trend

$$Y_t = \ddot{u} + \ddot{a} Y_{t-1} + e_t \qquad \text{Ho: } \ddot{a} = 1 \qquad [2]$$

Model 3: without constant and trend

$$Y_t = \mathring{a} Y_{t-1} + e_t \qquad \text{Ho: } \mathring{a} = 1 \qquad [3]$$

Where: $Y_t$ represents stock price series (in log); $\hat{u}$ and $\ddot{u}$ are constant; T: total number of observation; and $e_t$: error terms. The Phillips-Perron (PP) test statistics are based on the Phillips Z-Test.

The results for both sub-periods show that the null hypothesis of a unit root cannot be rejected which indicates the presence of a unit root in the levels of all indices (Table 10 and 11). There is no evidence to support the presence of a unit root in first differences of the stock price indices, hence, changes in stock prices are stationary. In other words, all stock price series are integrated of order one, I(1), in both sub-periods. Thus, the uniqueness of a unit root in the stock price level is confirmed.

5.1.2.2 Cointegration Tests

Given the I(1) properties of all the stock market indices, the cointegration (long-run) relation-ship between them can then be tested. In the study, the Johansen Maximum Likelihood test[10] is employed to test the long-run relationship among the stock market indices of the Asia-Pacific region. If two or more stock market price indices are found to be cointegrated, it implies that: in the long-run there is an equilibrium relationship between them, and even though the price series themselves may be non-stationary they will nevertheless move closely together over time. This section uses the logarithms of the daily stock market indices to examine the long-term inter-relationships between eight Asia-Pacific stock markets before and after financial deregulation and also, the period prior to and after the 1987 crash.

The findings, in general, are as follows (Table 12):

First, there are no significant pairwise co-movements between the Asia-Pacific stock markets in the first period, with the only exception of the pair being Singapore and Malaysia (as in cointegrating equation line 1). This result, however, is consistent with the result found in the previous test of correlation coefficients for sub-period 1 in Table 7.

Second, for the multivariate cointegration tests (for vectors of more than two markets), a total of 47 cointegrating vectors are found at 5% critical value in the first period (line 2- line 48). This result seems to be in line with several studies, such as Jaffe and Westerfield (1985), Scholhammer and Sand (1985), and Eun and Sim (1989), which

reported a substantial co-movement among national stock markets for the pre-October 1987 period.

Third, this study finds that the omission of Malaysia or Singapore from any sub-group increases the probability of no cointegrating vectors (line 21, 32, 41, 43, 45 and 47).

Fourth, this study also finds that sub-groups omitting Australia, Hong Kong and Japan, or any combination of two or three of these markets, would have a high probability of rejecting the null hypothesis of no cointegrating vectors (line 16, 23-26, 31-33, 36-40 and 44-48).

Fifth, no evidence of pairwise or multivariate cointegration is found for the second sub-period. The absence of cointegration in the second sub-period rules out the existence of a long-term equilibrium tending relationship among Asia-Pacific stock markets.[11] Hence, the diversification within the region is effective for the second period, but not for the first period.

### 5.2 Interdependencies among Asia-Pacific Stock Markets: Evidence using a Vector Autoregression Model

Using Vector Autoregression Model (VAR), this section analyses the degree to which a change in one country's stock price series exerts an influence on a change in other countries' stock price series and the time path of the latter. Hence, the major difference between this section on interdependencies and the earlier section on co-movement among national stock price series lies in the fact that this VAR test examines the dynamic structure of stock price developments. First, the study looks at the effect which a shock (innovation or news) in one stock market has on others. Then, it examines whether this pattern changed after the crash of October 1987 and discusses whether financial deregulation could be the reason for any such change. Furthermore, this study examines whether there is one or more dominant or particularly influential market within the region.[12]

In attempting to answer the above questions, an unrestricted vector autoregression (VAR) model is estimated. The VAR model is used to investigate the strength and persistence of the effects of a shock or innovation in one market on the other markets in the model. The Variance Decompositions technique (VDC) is

employed for interpreting the model. The VDC determines the proportion of each variable's (i.e. market's) error that is attributable to each of the innovations in the VAR model.[13]

The same data sets of the daily stock indices described earlier will be used. The daily stock indices for each of the eight stock markets are transformed to daily rates of return by taking first differences of their logarithms.[14] Furthermore, to examine whether there have been changes in inter-relationships among stock prices in the Asia-Pacific stock markets pre- and post- the October 1987 crash and before and after financial deregulation, the sample excludes the data covering the period of the crash and is thus divided into two sub-periods (January 03, 1977 to December 30, 1986 and January 03, 1988 to January 30, 1998).

Since most of the stock price series in this study are found to be I(1) and no cointegrating relationship exists in the second period, the application of an unrestricted VAR in first differences is appropriate for this study.[15] In this study, the lag length of the VAR is chosen to be 5 trading days, which is equivalent to one normal week.[16] Another pertinent issue on the VAR test is regarding the ordering. McMillin (1991) argued that differences in the order of the variables could have quite a sensitive effect on the pattern of response in the VAR analysis and it may produce major alterations in its properties. In this study, the markets are placed in the order according to the size of the market capitalisation: Japan, Hong Kong, Australia, Malaysia, Taiwan, Singapore, Korea, and Thailand.[17] The rationale for this ordering is the assumption that the market with higher capitalisation is more likely to dominate the other markets and less likely to respond contemporaneously to innovations in the other stock markets.[18]

The VDC will not be discussed in detail as the test methodologies have been covered widely by previous literature (Sims, 1980 and Pasaran and Shin, 1997). The Variance Decompositions results, which provide the decomposition of 5-day, 10-day, and 20-day ahead forecasts of stock market returns into fractions that are accounted for by innovations in different markets, are presented in Table 13 and Table 14 for both sub-periods, respectively.

The test results indicate that these markets yield high percentage VDCs of their own innovations throughout the lag periods in both sub-periods. For example, this is found in the 5-days ahead analysis for Japan (98.55), Korea (96.90), and Taiwan

(98.63) for the first sub-period; and Japan (98.79), Korea (95.66), Taiwan (94.42) for the second sub-period.

On the other hand, the variances of the stock market indices in Australia, Hong Kong, Malaysia, Singapore and Thailand have been influenced by other markets especially by Hong Kong, Japan and Malaysia. More interestingly, the average contribution of Hong Kong, Japan and Malaysia to variations in other countries are 1.92, 1.37, and 5.55 for first sub-period; 7.54, 5.46, and 3.79 for second sub-period, respectively.[19]

In addition, the variance of Singapore in the second sub-period reflects less influence from its own innovations (47.36) when compared with other markets in the region. The variance of Singapore is 'equally' attributed to innovations in Hong Kong (19.36) and Malaysia (19.24).

The overall results indicate that variance in Asia-Pacific stock markets are mostly due to their own innovations for the first sub-period. Yet, as shown in the second sub-period, no stock market is completely autonomous in that a market's own innovations 'fully' account for their variance. It is also noteworthy that a substantial increase in the degree of interaction is detected among Australia, Malaysia, Singapore and Thailand after financial deregulation. Hence, this leads to the conclusion that the financial reforms have enhanced the inter-relationships among Asia-Pacific stock markets.

Furthermore, the results also indicate that Hong Kong and Japan are the most influential markets in the region. Japan's innovations account for about 98 percent of its own variance in both sub-periods. While no single foreign market can explain more than 0.5 percent of the variance in Japan, Japan explained the variance of other markets in the region at the average of 5.46 percent.[20]

In summary, it is important to note that most of the stock markets in the region are found to be quite highly influenced by their own markets in both sub-periods (especially Japan, Korea and Taiwan), with the exception of Singapore in the second period. Japan and Hong Kong are the most influential in the region as the results show that other markets in the region tend to be quite sensitive in response to a shock or innovation in Japan and in Hong Kong for both periods. On the other hand, Malaysia

turns out to be the most interactive market. Malaysia has a high rate of response to all shocks from other markets, especially for the second sub-period.

Moreover, this study finds a substantial increase in the degree of interdependence after the 1987 crash, and hence, reflects the effect of financial deregulation in the region. The results also indicate that a significant link exists only between markets with less (or no) restrictions on foreign investment, such as Australia, Hong Kong, Singapore and Malaysia. On the other hand, Taiwan and Korea are not very responsive to innovations on other markets since the restrictions on foreign investment in these two markets are quite severe.

## 5.3 Stock Markets and Macroeconomic Fundamentals: A Causal Analysis

The earlier results indicate that financial liberalisation has enhanced market integration in the Asia-Pacific region. However, it was also found that weak inter-relationships have continued to exist especially for those countries with high capital controls. In the light of these findings, the next empirical work investigates the existence of any interaction between stock returns and macroeconomic fundamentals in Asia-Pacific countries. The methodology used is based on Granger Causality analysis. This test is related to the idea of the impact of historical information about one variable on another variable. Thus, it focuses on the predictive content of historical information of stock returns in explaining macroeconomic variables and it also allows an examination of the historical feedback effect of these macroeconomic variables on the stock markets.

### *5.3.1 Macroeconomic Variables*

The breakdown of the sample periods for this test has been elaborated at the early part of the empirical section of the study. Ther macroeconomic variables used include indices of money supply, consumer price index (CPI), exchange rates, call money rate, yield on government bonds, corporate bond rate, industrial production, trade balance, gross national product, private consumption and total consumption per capita. They cover eight Asia-Pacific countries, namely Australia, Hong Kong, Japan, Korea, Malaysia, Singapore, Taiwan and Thailand.

Since the data for the macroeconomic variables of these economies are available in different frequencies and with different starting and ending dates, the first column in

each of the tables from 15 to 22 provides a description of each macroeconomic variable in terms of frequency.

### *5.3.2 Granger-Causality test results*

The method of Granger-Causality test (Granger, 1969) involves estimating the following equations:

$$Y_t = a + b_i Y_{(t-i)} + c_i X_{(t-i)} + u_t \quad [4]$$

$$X_t = a' + b'_i X_{(t-i)} + c'_i Y_{(t-i)} + u'_t \quad [5]$$

where: $a$ and $a'$ are constant coefficients. u and u' are random disturbance. $Y_t$ is a vector of stock return series. $X_t$ is a vector of macroeconomic variable series.

In short, the Granger Causality test consists of running regressions of stock returns on itself lagged and on each lagged economic variable.[21] Hence, if the lagged values of economic variables do not contribute a statistically significant explanation then economic variables do not Granger-cause stock returns. Similarly, to examine whether stock returns Granger-cause economic variables, the regression of each economic variable on its lags and the lagged stock returns is run. The contribution of the lagged stock return will then be examined.

ADF and Phillips-Perron tests are used to check the stationarity of the series.[22] The null hypotheses of the Granger-Causality being tested are that the joint significance of all $c_i$ is zero if each economic variable does not Granger-cause stock returns; and that the joint significance of c'i is zero if stock returns do not Granger-cause each economic variable. Hence, the test is the standard F-test. The results of pairwise Granger Causality tests are reported in Tables 15 to 22. Each table contains three sample periods: the whole sample period: January 1973–January 1998; the sub-period: January 1988–January 1998; and the sub-period: January 1973–December 1987.

Several interesting observations emerge from the overall analysis. First, the findings show that the exchange rate and the corporate bond yield are the factors which ‘caused’ stock returns in many markets. Second, with few exceptions, stock returns are independent of inflation, money supply and the trade balance. Third, there is no support

of reverse causation. No evidence of feedback 'causal' relationships between stock returns and macroeconomic fundamentals is found in any period. Fourth, this study finds a reduction of the pair of the 'causal' relationship between stock returns and macroeconomic fundamentals after financial liberalisation. [23]

For each country in the causal analysis, the results can also be divided into three groups:

(i) " <==> " : indicates feedback in the causal analyses which means that 'causal' relationships exist in both directions to and from stock returns;

(ii) "==> " or "<== ": show a unidirectional causality in the causal analyses which indicates 'causal' relationships in just one direction from macroeconomic variables to stock returns;

(iii) " – x –": indicates independence in the causal analyses which means no 'causal' relationship in any direction.

For the first group, the stock returns in the Asia-Pacific region uniformly have no feedback in the causal analyses neither in the whole sample period nor in pre- and post-financial liberalisation sub-period.

Most stock returns in the Asia-Pacific region fall into the second group: unidirectional. Australia, Hong Kong, Malaysia and Thailand exhibit unidirectional causality between stock returns and a few macroeconomic fundamentals but there is no 'feedback' relationship.

Stock returns in Australia are unidirectionally 'caused' by the exchange rate, treasury bill rate, yield of government long-term bonds, corporate bond rate and default risk premium. Stock returns unidirectionally influence its industrial production and gross national product. In Hong Kong, stock market returns are unidirectionally 'caused' by the call money rate and the exchange rate but unidirectionally influenced its private consumption. There is unidirectional causality from stock returns to the exchange rate but from industrial production to stock returns in Malaysia. These findings are consistent with several studies [24] and they suggest that stock returns in Australia, Hong Kong and Malaysia may indeed respond to monetary variables and they also reflect forecasts of future output.

On the other hand, stock returns in Thailand are unidirectionally 'caused' by the exchange rate and unidirectionally influenced its call money rate and term structure. This indicates the importance of monetary variables in the Thai market.

For the second group, stock returns in Japan, Korea and Taiwan are unidirectionally 'caused' by their macroeconomic fundamentals, but with no influence on their macroeconomic fundamentals. In Japan, stock returns have no unidirectional influence on macroeconomic fundamentals and is only unidirectionally 'caused' by the yield on government long-term bonds and the corporate bond rate. In Korea there is only unidirectional causality from the exchange rate, call money rate, corporate bond rate and the term structure to stock returns. In Taiwan, stock returns are unidirectionally 'caused' by the money supply, exchange rate, yield of government long-term bonds, corporate bond rate, default risk premium and trade balance ratio. These findings may suggest that stock returns in Japan, Korea and Taiwan only respond to monetary variables. In addition, import and export performance also influences the Taiwanese market.

The third group, as in the case of Singapore, shows that there is no 'causal' relationship between the stock market and macroeconomic variables. This may indicate that Singapore is independent of its macroeconomic variables in the causal analyses.

Hence, the findings in general show that the exchange rate and corporate bond yield appear to have Granger-caused stock returns in most of the stock markets in the Asia-Pacific region. Other macroeconomic variables such as inflation, money supply and the trade balance do not Granger-cause stock returns. In short, the results are consistent with the view that stock returns only respond to monetary variables. However, this study also finds that most of the macroeconomic fundamentals in most of the Asia-Pacific countries are not predictors of stock returns, and hence, information captured in these stock markets do not reflect changes in the macroeconomic variables.

The overall conclusion is that much of the movement in Asia-Pacific stock markets appears to be quite independent of changes in fundamental economic conditions regardless of financial liberalisation.

## 6. Brief Concluding Remarks

The test results suggest clearly that the financial liberalisation has enhanced interaction and integration between the stock markets in the Asia-Pacific region. However, despite the rise in the interdependencies among the stock markets, no long-run relationship between their returns during the post-liberalisation period was uncovered. In fact a strong short-run relationship is reported, which may arise due to profit-seeking opportunities in transactions.

Supporting the short-run relationship, much of the movement in Asia-Pacific stock markets appears to be quite independent of changes in fundamental economic conditions. Hence, one possible implication is that stock markets in the Asia-Pacific region do not satisfy the criteria for full informational efficiency[25] and this may be evidence that Asia-Pacific stock markets are subject to speculative bubbles. The findings, therefore, help explain the volatilities of the stock markets in some of these economies during the 1997 East Asian financial crisis.

This paper can be enhanced further in two fronts: 1) methodology; and 2) policy analysis. On the first issue, given the availability of the data, a careful construction of a full-fledged model should be considered to generate further analysis on the topics discussed in the paper. The use of GARCH technique in uncovering the short-run (correlations) relationship between the stock market returns will be one extension to generate more meaningful analysis.

On the policy front, more complex issues emerged from the recent financial crisis in East Asia. The results of this paper have underscored the limited role of the fundamentals in the economies. The extreme volatility of the speculative capital flows, and the costly economic crises that have accompanied recent financial crashes, have led researchers to reconsider the merits of the trend toward the liberalisation of capital markets. Calvo and Mendoza (1999) argued that the globalisation of securities markets may promote contagion among investors by weakening incentives for gathering costly country-specific information. Given the availability of the data, it will therefore be interesting to evaluate the results further by estimating the effects of speculation on the stability of the stock markets in this region. Understanding this characteristic of the stock markets in the region should provide a valuable basis for formulating policies in managing capital flows in the future.

NOTES

1. In additional, overall net equity inflows in 1993, including Japan (US$20 billion) and Australia (US$2 billion), in emerging Asia were US$52 billion (J.P. Morgan's *World Financial Markets* (various issues)).
2. Total net portfolio inflows to emerging economies in 1997 dropped from US$26 billion to US$20 billion. (See JP Morgan's *World Financial Markets*, January 1998 issue.)
3. The underlying idea of international portfolio diversification is that a greater range of alternative portfolios can be considered to make a trade-off between the risk and the rate of return associated with that portfolio. As long as stock returns in different stock markets are not highly correlated, investors in the domestic market will gain by diversifying portfolios internationally.
4. For example, see Caporale and Pittis (1998), Crowder (1996), Masih and Masih (1995) and Yuhn (1996). Caporale and Pitts (1998) re-examined the relationship between cointegration and unpredictability of asset prices. They argued that even if it can be demonstrated that cointegration has nothing to do with market efficiency, the former is still a useful tool of analysis to determine whether or not asset prices are predictable.
5. See, for example, Kohlhagen (1983) and Khoury, Dodin, and Takada (1987). In Khoury, Dodin, and Takada's study, they examined the dependence between the financial markets of the major developed countries. Their results suggested that the presence of correlation, no matter what the size and the direction of the lag, is neither a necessary nor a sufficient condition for market integration.
6. Hours ahead of Greenwich Mean Time (GMT) time in each country: Thailand (GMT + 5); Hong Kong (GMT + 6); Singapore and Malaysia (GMT + 7); Korea and Taiwan (GMT + 8); and Australia and Japan (GMT + 9). The biggest gap is between Thailand and Australia which is less than 4 hours.
7. The daily stock return is calculated as the first difference of the logarithm of the market index in local currency.
8. For further details on both test statistics for correlation coefficients and equal correlation coefficients, see Dougherty (1992).
9. A spurious regression often has a high $R^2$ because the least-square estimates are not consistent. Also, the t-statistics in a spurious regression appear to be significant since the customary tests of statistical inference do not hold. The output of a spurious regression may "look good" but it has no economic meaning.
10. For detail, see Johansen (1988), and Johansen and Juselius (1990).
11. Since no cointegration relationship is found, we don't include the results for sub-period 2 in Table 12.
12. The definition of such a market is by asymmetry in its relation with others such that its price movement affects subsequent price movements in other markets but are not affected or less strongly affected by price movement of other markets. See Eun and Shim (1989).
13. For an overview of the VAR approach, see Charemza and Deadman (1992).
14. See Granger and Morgenstern (1970) for the transformation of variables to changes in logarithms. For the argument of using stock indices as in level or return, see Doan (1992) for details.
15. Alternative models with data in level have also been estimated over the sample period. The results of the two models, in level and in first difference, are qualitatively similar.
16. Alternative models with different lag lengths have also been tested, and the results are qualitatively similar. However, this study tests formally one overall lag length versus

another by using the lag length testing programme in RATs. A VAR with 5 (10, 15, 20) lags in each variable against 10 (15, 20) lags is tested. The hypothesis that the restriction of excluding 6 through 10 lags cannot be rejected, at the usual 5 percent significance level. Moreover, the results are robust for different lag length pairs. All in all, there seems to be little or no feedback to the current stock market returns from returns lagged more than 5 days.

17. According to the International Finance Corporation (IFC) in 1996, the market capitalisations (in US$ millions) of each Asia-Pacific stock market was: Japan (3,088,850); Hong Kong (449,318); Australia (311,998); Malaysia (307,179); Taiwan (273,608); Singapore (150,215); Korea (138,817); and Thailand (99,828).
18. Some alternative orderings, such as ordering according to the sequence of business hours, are also tested. The different ordering tests yield similar results with just one difference that whichever is in the first order yields the higher degree of response from other markets. However, when comparing all the tests in which each country, taken in turn, was placed first in the order, the results showed that Malaysia, Singapore, Hong Kong, Australia, and Japan, respectively, yield a high degree of response from other markets. In addition, an alternative method, the generalised impulse response analysis, which has the property of being invariant to the ordering of variables in the VAR model, is also applied in this study.
19. The higher rate of average contribution in Malaysia (5.55) than other two countries in first sub-period may be due to the fact that Malaysia is run under a different model with a shorter period starting 03 January1983 and ending 31 December 1986.
20. The average value for Japan, 5.46 percent, is compared with 7.54 percent for Hong Kong, another relatively influential stock market in the region with a slightly lower amount of its own variance accounted for by its own innovations (97.56 percent and 91.14 percent in the first and second sub-period, respectively) than Japan (98 percent for both sub-periods) in the second sub-period.
21. Using the residuals from both regression, the hypothesis that all coefficients are zero, $b1 = .... bi = 0$; and $c1 = .... ci = 0$, can be tested.
22. All the series in this study are found to be stationary in first difference, with the exception of the annual series which are stationary in second difference. The results are available with the authors, and can be made available upon request.
23. One explanation is financial liberalisation leads to increased foreign capital flows, which do not respond to domestic fundamentals.
24. See section 5.3.1.
25. See Fama (1991) .

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**Table 1: Aggregate Net Capital Flows to the Asia and Pacific Region, 1995-2000**
(billions of US dollars)

| Type of Capital Flow | 1995 | 1996 | 1997 | 1998 | 1999[c] | 2000[d] |
|---|---|---|---|---|---|---|
| Current Account Balance | -45.3 | -52.0 | -2.9 | 94.7 | 69.5 | 47.5 |
| External Financing | 141.8 | 182.7 | 108.6 | 32.5 | 42.8 | 68.8 |
| Private Flows | 132.8 | 176.4 | 66.8 | 4.2 | 40.2 | 59.3 |
| Equity Investment | 56.8 | 62.7 | 57.8 | 60.3 | 72.8 | 77.4 |
| Direct | 42.6 | 45.4 | 51.9 | 55.2 | 54.0 | 53.6 |
| Portfolio | 14.2 | 17.2 | 5.9 | 5.1 | 18.8 | 23.8 |
| Private Creditors | 76.0 | 113.7 | 8.9 | -56.1 | -32.6 | -18.1 |
| Commercial Banks | 63.3 | 80.1 | -14.5 | -59.6 | -31.8 | -17.6 |
| Nonbanks | 12.6 | 33.6 | 23.5 | 3.5 | -0.8 | -0.5 |
| Resident Lending/Others[a] | -63.0 | -76.1 | -96.8 | -76.3 | -58.7 | -67.0 |
| Reserves (exc. Gold)[a,b] | -33.6 | -54.6 | -9.0 | -51.0 | -53.6 | -49.2 |

Notes: a) Minus denotes increase; b) Includes resident net lending, monetary gold and errors and omissions; c) Estimate; d) Forecast
Source: Rajan and Siregar (2000)

**Table 2: Capitalisation in Asia-Pacific Stock Markets**
(US$ bllions)

| | 1987 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 |
|---|---|---|---|---|---|---|---|---|
| Australia | 105.7 | 107.6 | 144.9 | 135.4 | 203.9 | 219.2 | 245.2 | 311.9 |
| Hong Kong | 54.1 | 83.4 | 121,986 | 172.1 | 385.2 | 269.5 | 303.7 | 449.2 |
| Korea | 32.9 | 110.6 | 96.4 | 107.4 | 139.4 | 191.8 | 181.9 | 138.8 |
| Malaysia | 18.5 | 48.6 | 58.6 | 94.0 | 220.3 | 199.3 | 222.7 | 307.2 |
| Singapore | 17.9 | 34.3 | 47.6 | 48.8 | 132.7 | 134.5 | 148.04 | 150.2 |
| Taiwan | 48.7 | 100.7 | 124.9 | 101.1 | 195.2 | 247.3 | 187.2 | 273.6 |
| Thailand | 5.5 | 23.9 | 35.8 | 58.3 | 130.5 | 131.5 | 141.5 | 99.8 |
| Sub-Total | 283.3 | 509.1 | 594.4 | 717.2 | 1,287.4 | 1,393.1 | 1,430.3 | 1,731.2 |
| Japan | 2,802.9 | 2,917.7 | 3,130.9 | 2,399.0 | 2,999.8 | 3,719.9 | 3,667.3 | 3,088.9 |
| Total | 3,086.2 | 3,426.8 | 3,725.3 | 3,116.2 | 4,287.2 | 5,112.9 | 5,097.6 | 4,819.9 |

Source: Emerging Stock Markets Fact Book, various issues, IFC

**Table 3: Equity Market Changes in 1997 (end-1997 compared to end-1996)**

| | Hong Kong (Hang Seng) | Japan (Nikkei) | Korea (Kospi) | Malaysia (Composite) | Singapore (Straits Time) | Taiwan (Wighted) | Thailand (SET) |
|---|---|---|---|---|---|---|---|
| % Change In local currency | -20.3 | -21.2 | -42.4 | -52 | -31 | 18.1 | -55.2 |
| % Change In US Dollar Terms | -20.4 | -30.1 | -71.2 | -68.7 | -42.5 | -0.5 | -76.1 |

Source: - World Financial Markets, JPMorgan, 02/01/1998.
-Yang and Vandenberg (2000).

**Table 4: Summary of the Relaxation of Capital Controls**

| | 1972 | 1973 | 1974 | 1975 - 1977 | 1978 | 1979 | 1980 - 1982 | 1983 | 1984 - 1988 | 1989 | 1990 | 1991 - 1997 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Australia | * | * | * | * | * | x | ^ | o | o | o | o | o |
| Hong Kong | o | o | o | o | o | o | o | o | o | o | o | o |
| Japan | * | * | * | x | x | x | ^ | ^ | ^/o | ^/o | ^/o | ^/o |
| Korea | * | * | * | * | * | * | */x | */x | */x | x | x | x |
| Malaysia | x | ^ | ^ | o | o | o | o | o | o | o | o | o |
| Singapore | x | x/^ | x/^ | ^/o | o | o | o | o | o | o | o | o |
| Taiwan | * | * | * | * | * | * | */x | */x | x | x/^ | x/^ | x/^ |
| Thailand | x | x | x | x/^ | x/^ | x/^ | x/^ | x/^ | x/^ | x/^ | ^ | ^/o |

Key:

| | |
|---|---|
| * | Heavy Restrictions |
| x | Moderate Restrictions |
| ^ | Mild Restrictions |
| o | No Restrictions |

Source: Yang and Vandenberg (2000)

**Table 5: Summary of Exchange Rate Arrangements**

| | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 - 1989 | 1990 -1997 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Australia | PGC | MF | MF | MF | MF | MF | MF | MF | MF | IF | IF | IF |
| Hong Kong | IF | IF | IF | IF | IF | IF | IF | IF | US$ | US$ | US$ | US$ |
| Japan | MF | MF | MF | MF | MF | MF | MF | MF | MF | IF | IF | IF |
| Korea | US$ | US$ | US$ | US$ | US$ | MF | MF | MF | MF | MF | MF | NMF |
| Malaysia | MF | MF | MF | MF | MF | MF | MF | MF | MF | MF | MF | MF |
| Singapore | PGC | PGC | PGC | PGC | MF | MF | MF | MF | MF | MF | MF | MF |
| Taiwan | US$ | US$ | US$ | US$ | MF | MF | MF | MF | MF | MF | MF | MF |
| Thailand | MF | MF | MF | MF | MF | MF | MF | MF | MF | MF | PGC | PGC |

Key:

| | |
|---|---|
| US$: | Pegged to US Dollar |
| PGC: | Pegged to Composite |
| IF: | Independently Floating |
| MF: | Managed Floating |
| NMF: | New Managed Floating |

Source: Yang and Vandenberg (2000)

**Table 6: Summary of Interest rate Liberalisation**

| | 1970 | 1971 | 1972 - 1974 | 1975 - 1979 | 1980 | 1981 - 1987 | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 -1997 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Australia | x | x | ^ | ^ | o | o | o | o | o | o | o | o |
| Hong Kong | ^ | ^ | ^ | ^ | o | o | o | o | o | o | o | o |
| Japan | * | * | * | x | x | x | x/^ | x/^ | x/^ | ^ | ^ | ^ |
| Korea | * | * | * | * | * | */x | x | x | x | x/^ | x/^ | x/^ |
| Malaysia | * | * | * | * | x | ^ | o | o | o | o | o | o |
| Singapore | ^ | ^ | ^ | o | o | o | o | o | o | o | o | o |
| Taiwan | * | * | * | * | */x | */x | x | x/^ | x/^ | x/^ | x/^ | x/^ |
| Thailand | * | * | * | * | x | x | x | ^ | ^ | ^ | ^ | ^ |

Key:

| | |
|---|---|
| * | Heavy Restrictions |
| x | Moderate Restrictions |
| ^ | Mild Restrictions |
| o | No Restrictions |

Source: Yang and Vandenberg (2000)

**Table 7: Correlation Coefficients, Sub-period 1: 03/01/1977 –31/12/1986**

| | **Hong Kong** | **Japan** | **Korea** | **Malaysia**** | **Singapore** | **Taiwan** | **Thailand** |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| **Australia** | 0.148 (7.6) | 0.185 (9.6) | 0.012 (0.6)* | 0.065 (2.1) | 0.081 (4.1) | 0.005 (0.2)* | -0.007(0.3)* |
| **Hong Kong** | | 0.067 (3.4) | -0.012(0.5)* | 0.089 (2.8) | 0.147 (7.5) | -0.001(0.0)* | -0.021(1.0)* |
| **Japan** | | | 0.047(2.4) | 0.024 (0.7)* | 0.069 (3.5) | -0.067(3.4) | 0.033 (1.6)* |
| **Korea** | | | | 0.028 (0.9)* | 0.022 (1.1)* | -0.028(1.4)* | 0.026 (1.3)* |
| **Malaysia**** | | | | | 0.368(12.7) | 0.032 (1.0)* | -0.001(0.0)* |
| **Singapore** | | | | | | 0.004 (0.2)* | 0.056 (2.8) |
| **Taiwan** | | | | | | | 0.051 (2.6) |

Note: Test statistics for correlation coefficients are in ( ), and the critical value (5%) is +/- 1.96.

* The null hypothesis of correlation coefficients equal to zero is accepted.

** Sample period for Malaysia: 03/01/1983 – 31/12/1986

**Table 8: Correlation Coefficients, Sub-period 2: 03/01/1988 – 03/01/1998**

| | Hong Kong | Japan | Korea | Malaysia | Singapore | Taiwan | Thailand |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| **Australia** | 0.394 (21.9) | 0.312 (16.8) | 0.105 (5.4) | 0.332 (18.0) | 0.389 (21.6) | 0.183 (9.5) | 0.154 (7.9) |
| **Hong Kong** | | 0.267 (14.2) | 0.072 (3.7) | 0.452 (25.9) | 0.507 (30.1) | 0.221 (11.6) | 0.139 (7.1) |
| **Japan** | | | 0.059 (3.0) | 0.244 (12.8) | 0.319 (17.2) | 0.152 (7.8) | 0.144 (7.4) |
| **Korea** | | | | 0.137 (7.0) | 0.089 (4.5) | 0.108 (5.5) | 0.078 (4.0) |
| **Malaysia** | | | | | 0.672 (46.5) | 0.312 (16.8) | 0.163 (8.4) |
| **Singapore** | | | | | | 0.313 (16.8) | 0.179 (9.3) |
| **Taiwan** | | | | | | | 0.148 (7.6) |

Note: Test statistics for correlation coefficients are in ( ), and the critical value (5%) is +/- 1.96.

**Table 9: Test Statistics for Hypothesis of Equal Correlation Coefficients**

| | Hong Kong | Japan | Korea | Malaysia** | Singapore | Taiwan | Thailand |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| **Australia** | 9.674 | 4.905 | 3.378 | 7.639 | 12.568 | 4.887 | 5.869 |
| **Hong Kong** | | 7.471 | 3.007 | 10.859 | 14.853 | 8.489 | 5.821 |
| **Japan** | | | 0.435* | 6.139 | 9.456 | 7.969 | 4.051 |
| **Korea** | | | | 2.998 | 2.432 | 4.935 | -6.579* |
| **Malaysia**** | | | | | 11.686 | 0.072* | 4.761 |
| **Singapore** | | | | | | 10.269 | 4.518 |
| **Taiwan** | | | | | | | 3.547 |

Note: The critical value (5%) is 1.645

* The null hypothesis of correlation coefficients for both periods being equal is accepted.

** Note that the test statistics for Malaysia is involve different calculation since the sample period (T1) for Malaysia is different from others in period1.

## Table 10: Phillips-Perron Tests of Unit Roots

Sub-period 1: 03/01/1977 – 31/12/1986

| | Test Statistics | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | With Constant and Trend | | | | With Constant but Not Trend | | | No Constant and Trend | | |
| | Z(T(rho-1)) | Z(t(rho-1)) | Z(t(beta)) | Z(PSI3) | Z(T(rho-1)) | Z(t(rho-1)) | Z(t(alpha) | Z(T(rho-1)) | Z(t(rho-1)) | Result |
| | | | | | | | | | | |
| **Australia** | -2.23 | -0.66 | 1.48 | 0.97 | 0.35 | 0.27 | -0.07 | 0.26 | 2.98 | **I(1)** |
| **Hong Kong** | -3.31 | -1.03 | 1.36 | 1.08 | -1.42 | -0.72 | 0.89 | 0.34 | 1.71 | **I(1)** |
| **Japan** | -4.39 | -1.31 | 1.59 | 2.16 | 1.35 | 1.35 | -1.19 | 0.15 | 3.78 | **I(1)** |
| **Korea** | -0.81 | -0.24 | 1.41 | 1.07 | 1.29 | 0.46 | -0.39 | 0.19 | 1.64 | **I(1)** |
| **Malaysia** | -10.02 | -2.78 | -2.76 | 4.17 | -1.68 | -0.86 | 0.84 | -0.03 | -0.32 | **I(1)** |
| **Singapore** | -1.94 | -0.75 | 0.45 | 1.29 | -2.32 | -1.62 | 1.75 | 0.18 | 1.85 | **I(1)** |
| **Taiwan** | -5.71 | -1.52 | 1.64 | 1.62 | -1.71 | -0.78 | 0.85 | 0.15 | 1.55 | **I(1)** |
| **Thailand** | -2.41 | -0.91 | -0.41 | 0.99 | -3.87 | -1.47 | 1.53 | 0.16 | 1.39 | **I(1)** |
| | | | | | | | | | | |
| **Crit. (.05)*** | -21.8 | -3.41 | (+/-3.11) | 6.25 | -14.1 | -2.86 | (+/-2.83) | -8.1 | -1.95 | |

Note: Critical values are given in Fuller (1976) and Dickey and Fuller (1981)

## Table 11: Phillips-Perron Tests of Unit Roots

Sub-period 2: 03/01/1988 – 30/01/1998

| | Test Statistics | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | With Constant and Trend | | | | With Constant but Not Trend | | | No Constant and Trend | | |
| | Z(T(rho-1)) | Z(t(rho-1)) | Z(t(beta)) | Z(PSI3) | Z(T(rho-1)) | Z(t(rho-1)) | Z(t(alpha) | Z(T(rho-1)) | Z(t(rho-1)) | Result |
| | | | | | | | | | | |
| **Australia** | -10.48 | -2.17 | 2.23 | 2.79 | -1.73 | -0.79 | 0.84 | 0.09 | 1.58 | **I(1)** |
| **Hong Kong** | -6.46 | -1.18 | 1.06 | 1.56 | -2.09 | -1.43 | 1.55 | 0.17 | 1.37 | **I(1)** |
| **Japan** | -9.29 | -2.21 | -2.28 | 3.18 | -3.04 | -1.11 | 1.08 | -0.06 | -0.57 | **I(1)** |
| **Korea** | -8.29 | -2.01 | -1.31 | 3.03 | -9.17 | -2.22 | 2.22 | 0.01 | 0.03 | **I(1)** |
| **Malaysia** | 0.73 | 0.19 | -1.08 | 3.31 | -4.44 | -2.35 | 2.41 | 0.11 | 0.85 | **I(1)** |
| **Singapore** | -2.41 | -0.56 | -0.33 | 2.47 | -5.54 | -2.24 | 2.26 | 0.06 | 0.61 | **I(1)** |
| **Taiwan** | -8.57 | -2.21 | -0.35 | 3.77 | -10.55 | -2.76 | 2.79 | 0.13 | 0.89 | **I(1)** |
| **Thailand** | -1.51 | -0.54 | -2.05 | 4.37 | -5.31 | -2.16 | 2.18 | 0.05 | 0.33 | **I(1)** |
| | | | | | | | | | | |
| **Crit. (.05)*** | -21.8 | -3.41 | (+/-3.11) | 6.25 | -14.1 | -2.86 | (+/-2.83) | -8.1 | -1.95 | |

Note: Critical values are given in Fuller (1976) and Dickey and Fuller (1981)

**Table 12: Johansen Cointegration Test**

| | Country | | | | | | | | | Likelihood | 5% Critical | 1% Critical |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Australia** | **Hong Kong** | **Japan** | **Korea** | **Malaysia** | **Singapore** | **Taiwan** | **Thailand** | | Ratio* | Value | Value |
| | | | | | | | | | | | | |
| | Pairwise Cointegrating Vectors | | | | | | | | | Sub-period 1 | | |
| | | | | | | | | | | | | |
| 1 | | | | | X | X | | | | 30.76818 | 25.32 | 30.45 |
| | | | | | | | | | | | | |
| | Multivarate Cointegrating Vectors | | | | | | | | | Sub-period 1 | | |
| | | | | | | | | | | | | |
| | All Markets | | | | | | | | | | | |
| | | | | | | | | | | | | |
| 2 | X | X | X | X | X | X | X | X | | 189.7996 | 182.82 | 196.08 |
| | | | | | | | | | | | | |
| | Southern Bloc | | | | | | | | | | | |
| | | | | | | | | | | | | |
| 3 | X | X | | | X | X | | X | | 91.58838 | 87.31 | 96.58 |
| 4 | | X | | | X | X | | X | | 71.99378 | 62.99 | 70.05 |
| 5 | X | | | | X | X | | X | | 71.60456 | 62.99 | 70.05 |
| 6 | | | | | X | X | | X | | 54.58877 | 42.44 | 48.45 |
| | | | | | | | | | | | | |
| | Others | | | | | | | | | | | |
| | | | | | | | | | | | | |
| 7 | | X | X | X | X | X | X | X | | 163.9059** | 146.76 | 158.49 |
| 8 | X | | X | X | X | X | X | X | | 152.9989 | 146.76 | 158.49 |
| 9 | X | X | | X | X | X | X | X | | 161.4402** | 146.76 | 158.49 |
| 10 | X | X | X | | X | X | X | X | | 151.0851 | 146.76 | 158.49 |
| 11 | X | X | X | X | X | X | | X | | 149.0343 | 146.76 | 158.49 |
| 12 | | X | | X | X | X | X | X | | 136.336** | 114.9 | 124.75 |
| 13 | | X | X | | X | X | X | X | | 126.4983 | 114.9 | 124.75 |

**Table 12: cont'd**

| | Country | | | | | | | | Likelihood | 5% Critical | 1% Critical |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Australia** | **Hong Kong** | **Japan** | **Korea** | **Malaysia** | **Singapore** | **Taiwan** | **Thailand** | Ratio* | Value | Value |
| | Multivarate Cointegrating Vectors | | | | | | | | Sub-period 1 | | |
| | Others | | | | | | | | | | |
| 14 | | X | X | X | X | X | | X | 126.2184 | 114.9 | 124.75 |
| 15 | | X | X | X | X | X | X | | 117.9674 | 114.9 | 124.75 |
| 16 | X | | | X | X | X | X | X | 130.3917** | 114.9 | 124.75 |
| 17 | X | | X | | X | X | X | X | 118.757 | 114.9 | 124.75 |
| 18 | X | | X | X | X | | X | X | 117.8281 | 114.9 | 124.75 |
| 19 | X | | X | X | X | X | | X | 122.1345 | 114.9 | 124.75 |
| 20 | X | X | | | X | X | X | X | 118.6867 | 114.9 | 124.75 |
| 21 | X | X | | X | X | | X | X | 116.1543 | 114.9 | 124.75 |
| 22 | X | X | | X | X | X | | X | 130.6956 | 114.9 | 124.75 |
| 23 | | | | X | X | X | X | X | 107.0591** | 87.31 | 96.58 |
| 24 | | | X | | X | X | X | X | 95.61811 | 87.31 | 96.58 |
| 25 | | | X | X | X | X | | X | 100.8056** | 87.31 | 96.58 |
| 26 | | | X | X | X | X | X | | 92.86245 | 87.31 | 96.58 |
| 27 | | X | | | X | X | X | X | 95.4632 | 87.31 | 96.58 |
| 28 | | X | | X | X | X | | X | 108.2677** | 87.31 | 96.58 |
| 29 | | X | | X | X | X | X | | 95.98599 | 87.31 | 96.58 |
| 30 | | X | X | | X | X | | X | 92.62415 | 87.31 | 96.58 |
| 31 | X | | | | X | X | X | X | 93.90475 | 87.31 | 96.58 |
| 32 | X | | | X | X | | X | X | 93.21237 | 87.31 | 96.58 |
| 33 | X | | | X | X | X | | X | 106.4895** | 87.31 | 96.58 |
| 34 | X | | X | | X | X | | X | 89.7707 | 87.31 | 96.58 |
| 35 | | | | | X | X | X | X | 73.24294 | 62.99 | 70.05 |
| 36 | | | | X | X | | X | X | 72.27829 | 62.99 | 70.05 |
| 37 | | | | X | X | X | | X | 85.81807** | 62.99 | 70.05 |
| 38 | | | | X | X | X | X | | 74.14862 | 62.99 | 70.05 |

**Table 12: cont'd**

| | Country | | | | | | | | | Likelihood | 5% Critical | 1% Critical |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Australia** | **Hong Kong** | **Japan** | **Korea** | **Malaysia** | **Singapore** | **Taiwan** | **Thailand** | | Ratio* | Value | Value |
| | | | | | | | | | | | | |
| | Multivarate Cointegrating Vectors | | | | | | | | | Sub-period 1 | | |
| | | | | | | | | | | | | |
| | Others | | | | | | | | | | | |
| 39 | | | X | | X | X | | X | | 71.08737 | 62.99 | 70.05 |
| 40 | | | X | | X | X | X | | | 64.7139 | 62.99 | 70.05 |
| 41 | X | | | X | X | | | X | | 69.60524 | 62.99 | 70.05 |
| 42 | X | | | X | X | X | | | | 66.17315 | 62.99 | 70.05 |
| 43 | X | | | X | X | | | X | | 69.60524 | 62.99 | 70.05 |
| 44 | | | X | | X | X | | | | 45.80914 | 42.4845 | 48.45 |
| 45 | | | X | | X | | | X | | 44.32783 | 42.4845 | 48.45 |
| 46 | | | | X | X | X | | | | 56.77336 | 42.4845 | 48.45 |
| 47 | | | | X | X | | | X | | 51.39887 | 42.4845 | 48.45 |
| 48 | | | | | X | X | X | | | 44.72838 | 42.4845 | 48.45 |
| | | | | | | | | | | | | |
| | 18 | 15 | 19 | 27 | 48 | 40 | 24 | 33 | | | | |

## Table 13: Variance Decompositions; Sub-period 1: 03/01/1977 – 30/12/1986

| Relative | | Explained by Innovations in | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Variation in | Days | **Australia** | **Hong Kong** | **Japan** | **Korea** | **Malaysia** | **Singapore** | **Taiwan** | **Thailand** |
| | | | | | | | | | |
| **Australia** | **5** | 92.70 | 2.41 | 3.43 | 0.34 | 0.16 | 0.15 | 0.69 | 0.24 |
| | **10** | 92.55 | 2.42 | 3.46 | 0.38 | 0.19 | 0.21 | 0.71 | 0.25 |
| | **20** | 92.54 | 2.42 | 3.46 | 0.38 | 0.19 | 0.21 | 0.71 | 0.25 |
| | | | | | | | | | |
| **Hong Kong** | **5** | 0.04 | 97.56 | 1.70 | 0.01 | 0.46 | 0.26 | 0.38 | 0.02 |
| | **10** | 0.24 | 97.15 | 1.70 | 0.04 | 0.62 | 0.39 | 0.41 | 0.03 |
| | **20** | 0.25 | 97.16 | 1.70 | 0.04 | 0.63 | 0.39 | 0.41 | 0.03 |
| | | | | | | | | | |
| **Japan** | **5** | 0.32 | 0.42 | 98.55 | 0.07 | 0.21 | 0.15 | 0.26 | 0.19 |
| | **10** | 0.33 | 0.51 | 98.33 | 0.11 | 0.32 | 0.21 | 0.28 | 0.20 |
| | **20** | 0.33 | 0.51 | 98.33 | 0.11 | 0.33 | 0.21 | 0.28 | 0.20 |
| | | | | | | | | | |
| **Korea** | **5** | 0.97 | 0.33 | 1.18 | 96.90 | 0.38 | 0.20 | 0.26 | 0.12 |
| | **10** | 1.04 | 0.53 | 1.30 | 96.43 | 1.61 | 0.21 | 0.30 | 0.16 |
| | **20** | 1.04 | 0.53 | 1.30 | 96.43 | 1.61 | 0.21 | 0.30 | 0.16 |
| | | | | | | | | | |
| **Malaysia** | **5** | 0.47 | 1.21 | 0.83 | 0.32 | 95.51 | 1.21 | 0.34 | 0.08 |
| | **10** | 0.63 | 1.24 | 1.06 | 0.35 | 94.74 | 1.25 | 0.56 | 0.13 |
| | **20** | 0.63 | 1.24 | 1.06 | 0.35 | 94.73 | 1.25 | 0.56 | 0.14 |
| | | | | | | | | | |
| **Singapore** | **5** | 0.37 | 8.39 | 2.20 | 0.02 | 36.41 | 88.69 | 0.25 | 0.04 |
| | **10** | 0.48 | 8.41 | 2.20 | 0.06 | 36.06 | 88.18 | 0.60 | 0.04 |
| | **20** | 0.48 | 8.41 | 2.20 | 0.06 | 36.05 | 88.18 | 0.61 | 0.04 |
| | | | | | | | | | |
| **Taiwan** | **5** | 0.13 | 0.28 | 0.14 | 0.20 | 0.16 | 0.10 | 99.06 | 0.04 |
| | **10** | 0.14 | 0.42 | 0.23 | 0.25 | 0.73 | 0.22 | 98.64 | 0.07 |
| | **20** | 0.14 | 0.42 | 0.23 | 0.25 | 0.73 | 0.22 | 98.63 | 0.07 |
| | | | | | | | | | |
| **Thailand** | **5** | 0.24 | 0.43 | 0.10 | 0.18 | 1.09 | 0.22 | 0.22 | 98.63 |
| | **10** | 0.30 | 0.44 | 0.11 | 0.20 | 1.52 | 0.22 | 0.28 | 98.42 |
| | **20** | 0.31 | 0.44 | 0.11 | 0.20 | 1.56 | 0.22 | 0.28 | 98.42 |

**Table 14: Variance Decompositions; Sub-period 2: 03/01/1988 – 30/01/1998**

| Relative Variation in | Days | Explained by Innovations in | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | **Australia** | **Hong Kong** | **Japan** | **Korea** | **Malaysia** | **Singapore** | **Taiwan** | **Thailand** |
| **Australia** | **5** | 79.23 | 10.35 | 9.65 | 0.17 | 0.25 | 0.09 | 0.05 | 0.22 |
| | **10** | 79.03 | 10.44 | 9.64 | 0.19 | 0.27 | 0.10 | 0.08 | 0.23 |
| | **20** | 79.03 | 10.44 | 9.64 | 0.20 | 0.27 | 0.10 | 0.09 | 0.24 |
| **Hong Kong** | **5** | 0.22 | 91.14 | 7.18 | 0.21 | 0.65 | 0.12 | 0.06 | 0.38 |
| | **10** | 0.23 | 90.98 | 7.14 | 0.29 | 0.67 | 0.14 | 0.13 | 0.39 |
| | **20** | 0.23 | 90.98 | 7.14 | 0.29 | 0.67 | 0.14 | 0.13 | 0.38 |
| **Japan** | **5** | 0.16 | 0.03 | 98.79 | 0.49 | 0.03 | 0.25 | 0.08 | 0.13 |
| | **10** | 0.17 | 0.04 | 98.72 | 0.50 | 0.04 | 0.27 | 0.10 | 0.14 |
| | **20** | 0.17 | 0.05 | 98.72 | 0.50 | 0.04 | 0.27 | 0.10 | 0.14 |
| **Korea** | **5** | 0.60 | 0.43 | 0.91 | 95.66 | 1.10 | 0.09 | 0.54 | 0.66 |
| | **10** | 0.66 | 0.71 | 0.90 | 94.49 | 1.23 | 0.39 | 0.59 | 0.99 |
| | **20** | 0.66 | 0.72 | 0.90 | 94.48 | 1.23 | 0.39 | 0.59 | 0.99 |
| **Malaysia** | **5** | 2.17 | 16.03 | 5.87 | 0.86 | 73.89 | 0.48 | 0.58 | 0.09 |
| | **10** | 2.17 | 16.21 | 5.88 | 0.94 | 73.31 | 0.48 | 0.81 | 0.19 |
| | **20** | 2.17 | 16.21 | 5.88 | 0.94 | 73.30 | 0.49 | 0.80 | 0.19 |
| **Singapore** | **5** | 2.86 | 19.36 | 9.87 | 0.59 | 19.24 | 47.36 | 0.47 | 0.22 |
| | **10** | 2.85 | 19.41 | 9.84 | 0.61 | 19.19 | 47.16 | 0.66 | 0.25 |
| | **20** | 2.85 | 19.41 | 9.84 | 0.61 | 19.19 | 47.15 | 0.66 | 0.25 |
| **Taiwan** | **5** | 0.84 | 1.66 | 2.12 | 0.12 | 0.40 | 0.34 | 94.42 | 0.08 |
| | **10** | 0.83 | 1.65 | 2.13 | 0.19 | 0.43 | 0.36 | 94.25 | 0.10 |
| | **20** | 0.84 | 1.65 | 2.13 | 0.19 | 0.43 | 0.36 | 94.25 | 0.10 |
| **Thailand** | **5** | 0.78 | 4.97 | 2.62 | 0.96 | 4.87 | 1.91 | 0.68 | 83.18 |
| | **10** | 0.80 | 4.98 | 2.61 | 1.06 | 4.87 | 1.92 | 0.83 | 82.90 |
| | **20** | 0.80 | 4.99 | 2.61 | 1.05 | 4.87 | 1.93 | 0.83 | 82.90 |

**Table 15: Australia: Pairwise Granger Causality Tests**

| | Period: around 1973 -- 1998 | | | | Period: around 1988 -- 1998 | | | | Period: around 1973 -- 1987 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Economic Variables | Regression Pair | Obs | F-statistic | Probability | Regression Pair | Obs | F-Statistic | Probability | Regression Pair | Obs | F-Statistic | Probability |
| | y x | | | | y x | | | | y x | | | |
| Money Supply | DLM -x- DLAU | 251 | 0.50435 | 0.60452 | DLM -x- DLAU | 74 | 0.37339 | 0.68978 | DLM -x- DLAU | 177 | 1.37051 | 0.25674 |
| (73:01-94:02; monthly) | DLAU -x- DLM | | 2.28558 | 0.10387 | DLAU -x- DLM | | 1.45258 | 0.24103 | DLAU -x- DLM | | 0.86981 | 0.42087 |
| Inflation | DLCPI -x- DLAU | 96 | 0.42468 | 0.65527 | DLCPI -x- DLAU | 39 | 2.02133 | 0.14809 | DLCPI -x- DLAU | 57 | 0.89869 | 0.41333 |
| (73:q1-97:q3; quarterly) | DLAU -x- DLCPI | | 0.46344 | 0.63059 | DLAU -x- DLCPI | | 0.23521 | 0.79168 | DLAU -x- DLCPI | | 1.74113 | 0.18539 |
| Exchange Rate | **DLEX---->DLAU** | 286 | 3.91721* | 0.02099 | DLEX -x- DLAU | 120 | 1.42845 | 0.24391 | DLEX -x- DLAU | 177 | 1.82664 | 0.16406 |
| (73:01-97:12; monthly) | DLAU -x- DLEX | | 1.96816 | 0.14163 | DLAU -x- DLEX | | 1.17926 | 0.31121 | DLAU -x- DLEX | | 1.15115 | 0.31871 |
| Treasury Bill Rate | **DLTB---->DLAU** | 296 | 4.11395* | 0.01731 | DLTB -x- DLAU | 119 | 2.73355 | 0.06952 | DLTB -x- DLAU | 177 | 2.51496 | 0.08384 |
| (73:01-97:11; monthly) | DLAU -x- DLTB | | 0.37054 | 0.69068 | DLAU -x- DLTB | | 1.94562 | 0.14761 | DLAU -x- DLTB | | 1.07858 | 0.34237 |
| G-Bond (long-term) | **DLGB---->DLAU** | 297 | 9.79821* | 0.00007 | **DLGB---->DLAU** | 120 | 11.3788* | 0.00003 | **DLGB---->DLAU** | 177 | 4.03924* | 0.01937 |
| (73:01-97:12; monthly) | DLAU -x- DLGB | | 0.82187 | 0.44062 | DLAU -x- DLGB | | 1.43746 | 0.24177 | DLAU -x- DLGB | | 0.38737 | 0.67943 |
| Co-Bond (low-grade) | **DLCB---->DLAU** | 99 | 10.3131* | 0.00008 | **DLCB---->DLAU** | 99 | 10.3131* | 0.00008 | na na | na | na | na |
| (89:09-98:02; monthly) | DLAU -x- DLCB | | 0.36735 | 0.69356 | DLAU -x- DLCB | | 0.36735 | 0.69356 | na na | na | na | na |
| Term Structure | TS -x- DLAU | 296 | 0.59453 | 0.55249 | TS -x- DLAU | 119 | 1.80521 | 0.16911 | TS -x- DLAU | 177 | 0.94728 | 0.38981 |
| (73:01-97:11; monthly) | DLAU -x- TS | | 0.16071 | 0.85162 | DLAU -x- TS | | 1.59921 | 0.20655 | DLAU -x- TS | | 0.64234 | 0.52732 |
| Default Risk Premium | **DR ---->DLAU** | 97 | 15.9686* | 0.00001 | **DR ---->DLAU** | 97 | 15.9686* | 0.00001 | na na | na | na | na |
| (89:09-98:02; monthly) | DLAU -x- DR | | 0.51391 | 0.59987 | DLAU -x- DR | | 0.51391 | 0.59987 | na na | na | na | na |
| Industrial Production | DLIP -x- DLAU | 91 | 0.39402 | 0.67555 | DLIP -x- DLAU | 34 | 0.22175 | 0.80246 | DLIP -x- DLAU | 57 | 0.93535 | 0.39895 |
| (73:q1-96:q2; quarterly) | **DLAU ---->DLIP** | | 8.20311* | 0.00055 | DLAU -x- DLIP | | 3.04375 | 0.06311 | **DLAU ---->DLIP** | | 6.40869* | 0.00325 |

**CONT..**

| | Period: around 1973 -- 1998 | | | | | Period: around 1988 -- 1998 | | | | | Period: around 1973 -- 1987 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Economic Variables | Regression Pair | | Obs | F-statistic | Probability | Regression Pair | | Obs | F-Statistic | Probability | Regression Pair | | Obs | F-Statistic | Probability |
| | y | x | | | | y | x | | | | y | x | | | |
| Trade Balance Ratio | TBR | DLAU | 84 | 0.19387 | 0.82415 | TBR | DLAU | 27 | 0.08482 | 0.91898 | TBR | DLAU | 57 | 0.06157 | 0.94036 |
| (73:q1-94:q3; quarterly) | DLAU | TBR | | 0.56261 | 0.57199 | DLAU | TBR | | 1.43224 | 0.26018 | DLAU | TBR | | 0.59605 | 0.55471 |
| Trade Balance | DLTR | DLAU | 84 | 0.36037 | 0.69856 | DLTR | DLAU | 27 | 0.01168 | 0.96641 | DLTR | DLAU | 57 | 0.86768 | 0.42591 |
| (73:q1-94:q3; quarterly) | DLAU | DLTR | | 1.51291 | 0.22658 | **DLAU---->DLTR** | | | 4.76272* | 0.01912 | DLAU | DLTR | | 0.05013 | 0.95115 |
| Gross National Product | DLGNP | DLAU | 95 | 0.87522 | 0.42028 | DLGNP | DLAU | 38 | 1.35977 | 0.27073 | DLGNP | DLAU | 57 | 0.79395 | 0.45746 |
| (73:q1-97:q2; quarterly) | **DLAU-->DLGNP** | | | 3.01652* | 0.05395 | DLAU | DLGNP | | 0.16897 | 0.84526 | DLAU | DLGNP | | 2.36165 | 0.10431 |
| Private Consumption | DLPC | DLAU | 20 | 0.43602 | 0.65454 | DLPC | DLAU | 9 | 0.94545 | 0.46106 | DLPC | DLAU | 11 | 0.39581 | 0.68951 |
| (73 - 96; annually) | DLAU | DLPC | | 0.56537 | 0.57981 | DLAU | DLPC | | 0.63076 | 0.57796 | DLAU | DLPC | | 0.49334 | 0.63334 |
| Consumption per capital | PCP | DLAU | 20 | 1.78145 | 0.20223 | PCP | DLAU | 9 | 0.14941 | 0.86582 | PCP | DLAU | 11 | 0.80111 | 0.49162 |
| (73 - 96; annually) | DLAU | PCP | | 1.92368 | 0.18043 | DLAU | PCP | | 1.42992 | 0.34001 | DLAU | PCP | | 1.83002 | 0.23962 |

* Indicates Significance at 5% level (reject H0: y (or x) doesn't Granger Causse x (or y)).

**Table 16: Hong Kong: Pairwise Granger Causality Tests**

| | Period: around 1973 -- 1998 | | | | | Period: around 1988 -- 1998 | | | | | Period: around 1973 -- 1987 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Economic Variables | Regression Pair | | Obs | F-statistic | Probability | Regression Pair | | Obs | F-Statistic | Probability | Regression Pair | | Obs | F-Statistic | Probability |
| | y | x | | | | y | x | | | | y | x | | | |
| | | | | | | | | | | | | | | | |
| Money Supply | DLM | -x- DLHK | 203 | 2.2159 | 0.11175 | DLM | -x- DLHK | 122 | 1.88536 | 0.15636 | DLM | -x- DLHK | 81 | 0.89759 | 0.41183 |
| (81:01-98:02; monthly) | DLHK | -x- DLM | | 0.06868 | 0.93365 | DLHK | -x- DLM | | 0.26995 | 0.76389 | DLHK | -x- DLM | | 0.06524 | 0.99477 |
| | | | | | | | | | | | | | | | |
| Inflation | DLCPI | -x- DLHK | 260 | 2.16154 | 0.11725 | DLCPI | -x- DLHK | 119 | 0.14484 | 0.86532 | DLCPI | -x- DLHK | 141 | 1.88755 | 0.15539 |
| (76:01-97:11; monthly) | DLHK | -x- DLCPI | | 1.36006 | 0.25851 | DLHK | -x- DLCPI | | 0.46695 | 0.62811 | DLHK | -x- DLCPI | | 0.76358 | 0.46798 |
| | | | | | | | | | | | | | | | |
| Exchange Rate | DLEX | -x- DLHK | 237 | 0.00688 | 0.99315 | **DLEX----->DLHK** | | 120 | 3.56081* | 0.03159 | DLEX | -x- DLHK | 117 | 0.86761 | 0.42276 |
| (78:01-97:12; monthly) | **DLHK----->DLEX** | | | 5.22704* | 0.00602 | DLHK | -x- DLEX | | 0.53686 | 0.58604 | **DLHK----->DLEX** | | | 4.99545* | 0.00835 |
| | | | | | | | | | | | | | | | |
| Interest Rate(callmoney) | DLI | -x- DLHK | 143 | 0.06861 | 0.93373 | DLI | -x- DLHK | 122 | 0.08674 | 0.91697 | DLI | -x- DLHK | 21 | 0.36127 | 0.70233 |
| (86:01-98:02; monthly) | **DLHK----> DLI** | | | 11.3694* | 0.00002 | **DLHK----> DLI** | | | 13.1694* | 0.00001 | **DLHK----> DLI** | | | 4.76751* | 0.02376 |
| | | | | | | | | | | | | | | | |
| G-Bond (long-term) | na | na | na | na | na | na | na | na | na | na | na | na | na | na | na |
| | na | na | na | na | na | na | na | na | na | na | na | na | na | na | na |
| | | | | | | na | na | na | na | na | na | na | na | na | na |
| Co-Bond (low-grade) | na | na | na | na | na | na | na | na | na | na | na | na | na | na | na |
| | na | na | na | na | na | na | na | na | na | na | na | na | na | na | na |
| | | | | | | na | na | na | na | na | na | na | na | na | na |
| Term Structure | na | na | na | na | na | na | na | na | na | na | na | na | na | na | na |
| | na | na | na | na | na | na | na | na | na | na | na | na | na | na | na |
| | | | | | | | | | | | | | | | |
| Default Risk Premium | na | na | na | na | na | na | na | na | na | na | na | na | na | na | na |
| | na | na | na | na | na | na | na | na | na | na | na | na | na | na | na |
| | | | | | | | | | | | | | | | |
| Industrial Production | DLIP | -x- DLHK | 60 | 0.30967 | 0.73496 | DLIP | -x- DLHK | 39 | 0.12527 | 0.88266 | DLIP | -x- DLHK | 21 | 0.20871 | 0.81381 |
| (82:q1-97:q3; quarterly) | DLHK | -x- DLIP | | 0.24312 | 0.78502 | DLHK | -x- DLIP | | 0.02133 | 0.97891 | DLHK | -x- DLIP | | 0.64922 | 0.53568 |

**CONT..**

| | Period: around 1973 -- 1998 | | | | | Period: around 1988 -- 1998 | | | | | Period: around 1973 -- 1987 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Economic Variables | Regression Pair | | Obs | F-statistic | Probability | Regression Pair | | Obs | F-Statistic | Probability | Regression Pair | | Obs | F-Statistic | Probability |
| | y | x | | | | y | x | | | | y | x | | | |
| | | | | | | | | | | | | | | | |
| Trade Balance Ratio | TBR -x- DLHK | | 88 | 2.44607 | 0.09286 | TBR -x- DLHK | | 39 | 2.76771 | 0.07698 | TBR -x- DLHK | | 49 | 0.073908 | 0.48339 |
| (75:q1-97:q4; quarterly) | DLHK -x- TBR | | | 0.09432 | 0.91009 | DLHK -x- TBR | | | 0.98591 | 0.38351 | DLHK -x- TBR | | | 0.01768 | 0.98248 |
| | | | | | | | | | | | | | | | 0.98248 |
| Trade Balance | DLTR x- DLHK | | 88 | 0.43643 | 0.64787 | DLTR x- DLHK | | 39 | 0.91246 | 0.41114 | DLTR x- DLHK | | 49 | 0.23475 | 0.79176 |
| (75:q1-97:q4; quarterly) | DLHK -x- DLTR | | | 0.28423 | 0.75332 | DLHK -x- DLTR | | | 0.22412 | 0.80039 | DLHK -x- DLTR | | | 0.22791 | 0.79713 |
| | | | | | | | | | | | | | | | |
| Gross National Product | DLGNP-x-DLHK | | 96 | 0.27886 | 0.75729 | DLGNP-x-DLHK | | 39 | 0.29818 | 0.74409 | DLGNP-x-DLHK | | 57 | 0.15493 | 0.85687 |
| (73:q1-97:q3; quarterly) | DLHK-x-DLGNP | | | 1.28579 | 0.28141 | DLHK-x-DLGNP | | | 0.18215 | 0.83429 | DLHK-x-DLGNP | | | 1.85794 | 0.16621 |
| | | | | | | | | | | | | | | | |
| Private Consumption | DLPC -x- DLHK | | 96 | 0.59597 | 0.55316 | DLPC x- DLHK | | 39 | 0.51687 | 0.60101 | DLPC -x- DLHK | | 57 | 0.28309 | 0.75461 |
| (73:q1-97:q3; quarterly) | **DLHK---->DLPC** | | | 3.85401* | 0.02474 | DLHK -x- DLPC | | | 0.73446 | 0.48722 | **DLHK---->DLPC** | | | 4.71729* | 0.01311 |
| | | | | | | | | | | | | | | | |
| Consumption per capital | na | na | na | na | na | na | na | na | na | na | na | na | na | na | na |
| | na | na | na | na | na | na | na | na | na | na | na | na | na | na | na |

* Indicates Significance at 5% level (reject H0: y (or x) doesn't Granger Cause x (or y)).

**Table 17: Japan: Pairwise Granger Causality Tests**

| | Period: around 1973 -- 1998 | | | | Period: around 1988 -- 1998 | | | | Period: around 1973 -- 1987 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Economic Variables | Regression Pair | Obs | F-statistic | Probability | Regression Pair | Obs | F-Statistic | Probability | Regression Pair | Obs | F-Statistic | Probability |
| | y x | | | | y x | | | | y x | | | |
| Money Supply | DLM -x- DLJP | 249 | 1.28957 | 0.27726 | DLM -x- DLJP | 72 | 1.87902 | 0.16071 | DLM -x- DLJP | 177 | 0.97361 | 0.37979 |
| (73:01-93:12; monthly) | DLJP -x- DLM | | 0.22344 | 0.79992 | DLJP -x- DLM | | 1.85849 | 0.16386 | DLJP -x- DLM | | 1.63838 | 0.19731 |
| Inflation | DLCPI -x- DLJP | 297 | 0.38075 | 0.68369 | DLCPI -x- DLJP | 120 | 0.17588 | 0.83895 | DLCPI -x- DLJP | 177 | 2.57782 | 0.07887 |
| (73:01-97:12; monthly) | DLJP -x- DLCPI | | 1.25809 | 0.28573 | DLJP -x- DLCPI | | 0.89763 | 0.41037 | DLJP -x- DLCPI | | 2.55826 | 0.08038 |
| Exchange Rate | DLEX -x- DLJP | 297 | 1.25951 | 0.28533 | DLEX -x- DLJP | 120 | 0.12225 | 0.88504 | DLEX -x- DLJP | 177 | 2.32793 | 0.10056 |
| (73:01-97:12; monthly) | DLJP -x- DLEX | | 0.26169 | 0.76993 | DLJP -x- DLEX | | 0.44869 | 0.63958 | DLJP -x- DLEX | | 1.36574 | 0.25794 |
| Interest Rate(callmoney) | DLI -x- DLJP | 298 | 1.34824 | 0.26131 | DLI -x- DLJP | 121 | 0.47556 | 0.62274 | DLI -x- DLJP | 177 | 1.54344 | 0.21659 |
| (73:01-98:01; monthly) | DLJP -x- DLI | | 0.11983 | 0.88711 | DLJP -x- DLI | | 0.41571 | 0.66085 | **DLJP ----> DLI** | | 3.04494* | 0.05017 |
| G-Bond (long-term) | **DLGB---->DLJP** | 298 | 3.29042* | 0.03862 | DLGB -x- DLJP | 121 | 1.06908 | 0.34668 | **DLGB---->DLJP** | 177 | 10.3088* | 0.00005 |
| (73:01-98:01; monthly) | DLJP -x- DLGB | | 2.31637 | 0.10043 | DLJP -x- DLGB | | 1.15255 | 0.31942 | DLJP -x- DLGB | | 1.87985 | 0.15573 |
| Co-Bond (low-grade) | **DLCB---->DLJP** | 297 | 2.91218* | 0.05594 | DLCB -x- DLJP | 120 | 0.28962 | 0.74909 | **DLCB---->DLJP** | 177 | 5.64551* | 0.00422 |
| (73:01-97:12; monthly) | DLJP -x- DLCB | | 1.44796 | 0.23673 | DLJP -x- DLCB | | 1.76089 | 0.17649 | DLJP -x- DLCB | | 0.38097 | 0.68378 |
| Term Structure | TS -x- DLJP | 297 | 0.41993 | 0.65749 | TS -x- DLJP | 120 | 1.72869 | 0.82111 | TS -x- DLJP | 177 | 1.34819 | 0.26244 |
| (73:01-98:01; monthly) | DLJP -x- TS | | 2.36027 | 0.09619 | DLJP -x- TS | | 0.08121 | 0.92205 | **DLJP ----> TS** | | 5.83792* | 0.00352 |
| Default Risk Premium | DR -x- DLJP | 297 | 0.82621 | 0.43873 | DR -x- DLJP | 120 | 1.35629 | 0.26171 | **DR ---->DLJP** | 177 | 3.74671* | 0.02254 |
| (73:01-97:12; monthly) | DLJP -x- DR | | 0.08022 | 0.50731 | DLJP -x- DR | | 0.16779 | 0.84574 | DLJP -x- DR | | 0.75349 | 0.47227 |
| Industrial Production | DLIP -x- DLJP | 297 | 0.84163 | 0.43205 | DLIP -x- DLJP | 120 | 0.33658 | 0.71491 | DLIP -x- DLJP | 177 | 0.73981 | 0.47872 |

**Table 17: cont'd.**

| | Period: around 1973 -- 1998 | | | | | Period: around 1988 -- 1998 | | | | | Period: around 1973 -- 1987 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Economic Variables | Regression Pair | | Obs | F-statistic | Probability | Regression Pair | | Obs | F-Statistic | Probability | Regression Pair | | Obs | F-Statistic | Probability |
| | y | x | | | | y | x | | | | y | x | | | |
| | | | | | | | | | | | | | | | |
| (73:01-97:12; monthly) | DLJP -x- DLIP | | | 0.36862 | 0.69201 | DLJP -x- DLIP | | | 0.10297 | 0.90224 | DLJP -x- DLIP | | | 1.50321 | 0.22532 |
| | | | | | | | | | | | | | | | |
| Trade Balance Ratio | TBR -x- DLJP | | 85 | 0.91713 | 0.40383 | TBR -x- DLJP | | 28 | 0.41693 | 0.66395 | TBR -x- DLJP | | 57 | 1.14643 | 0.32567 |
| (73:q1-97:q3; quarterly) | DLJP -x- TBR | | | 2.09941 | 0.12923 | DLJP -x- TBR | | | 0.07714 | 0.92601 | **DLJP ----> TBR** | | | 4.22015* | 0.02003 |
| | | | | | | | | | | | | | | | |
| Trade Balance | DLTR -x- DLJP | | 85 | 1.35949 | 0.26266 | DLTR -x- DLJP | | 28 | 1.00688 | 0.38091 | DLTR -x- DLJP | | 57 | 1.93859 | 0.15417 |
| (73:q1-97:q3; quarterly) | DLJP -x- DLTR | | | 0.99895 | 0.37281 | DLJP -x- DLTR | | | 0.77508 | 0.47233 | DLJP -x- DLTR | | | 2.57371 | 0.08594 |
| | | | | | | | | | | | | | | | |
| Gross National Product | DLGNP-x-DLJP | | 96 | 0.45266 | 0.63736 | DLGNP-x-DLJP | | 39 | 0.15177 | 0.85976 | **DLGNP-->DLJP** | | 56 | 10.1998* | 0.00019 |
| (73:q1-97:q3; quarterly) | DLJP-x-DLGNP | | | 0.19925 | 0.81971 | DLJP-x-DLGNP | | | 0.04931 | 0.95195 | DLJP-x-DLGNP | | | 2.84393 | 0.06946 |
| | | | | | | | | | | | | | | | |
| Private Consumption | DLPC x- DLJP | | 96 | 1.02542 | 0.036275 | DLPC x- DLJP | | 39 | 0.53239 | 0.59202 | **DLPC ---->DLJP** | | 57 | 8.03174* | 0.00091 |
| (73:q1-97:q3; quarterly) | DLJP -x- DLPC | | | 0.28115 | 0.75557 | DLJP -x- DLPC | | | 0.67889 | 0.51392 | DLJP -x- DLPC | | | 0.94828 | 0.39401 |
| | | | | | | | | | | | | | | | |
| Consumption per capital | na | na | na | na | na | na | na | na | na | na | na | na | na | na | na |
| | na | na | na | na | na | na | na | na | na | na | na | na | na | na | na |

* Indicates Significance at 5% level (reject H0: y (or x) doesn't Granger Causse x (or y)).

**Table 18: Korea: Pairwise Granger Causality Tests**

| | Period: around 1973 -- 1998 | | | | Period: around 1988 -- 1998 | | | | Period: around 1973 -- 1987 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Economic Variables | Regression Pair | Obs | F-statistic | Probability | Regression Pair | Obs | F-Statistic | Probability | Regression Pair | Obs | F-Statistic | Probability |
| | y x | | | | y x | | | | y x | | | |
| Money Supply | DLM -x- DLKO | 225 | 0.02517 | 0.97514 | DLM -x- DLKO | 72 | 0.43831 | 0.64696 | DLM -x- DLKO | 153 | 1.16871 | 0.31362 |
| (75:01-93:12; monthly) | DLKO -x- DLM | | 1.54997 | 0.21456 | DLKO -x- DLM | | 1.05377 | 0.35433 | DLKO -x- DLM | | 0.73558 | 0.48097 |
| Inflation | DLCPI -x- DLKO | 273 | 0.37223 | 0.68955 | DLCPI -x- DLKO | 120 | 0.07074 | 0.93174 | DLCPI -x- DLKO | 153 | 1.22551 | 0.25657 |
| (75:01-97:12; monthly) | DLKO -x- DLCPI | | 0.09617 | 0.90834 | DLKO -x- DLCPI | | 0.16756 | 0.84593 | DLKO -x- DLCPI | | 0.12713 | 0.88071 |
| Exchange Rate | **DLEX---->DLKO** | 272 | 6.16878* | 0.00241 | DLEX -x- DLKO | 120 | 2.29431 | 0.10543 | **DLEX---->DLKO** | 152 | 5.93889* | 0.00331 |
| (75:01-97:12; monthly) | DLKO -x- DLEX | | 2.48713 | 0.08507 | DLKO -x- DLEX | | 1.50783 | 0.22573 | DLKO -x- DLEX | | 2.66144 | 0.07321 |
| Interest Rate(callmoney) | **DLI ----> DLKO** | 252 | 5.66975* | 0.00391 | **DLI ----> DLKO** | 118 | 4.95567* | 0.00865 | DLI -x- DLKO | 134 | 2.09175 | 0.12764 |
| (76:08-97:10; monthly) | DLKO -x- DLI | | 2.56888 | 0.07867 | DLKO -x- DLI | | 1.78125 | 0.17312 | DLKO -x- DLI | | 0.43281 | 0.64962 |
| G-Bond (long-term) | DLGB -x- DLKO | 185 | 1.29811 | 0.27559 | DLGB -x- DLKO | 120 | 1.04221 | 0.35598 | DLGB -x- DLKO | 65 | 0.33042 | 0.71992 |
| (82:05-97:12; monthly) | DLKO -x- DLGB | | 0.41543 | 0.66068 | DLKO -x- DLGB | | 0.59375 | 0.55394 | DLKO -x- DLGB | | 0.29555 | 0.74521 |
| Co-Bond (low-grade) | **DLCB---->DLKO** | 215 | 11.8306* | 0.00001 | **DLCB---->DLKO** | 122 | 11.3675* | 0.00003 | DLCB -x- DLKO | 93 | 0.1389 | 0.87051 |
| (80:01-98:02; monthly) | DLKO -x- DLCB | | 0.19915 | 0.81958 | DLKO -x- DLCB | | 0.09625 | 0.90831 | DLKO -x- DLCB | | 1.19964 | 0.30618 |
| Term Structure | **TS ---->DLKO** | 183 | 3.17968 | 0.04397 | **TS ---->DLKO** | 118 | 3.01196* | 0.05316 | TS -x- DLKO | 65 | 0.76935 | 0.46783 |
| (82:05-97:10; monthly) | DLKO -x- TS | | 1.00173 | 0.36931 | DLKO -x- TS | | 1.99679 | 0.14053 | DLKO -x- TS | | 1.25346 | 0.29288 |
| Default Risk Premium | DR -x- DLKO | 185 | 0.66973 | 0.51312 | DR -x- DLKO | 120 | 1.20494 | 0.30346 | DR -x- DLKO | 65 | 0.26155 | 0.77073 |
| (82:05-97:12; monthly) | DLKO -x- DR | | 1.34285 | 0.26371 | DLKO -x- DR | | 0.71952 | 0.48917 | DLKO -x- DR | | 0.57709 | 0.56462 |
| Industrial Production | DLIP -x- DLKO | 272 | 2.14873 | 0.11864 | DLIP -x- DLKO | 119 | 0.12138 | 0.88581 | **DLIP ---->DLKO** | 153 | 4.40352* | 0.01388 |
| (75:01-97:11; monthly) | DLKO -x- DLIP | | 0.42573 | 0.65373 | DLKO -x- DLIP | | 0.50296 | 0.60607 | **DLKO----> DLIP** | | 3.13311* | 0.04649 |

Table 18: cont'd.

| | Period: around 1973 -- 1998 | | | | | Period: around 1988 -- 1998 | | | | | Period: around 1973 -- 1987 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Economic Variables | Regression Pair | | Obs | F-statistic | Probability | Regression Pair | | Obs | F-Statistic | Probability | Regression Pair | | Obs | F-Statistic | Probability |
| | y | x | | | | y | x | | | | y | x | | | |
| | | | | | | | | | | | | | | | |
| Trade Balance Ratio | TBR | DLKO | 77 | 0.28371 | 0.75381 | TBR | DLKO | 28 | 1.70192 | 0.20397 | TBR | DLKO | 49 | 0.05773 | 0.94398 |
| (75:q1-94:q4; quarterly) | DLKO | TBR | | 1.07637 | 0.34625 | DLKO | TBR | | 2.25128 | 0.12796 | DLKO | TBR | | 0.22566 | 0.79891 |
| | | | | | | | | | | | | | | | |
| Trade Balance | DLTR | DLKO | 77 | 0.73825 | 0.48153 | DLTR | DLKO | 28 | 1.80789 | 0.18654 | DLTR | DLKO | 49 | 0.31694 | 0.73002 |
| (75:q1-94:q4; quarterly) | DLKO | DLTR | | 0.21131 | 0.81003 | DLKO | DLTR | | 0.76079 | 0.47871 | DLKO | DLTR | | 0.34116 | 0.71281 |
| | | | | | | | | | | | | | | | |
| Gross National Product | DLGNP | DLKO | 85 | 0.22931 | 0.79561 | DLGNP | DLKO | 36 | 2.33418 | 0.11369 | DLGNP | DLKO | 49 | 0.87079 | 0.42571 |
| (75:q1-96:q4; quarterly) | DLKO | DLGNP | | 0.03877 | 0.96199 | DLKO | DLGNP | | 6.75601 | 0.47801 | DLKO | DLGNP | | 0.48413 | 0.61948 |
| | | | | | | | | | | | | | | | |
| Private Consumption | DLPC | DLKO | 85 | 0.23306 | 0.79264 | DLPC | DLKO | 36 | 1.70708 | 0.19806 | DLPC | DLKO | 49 | 1.98833 | 0.14904 |
| (75:q1-96:q4; quarterly) | DLKO | DLPC | | 0.09782 | 0.90892 | DLKO | DLPC | | 0.32314 | 0.72628 | DLKO | DLPC | | 0.90178 | 0.41321 |
| | | | | | | | | | | | | | | | |
| Consumption per capital | na | na | na | na | na | na | na | na | na | na | na | na | na | na | na |
| | na | na | na | na | na | na | na | na | na | na | na | na | na | na | na |

* Indicates Significance at 5% level (reject H0: y (or x) doesn't Granger Causse x (or y)).

**Table 19: Malaysia: Pairwise Granger Causality Tests**

| | Period: around 1973 -- 1998 | | | | | Period: around 1988 -- 1998 | | | | | Period: around 1973 -- 1987 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Economic Variables | Regression Pair | | Obs | F-statistic | Probability | Regression Pair | | Obs | F-Statistic | Probability | Regression Pair | | Obs | F-Statistic | Probability |
| | y | x | | | | y | x | | | | y | x | | | |
| Money Supply | DLM | -x- DLMY | 163 | 1.63817 | 0.19762 | DLM | -x- DLMY | 71 | 0.95492 | 0.39011 | DLM | -x- DLMY | 92 | 0.61016 | 0.54557 |
| (80:02-93:11; monthly) | DLMY | -x- DLM | | 0.05119 | 0.95011 | DLMY | -x- DLM | | 1.31283 | 0.27599 | DLMY | -x- DLM | | 1.25324 | 0.29068 |
| Inflation | DLCPI | -x- DLMY | 211 | 1.69554 | 0.18605 | DLCPI | -x- DLMY | 119 | 0.87135 | 0.42116 | DLCPI | -x- DLMY | 92 | 0.92391 | 0.40082 |
| (80:02-97:11; monthly) | DLMY | -x- DLCPI | | 2.55976 | 0.07978 | **DLMY--->DLCPI** | | | 3.63447* | 0.02951 | DLMY | -x- DLCPI | | 0.54422 | 0.58226 |
| Exchange Rate | **DLEX---->DLMY** | | 212 | 6.36827* | 0.00207 | **DLEX---->DLMY** | | 120 | 8.79749* | 0.00028 | DLEX | -x- DLMY | 92 | 1.09194 | 0.34012 |
| (80:02-97:12; monthly) | DLMY | -x- DLEX | | 0.20367 | 0.81589 | DLMY | -x- DLEX | | 0.61168 | 0.54419 | DLMY | -x- DLEX | | 0.25911 | 0.77233 |
| Interest Rate(callmoney) | DLI | -x- DLMY | 176 | 2.38634 | 0.09502 | DLI | -x- DLMY | 84 | 0.45694 | 0.63488 | DLI | -x- DLMY | 92 | 1.77182 | 0.17611 |
| (80:02-94:12; monthly) | DLMY | -x- DLI | | 1.0621 | 0.36414 | DLMY | -x- DLI | | 0.17437 | 0.84031 | DLMY | -x- DLI | | 0.77099 | 0.46569 |
| G-Bond (long-term) | na | na | na | na | na | na | na | na | na | na | na | na | na | na | na |
| | na | na | na | na | na | na | na | na | na | na | na | na | na | na | na |
| | | | | | | na | na | na | na | na | na | na | na | na | na |
| Co-Bond (low-grade) | na | na | na | na | na | na | na | na | na | na | na | na | na | na | na |
| | na | na | na | na | na | na | na | na | na | na | na | na | na | na | na |
| | | | | | | na | na | na | na | na | na | na | na | na | na |
| Term Structure | na | na | na | na | na | na | na | na | na | na | na | na | na | na | na |
| | na | na | na | na | na | na | na | na | na | na | na | na | na | na | na |
| Default Risk Premium | na | na | na | na | na | na | na | na | na | na | na | na | na | na | na |
| | na | na | na | na | na | na | na | na | na | na | na | na | na | na | na |
| Industrial Production | DLIP | -x- DLMY | 209 | 1.71125 | 0.18322 | DLIP | -x- DLMY | 117 | 1.18343 | 0.31003 | DLIP | -x- DLMY | 92 | 0.61027 | 0.54551 |

**Table 19: cont'd.**

| | Period: around 1973 -- 1998 | | | | | Period: around 1988 -- 1998 | | | | | Period: around 1973 -- 1987 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Economic Variables | Regression Pair | | Obs | F-statistic | Probability | Regression Pair | | Obs | F-Statistic | Probability | Regression Pair | | Obs | F-Statistic | Probability |
| | y | x | | | | y | x | | | | y | x | | | |
| (80:02-97:09; monthly) | **DLMY ---->DLIP** | | | 3.57624* | 0.02975 | **DLMY ---->DLIP** | | | 4.61431* | 0.01187 | DLMY -x- DLIP | | | 0.68621 | 0.50619 |
| Trade Balance Ratio | TBR -x- DLMY | | 10 | 1.14424 | 0.32025 | TBR -x- DLMY | | 6 | 0.01222 | 0.91895 | TBR -x- DLMY | | 4 | 1.61031 | 0.42488 |
| (81 - 93; annually) | DLMY -x- TBR | | | 0.07038 | 0.79842 | DLMY -x- TBR | | | 5.35891 | 0.10356 | DLMY -x- TBR | | | 53.277 | 0.08668 |
| Trade Balance | DLTR x- DLMY | | 10 | 0.31271 | 0.59345 | DLTR x- DLMY | | 6 | 0.03632 | 0.96555 | DLTR x- DLMY | | 4 | 0.05726 | 0.85048 |
| (81 - 93; annually) | DLMY -x- DLTR | | | 1.01339 | 0.34761 | DLMY -x- DLTR | | | 21.2761 | 0.15153 | DLMY -x- DLTR | | | 0.00085 | 0.98142 |
| Gross National Product | DLGNP-x-DLMY | | 13 | 0.45965 | 0.51317 | DLGNP-x-DLMY | | 9 | 0.28726 | 0.61162 | **DLGNP-->DLMY** | | 4 | 467.731* | 0.02942 |
| (81 - 96; annually) | DLMY-x-DLGNP | | | 1.45234 | 0.25591 | DLMY-x-DLGNP | | | 0.20087 | 0.66975 | DLMY-x-DLGNP | | | 1.85693 | 0.40303 |
| Private Consumption | DLPC x- DLMY | | 12 | 0.44385 | 0.65844 | DLPC x- DLMY | | 9 | 0.77146 | 0.52077 | DLPC x- DLMY | | 4 | 0.05726 | 0.85048 |
| (81 - 96; annually) | DLMY -x- DLPC | | | 1.68089 | 0.25341 | DLMY -x- DLPC | | | 2.95698 | 0.16279 | DLMY -x- DLPC | | | 0.00085 | 0.98142 |
| Consumption per capital | na | na | na | na | na | na | na | na | na | na | na | na | na | na | na |
| | na | na | na | na | na | na | na | na | na | na | na | na | na | na | na |

* Indicates Significance at 5% level (reject H0: y (or x) doesn't Granger Causse x (or y)).

**Table 20: Singapore: Pairwise Granger Causality Tests**

| | Period: around 1973 -- 1998 | | | | | Period: around 1988 -- 1998 | | | | | Period: around 1973 -- 1987 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Economic Variables | Regression Pair | | Obs | F-statistic | Probability | Regression Pair | | Obs | F-Statistic | Probability | Regression Pair | | Obs | F-Statistic | Probability |
| | y | x | | | | y | x | | | | y | x | | | |
| Money Supply | DLM -x- DLSG | | 96 | 1.76187 | 0.17779 | DLM -x- DLSG | | 72 | 1.70231 | 0.19005 | na | na | na | na | na |
| (86:02-93:12; monthly) | DLSG -x- DLM | | | 0.65131 | 0.52389 | DLSG -x- DLM | | | 1.87022 | 0.16205 | na | na | na | na | na |
| Inflation | DLCPI -x- DLSG | | 137 | 0.94954 | 0.38955 | DLCPI -x- DLSG | | 117 | 0.68298 | 0.5072 | na | na | na | na | na |
| (86:02-97:09; monthly) | DLSG -x- DLCPI | | | 0.01114 | 0.98892 | DLSG -x- DLCPI | | | 0.13266 | 0.87591 | na | na | na | na | na |
| Exchange Rate | DLEX -x- DLSG | | 140 | 0.99407 | 0.37276 | DLEX -x- DLSG | | 119 | 1.62956 | 0.20055 | na | na | na | na | na |
| (86:02-97:12; monthly) | DLSG -x- DLEX | | | 0.02969 | 0.97076 | DLSG -x- DLEX | | | 0.46489 | 0.62939 | na | na | na | na | na |
| Interest Rate(callmoney) | DLI -x- DLSG | | 139 | 0.04995 | 0.95129 | DLI -x- DLSG | | 119 | 0.25469 | 0.77561 | na | na | na | na | na |
| (86:02-97:11; monthly) | DLSG -x- DLI | | | 1.74288 | 0.17896 | DLSG -x- DLI | | | 1.93658 | 0.14891 | na | na | na | na | na |
| G-Bond (long-term) | na | na | na | na | na | na | na | na | na | na | na | na | na | na | na |
| | na | na | na | na | na | na | na | na | na | na | na | na | na | na | na |
| | | | | | | na | na | na | na | na | na | na | na | na | na |
| Co-Bond (low-grade) | na | na | na | na | na | na | na | na | na | na | na | na | na | na | na |
| | na | na | na | na | na | na | na | na | na | na | na | na | na | na | na |
| | | | | | | na | na | na | na | na | na | na | na | na | na |
| Term Structure | na | na | na | na | na | na | na | na | na | na | na | na | na | na | na |
| | na | na | na | na | na | na | na | na | na | na | na | na | na | na | na |
| Default Risk Premium | na | na | na | na | na | na | na | na | na | na | na | na | na | na | na |
| | na | na | na | na | na | na | na | na | na | na | na | na | na | na | na |
| Industrial Production | DLIP -x- DLSG | | 42 | 0.64731 | 0.52928 | DLIP -x- DLSG | | 38 | 0.59245 | 0.55874 | na | na | na | na | na |

**CONT..**

| | Period: around 1973 -- 1998 | | | | | Period: around 1988 -- 1998 | | | | | Period: around 1973 -- 1987 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Economic Variables | Regression Pair | | Obs | F-statistic | Probability | Regression Pair | | Obs | F-Statistic | Probability | Regression Pair | | Obs | F-Statistic | Probability |
| | y | x | | | | y | x | | | | y | x | | | |
| | | | | | | | | | | | | | | | |
| (86:q2-97:q2; quarterly) | DLSG -x- DLIP | | | 0.73781 | 0.48507 | DLSG -x- DLIP | | | 0.44972 | 0.64165 | na | na | na | na | na |
| | | | | | | | | | | | | | | | |
| Trade Balance Ratio | na | na | na | na | na | na | na | na | na | na | na | na | na | na | na |
| | na | na | na | na | na | na | na | na | na | na | na | na | na | na | na |
| | | | | | | | | | | | | | | | |
| Trade Balance | DLTR -x- DLSG | | 140 | 0.86064 | 0.42521 | DLTR -x- DLSG | | 120 | 0.83452 | 0.43671 | na | na | na | na | na |
| (86:02-97:12; monthly) | DLSG -x- DLTR | | | 0.13395 | 0.87475 | DLSG -x- DLTR | | | 0.32918 | 0.72019 | na | na | na | na | na |
| | | | | | | | | | | | | | | | |
| Gross National Product | DLGNP-x-DLSG | | 6 | 2.79771 | 0.38938 | na | na | na | na | na | na | na | na | na | na |
| (87 - 96; annunally) | DLSG-x-DLGNP | | | 0.31057 | 0.78541 | na | na | na | na | na | na | na | na | na | na |
| | | | | | | | | | | | | | | | |
| Private Consumption | DLPC x- DLSG | | 6 | 21.2357 | 0.15167 | na | na | na | na | na | na | na | na | na | na |
| (87 - 96; annunally) | DLSG -x- DLPC | | | 3.55848 | 0.34987 | na | na | na | na | na | na | na | na | na | na |
| | | | | | | | | | | | | | | | |
| Consumption per capital | PCP x- DLSG | | 6 | 0.53271 | 0.69582 | na | na | na | na | na | na | na | na | na | na |
| (87 - 96; annunally) | DLSG -x- PCP | | | 23.1448 | 0.14542 | na | na | na | na | na | na | na | na | na | na |

* Indicates Significance at 5% level (reject H0: y (or x) doesn't Granger Causse x (or y)).

**Table 21: Thailand: Pairwise Granger Causality Tests**

| | Period: around 1973 -- 1998 | | | | | Period: around 1988 -- 1998 | | | | | Period: around 1973 -- 1987 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Economic Variables | Regression Pair | | Obs | F-statistic | Probability | Regression Pair | | Obs | F-Statistic | Probability | Regression Pair | | Obs | F-Statistic | Probability |
| | y | x | | | | y | x | | | | y | x | | | |
| Money Supply | DLM | -x- DLTH | 175 | 0.07092 | 0.93157 | DLM | -x- DLTH | 70 | 0.31041 | 0.73424 | DLM | -x- DLTH | 105 | 0.32201 | 0.72544 |
| (79:01-93:10; monthly) | DLTH | -x- DLM | | 0.02083 | 0.97939 | DLTH | -x- DLM | | 1.29167 | 0.28177 | DLTH | -x- DLM | | 1.61227 | 0.20458 |
| Inflation | DLCPI | -x- DLTH | 214 | 0.74824 | 0.47446 | DLCPI | -x- DLTH | 121 | 0.63062 | 0.53408 | DLCPI | -x- DLTH | 93 | 0.18921 | 0.82796 |
| (80:01-98:01; monthly) | DLTH | -x- DLCPI | | 0.05317 | 0.94823 | DLTH | -x- DLCPI | | 0.32522 | 0.72302 | DLTH | -x- DLCPI | | 1.13406 | 0.32638 |
| Exchange Rate | **DLEX--->DLTH** | | 1845 | 10.3978* | 0.00003 | na | na | na | na | na | na | na | na | na | na |
| (91:01:02-98:01:30; daily) | DLTH | -x- DLEX | | 1.17333 | 0.30975 | na | na | na | na | na | na | na | na | na | na |
| Interest Rate(callmoney) | DLI | -x- DLTH | 89 | 1.05813 | 0.35168 | na | na | na | na | na | na | na | na | na | na |
| (88:10-96:05; monthly) | **DTH** | **---->DLI** | | 3.38908* | 0.03842 | na | na | na | na | na | na | na | na | na | na |
| G-Bond (long-term) | DLGB | -x- DLTH | 206 | 0.03954 | 0.96124 | DLGB | -x- DLTH | 113 | 1.35281 | 0.26286 | DLGB | -x- DLTH | 93 | 0.78266 | 0.46034 |
| (80:01-97:05; monthly) | DLTH | -x- DLGB | | 0.15679 | 0.85499 | DLTH | -x- DLGB | | 0.01895 | 0.98123 | DLTH | -x- DLGB | | 0.46543 | 0.62941 |
| Co-Bond (low-grade) | na | na | na | na | na | na | na | na | na | na | na | na | na | na | na |
| | na | na | na | na | na | na | na | na | na | na | na | na | na | na | na |
| Term Structure | TS | -x- DLTH | 89 | 1.18246 | 0.31157 | na | na | na | na | na | na | na | na | na | na |
| (88:10-96:05; monthly) | **DLTH** | **---->TS** | | 3.67761* | 0.02944 | na | na | na | na | na | na | na | na | na | na |
| Default Risk Premium | na | na | na | na | na | na | na | na | na | na | na | na | na | na | na |
| | na | na | na | na | na | na | na | na | na | na | na | na | na | na | na |
| Industrial Production | DLIP | -x- DLTH | 70 | 0.44456 | 0.64304 | DLIP | -x- DLTH | 61 | 1.47131 | 0.23837 | na | na | na | na | na |

**CONT..**

| | Period: around 1973 -- 1998 | | | | | Period: around 1988 -- 1998 | | | | | Period: around 1973 -- 1987 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Economic Variables | Regression Pair | | Obs | F-statistic | Probability | Regression Pair | | Obs | F-Statistic | Probability | Regression Pair | | Obs | F-Statistic | Probability |
| | y | x | | | | y | x | | | | y | x | | | |
| | | | | | | | | | | | | | | | |
| (87:01-93:01; monthly) | DLTH -x- DLIP | | | 2.62986 | 0.07975 | DLTH -x- DLIP | | | 2.08895 | 0.13336 | na | na | na | na | na |
| | | | | | | | | | | | | | | | |
| Trade Balance Ratio | na | na | na | na | na | na | na | na | na | na | na | na | na | na | na |
| | na | na | na | na | na | na | na | na | na | na | na | na | na | na | na |
| | | | | | | | | | | | | | | | |
| Trade Balance | DLTR x- DLTH | | 213 | 0.19228 | 0.82523 | DLTR x- DLTH | | 120 | 0.03309 | 0.96746 | DLTR x- DLTH | | 93 | 0.40952 | 0.66523 |
| (80:01-97:12; monthly) | DLTH -x- DLTR | | | 0.34632 | 0.70769 | DLTH -x- DLTR | | | 0.44179 | 0.64397 | DLTH -x- DLTR | | | 0.21619 | 0.80601 |
| | | | | | | | | | | | | | | | |
| Gross National Product | na | na | na | na | na | na | na | na | na | na | na | na | na | na | na |
| | na | na | na | na | na | na | na | na | na | na | na | na | na | na | na |
| | | | | | | | | | | | | | | | |
| Private Consumption | na | na | na | na | na | na | na | na | na | na | na | na | na | na | na |
| | na | na | na | na | na | na | na | na | na | na | na | na | na | na | na |
| | | | | | | | | | | | | | | | |
| Consumption per capital | na | na | na | na | na | na | na | na | na | na | na | na | na | na | na |
| | na | na | na | na | na | na | na | na | na | na | na | na | na | na | na |

* Indicates Significance at 5% level (reject H0: y (or x) doesn't Granger Causse x (or y)).

**Table 22: Taiwan: Pairwise Granger Causality Tests**

| | Period: around 1973 -- 1998 | | | | Period: around 1988 -- 1998 | | | | Period: around 1973 -- 1987 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Economic Variables | Regression Pair | Obs | F-statistic | Probability | Regression Pair | Obs | F-Statistic | Probability | Regression Pair | | Obs | F-Statistic | Probability |
| | y x | | | | y x | | | | y | x | | | |
| Money Supply | **DLM---->DLTW** | 143 | 3.78671* | 0.02506 | **DLM---->DLTW** | 122 | 4.58441* | 0.01211 | na | na | na | na | na |
| (86:01-98:02; monthly) | DLTW -x- DLM | | 0.16607 | 0.84716 | DLTW -x- DLM | | 0.01809 | 0.98208 | na | na | na | na | na |
| Inflation | DLCPI -x- DLTW | 141 | 1.03484 | 0.35806 | DLCPI -x- DLTW | 120 | 2.68101 | 0.07277 | na | na | na | na | na |
| (86:01-97:12; monthly) | DLTW -x- DLCPI | | 0.34618 | 0.70801 | DLTW -x- DLCPI | | 1.54225 | 0.21829 | na | na | na | na | na |
| Exchange Rate | DLEX x- DLTW | 1582 | 0.25601 | 0.77416 | na na | na | na | na | na | na | na | na | na |
| (92:01:06-98:01:30;daily) | **DLTW--->DLEX** | | 6.16447* | 0.00215 | na na | na | na | na | na | na | na | na | na |
| Treasury Bill Rate | DLTB -x- DLTW | 136 | 0.96161 | 0.38496 | DLTB -x- DLTW | 115 | 1.06659 | 0.34771 | na | na | na | na | na |
| (86:01-97:07; monthly) | DLTW -x- DLTB | | 2.79735 | 0.06462 | DLTW -x- DLTB | | 1.41556 | 0.24718 | na | na | na | na | na |
| G-Bond (long-term) | **DLGB---->DLTW** | 110 | 0.13647 | 0.87259 | na na | na | na | na | na | na | na | na | na |
| (86:01-95:05; monthly) | DLTW -x- DLGB | | 0.04321 | 0.95774 | na na | na | na | na | na | na | na | na | na |
| Co-Bond (low-grade) | **DLCB---->DLTW** | 142 | 10.0005* | 0.00008 | **DLCB---->DLTW** | 121 | 5.39177* | 0.00577 | na | na | na | na | na |
| (86:01-98:01; monthly) | DLTW -x- DLCB | | 2.02086 | 0.13648 | **DLTW---->DLCB** | | 3.48419* | 0.03393 | na | na | na | na | na |
| Term Structure | TS -x- DLTW | 110 | 0.63621 | 0.53132 | TS -x- DLTW | 89 | 0.81106 | 0.44783 | na | na | na | na | na |
| (86:01-95:05; monthly) | DLTW -x- TS | | 2.23997 | 0.11153 | DLTW -x- TS | | 1.28987 | 0.28071 | na | na | na | na | na |

**CONT..**

| | Period: around 1973 -- 1998 | | | | | Period: around 1988 -- 1998 | | | | | Period: around 1973 -- 1987 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Economic Variables | Regression Pair | | Obs | F-statistic | Probability | Regression Pair | | Obs | F-Statistic | Probability | Regression Pair | | Obs | F-Statistic | Probability |
| | y | x | | | | y | x | | | | y | x | | | |
| Default Risk Premium | **DR -----> DLTW** | | 110 | 8.35505* | 0.00043 | **DR -----> DLTW** | | 89 | 4.17939* | 0.01861 | na | na | na | na | na |
| (86:01-95:05; monthly) | DLTW -x- DR | | | 1.81733 | 0.16753 | **DLTW----->DR** | | | 3.01465* | 0.0544 | na | na | na | na | na |
| Industrial Production | DLIP -x- DLTW | | 141 | 0.46134 | 0.63142 | DLIP -x- DLTW | | 120 | 0.32742 | 0.72145 | na | na | na | na | na |
| (86:01-97:12; monthly) | DLTW -x- DLIP | | | 0.15292 | 0.85834 | DLTW -x- DLIP | | | 0.55857 | 0.57357 | na | na | na | na | na |
| Trade Balance Ratio | **TBR----->DLTW** | | 36 | 14.2063* | 0.00004 | na | na | na | na | na | na | na | na | na | na |
| (88:q1-97:q3; quarterly) | DLTW -x- TBR | | | 0.05869 | 0.94311 | na | na | na | na | na | na | na | na | na | na |
| Trade Balance | DLTR x- DLTW | | 36 | 0.08604 | 0.91778 | na | na | na | na | na | na | na | na | na | na |
| (88:q1-97:q3; quarterly) | DLTW -x- DLTR | | | 0.44344 | 0.65214 | na | na | na | na | na | na | na | na | na | na |
| Gross National Product | DLGNP-x- DLTW | | 44 | 0.53035 | 0.59258 | DLGNP-x-DLTW | | 39 | 0.22598 | 0.79893 | na | na | na | na | na |
| (86:q1-97:q3; quarterly) | DLTW-x- DLGNP | | | 1.22541 | 0.30471 | DLTW-x-DLGNP | | | 1.77562 | 0.18473 | na | na | na | na | na |
| Private Consumption | DLPC x- DLTW | | 44 | 0.36889 | 0.69389 | DLPC x- DLTW | | 39 | 0.77834 | 0.46718 | na | na | na | na | na |
| (86:q1-97:q3; quarterly) | DLTW -x- DLPC | | | 0.16662 | 0.84712 | DLTW -x- DLPC | | | 0.18602 | 0.83111 | na | na | na | na | na |
| Consumption per capital | na | na | na | na | na | na | na | na | na | na | na | na | na | na | na |
| | na | na | na | na | na | na | na | na | na | na | na | na | na | na | na |

* Indicates Significance at 5% level (reject H0: y (or x) doesn't Granger Causse x (or y)).

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