ASIAN PACIFIC STOCK MARKET LINKAGES: EVIDENCE DURING THE FINANCIAL CRISIS

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Abstract

This paper examines the short-run and long-run price linkages among Asian Pacific equity markets in the period surrounding the Asian economic, financial and currency crises. The daily data from January 1997 to December 2000 composed of value weighted equity market indices for Malaysian, Japan, Hong Kong and Australia are used. The unit root test, cointergration test, error correction model and the causality tests are conducted to examine the relationship among these markets. Our results show that there is a stationary long-run relationship and a significant short-run causal linkage for certain cases among Asian Pacific equity markets. Furthermore, the long-run interdependence has strengthened since the onset of the crises. The causal relationships that exist between the developed, and emerging equity markets, suggest that opportunities for international portfolio diversification in Asian Pacific equity markets still exist.

Keywords: Asian Pacific equity markets, Linkages, Granger causality, financial crisis.

1. Introduction

The growing linkages of Asian capital market have been well documented in the literature over the last several years. Studies by Corhay, Rad and Urbain (1995), Kwan, Sim and Cotsomitis (1995), Pan, Liu and Roth (1999) have focused on the existence of common stochastic trends and volatility in Asian-Pacific equity markets. While Chan, Gup, and Pan (1992) on the hand examine the temporal relationship between Asian-Pacific stock markets and show that the stock markets indices are not cointegrated. The reason for the high interest in the subject matter is due to the factor such as development and growth of derivative securities, which has stimulated financial integration. The other factor such as reduced in price volatility and narrower spreads through the existence of a wider market participation. This has the potential of lowering the firm's cost of capital. There is also growing evidence that larger financial sectors are less prone to shock than smaller financial sectors.

This paper is concerned with the growing interest on the stock markets' integration. More specifically, the study focuses on examining whether stock markets in Asian- Pacific region (Australia, Japan, Hong Kong and Malaysia) are integrated during the period from 1997 to 2000. The study differs from previous study on capital market linkages in several ways. This study emphasizes on of both developed and emergence economies. Specifically, the study examine whether smaller market, especially Malaysia have strongly being influence by the bigger players (or otherwise) in the Asian-Pacific region following the financial and currency crises which spread across Asia. Indeed, the more developed markets themselves were no longer isolated from conditions in the emerging markets.

This phenomenon of growing integration of Asian financial markets has obvious implications for international portfolio diversification. It has been hypothesised that as low correlations of returns exists, diversifying across national markets allows investors to reduce portfolio risk while holding expected return constant. This would appear to have been a major factor in the interest international investors expressed in Asian emerging markets before the crises.

The organization of the paper is as follows. Section 2 presents a brief literature survey, while section 3 describe the data and its sources. Section 4 describes the methodology employed in the study. Empirical findings are discussed in section 5. Concluding remarks are found in section 6.

2. **Literature Review**

One of the major tenets of portfolio theory concerns the advantages of international diversification. With regards to international stock markets, gains from international diversification can only be realized as long as stock returns in different local markets are less than perfectly correlated with the home market and the correlation structure is stable. While early studies, which examined the interdependence among major stock market indices, employed a variety of different empirical methodologies ranging from simple correlation, variance-covariance, to spectral analysis, the conclusion of these early studies was that there is a lack of interdependence across borders in stock prices. In general they find that there was low or negative correlation among national stock indices providing supporting evidence for the benefits of international diversification. They also discovered that stock markets across borders were segmented and as such risk reduction through international portfolio diversification is possible and in fact was beneficial.

More recent research presents evidence which suggest that there is a substantial degree of interdependence among stock markets that has increased during the 1980s and early 1990s, although the size and signs of the correlation coefficients vary depend on the choice of markets, the sample period examined, the frequency of the data and the different empirical methodologies employed.[2] These studies were concerned primarily with short-run stock market relationships and focused on how different stock markets are linked and transmit information between each other in the short run. Long-run information may also exist among national stock markets. The increased economic interdependence and policy coordination between countries can indirectly link stock prices in the long run. The increased economic interdependence and policy coordination between countries can indirectly link stock prices in the long run. For example, relative changes in stock indices may reflect changes in national incomes across countries. With the development of the theory of cointegration by Engle and Granger (1987) a new method for testing international equity market linkages was available. The property of cointegration is important in the context of stock market linkages because it allows a framework which models both short run as well as long-run relationships between variables simultaneously via the error correction representation of the cointegrating relations.

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[2]. For a detailed review of some conflicting findings see, Khoury, Dodin and Takada (1987), Dwyer and Hafer (1988), Hamao, Masulis, and Ng (1990), and Arshanapalli and Doukas (1993).

Compared with the number of papers examining short-run linkages, there have been relatively few studies examining the long run relationships among international stock market prices.

A review of the empirical research of employing the Johansen type cointegration tests yield mixed results. Employing this methodology, Jeon and Chiang (1991) examine weekly stock index data over the period 1975 to 1990 for the four largest stock exchanges including a S&P 500 composite index for the United States, the FT-500 share index for the United Kingdom, the FAZ share index for Germany and the Nikkei 225 index for Japan. They cannot reject the null hypothesis of one CIV among the four stock market indices. This implies that the system contains three common trends.

In contrast to the above studies, Kasa (1992), focusing on the results for quarterly data, concludes that only one single common trend drives the five equity markets of the US, Japan, the UK, Canada and Germany, there are four CIV among the five variables. The implication is that the G-5 nations stock market price indices share a very stable long run relationship.

Mathur and Subrahmanyam (1990) study the interdependencies among the stock market indices for four Nordic countries (Denmark, Finland, Norway and Sweden) and the US, using the concept of Granger causality. The VAR model results indicate that the US market affected only the Danish markets. The Norwegian, Danish, and Finnish markets did not "Granger cause" any other market.

Jeon and Furstenburg (1990) perform a study on the inter-relationship among major markets**.** They examine the relationships among stock prices in the major world stock exchanges of Tokyo, Frankfurt, London and New York, using the vector autoregression (VAR) approach to daily stock price indices of those markets for the period between January 1986 and November 1988. The study shows a significant structural change with regard to the correlation structure and leadership in the world stock markets crash of October 1987. The degree of international co-movements in the stock price indices has increased significantly since the crash.

Cheung and Ho (1989) conduct a study on the causal relationship between the US market and four Asian–Pacific markets, i.e., Australia, Hong Kong, Singapore and Malaysia and find that a bi-directional relationship exist between the US and Singapore. However, a unidirectional relationship running from the US market to the Hong Kong market and to the Malaysian market is found.

Bailey and Stulz (1990) examine the prospects for international portfolio diversification among Pacific basin stock markets using daily returns for the Hong Kong, Japan Malaysia, Philippines, Singapore, Korea, Taiwan and Thailand stock market indexes over the period January 1977 to December 1985. They employ simple correlation analysis to detect significant interrelations among markets. Their results indicate that the degree of correlation between US and Asian equity return depended upon the period specification, whether daily, weekly or monthly. For example, with daily returns only the correlations between the US and Hong Kong, Japan and Taiwan were significant, while for monthly returns all Asian market correlation were significant, with the exception of the Philippines and Thailand.

Studies done by Cheung and Mak (1992) also used national share market indices to analyze financial integration, though defined in terms of weekly returns over the period January 1977 to June 1988. They find that that the US stock market leads most of the Asian-Pacific stock markets with the exception of the three relatively closed market (Taiwan, Korea and

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Thailand). Similar testing procedures are also performed to examine the causal relationship between the Japanese market and other smaller Asian emerging markets. The regional factor (Japanese market) seems to have a less significant impaction of the Asian-Pacific markets. They concluded that opportunities still existed for portfolio diversification in Asia by international investors.

Janakiramanan and Lamba (1998) examine the Asian emerging markets in the broader context of the Pacific-Basin (that is along with the United States, Australia and New Zealand). The results of a vector autoregression (VAR) model provide evidence " that markets that are geographically and economically close and/or have large numbers of cross border listings exert significant influence over each other". Importantly, while the US market is obviously the most influential market, they find that its effect had diminished over more recent years in favor of regional influences.

Kwan, Sim and Cotsomitis (1995*)* also use Cointegration test to analysis long-term links between world equity markets including Japan, Taiwan, Korea, Singapore and Hong Kong as well as Granger causality tests to quantify short term causal relationship. Focusing on the 'four little tigers', they conclude a (Uni.-directional) causal sequence in all but four of twelve cases considered and that the existence of significant lead-lag relationships between equity markets points to a rejection of the informational market efficient hypothesis"

Studies performed by Roca (1999) who use similar techniques as Kwan, el. al. (1995) to investigate short and long term price linkages between Asian equity markets over the period December 1974 to December 1995, and made allowance for the structural shifts associated with the 1987 stock crash market. However, contrary to the findings of Kwan *et.al.* (1995), he finds evidence suggesting that the "lack of cointegration between the equity markets of Australia and the US, UK, Hong Kong, Singapore, Taiwan and Korea means that the latter markets could serve as good avenues for long term portfolio diversification".

3. Data and Methodology

Data Description

Our empirical study is based on daily closing values of the stock market indices of four Asian Pacific equity market. The data include value-weighted equity market indices of Hang Seng, Kuala Lumpur Composite Index, Nikkei 225 and Australia All Ordinaries. Hong Kong, Japan and Australia are categorized as 'developed' while Kuala Lumpur is regarded as emerging.' The sample period starts from January 9, 1997 through December 22, 2000.

The Ljung-Box Q statistic for returns present in Table 1 shows that, all the Asian markets investigated have very high and significant autocorrelation at all lag tested suggesting that yesterday price is highly correlated with today price.

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TABLE 1: LJUNG-BOX Q TEST RESULT

	AUS	HS	NK	CI
LB (1)	220.2236*	69.2330*	80.1176*	15.315*
LB (6)	220.2243*	70.3825*	86.5024*	38.7592*
LB (12)	220.2349*	78.4189*	89.5272*	47.3605*
LB (24)	220.2700*	98.0001*	93.5363*	71.2589*

Notes:LB (1), LB (6), LB (12) and LB (24) indicate the calculated values of the Ljung-Box Statistic. The** Significant at 1% level.

Methodology

The study investigates price linkages between and among Asian Pacific equity markets using the unit root test, cointegration test and error correction model (ECM). As shown by many previous researchers, all these tests provide a more comprehensive investigation of equity market price linkages and are able to assist in tackling short-term aspects of the issue. The previous studies have focused either on the short-term (see Eun and Shim, 1989, Cheung and Mak, 1992, Espitia and Santamaria, 1994, for instance) or long-term (see Ma, 1993), aspects of equity market integration.

TEST FOR COINTEGRATION

The concept of cointegration, introduced by Granger (1981,1986) and further developed by Engle and Granger (1987), incorporates the presence of nonstationarity, long-term relationship and short-run dynamics in the modeling process. Since a lengthy, detailed description of cointegration can be found in many textbooks (see Engle and Granger, 1991; Davidson and Mac Kinnon, 1993; Benerjee, Dolado, Galbraith and Hendry, 1993; Hamilton, 1994), a brief overview is sufficient here. A financial time series is said to be integrated of one order i.e, I (1), if it becomes stationary after differencing once. If two series are integrated of order one, there may have a linear combination that is stationary without requiring differencing and, if they do, they are said to be cointegrated.

Cointegration (Engle and Granger, 1987 and Johansen, 1988) analysis is used to examine long-term aspects while the other three techniques are utilized for the examination of the short-term aspects. 'Cointegration among a set of variable implies that even if they are nonstationarity, they never drift apart. In contrast, lack of cointegration suggests that such variables have no long-run link' (Arshanapalli and Doukas, 1993, p.195). Cointegration analysis captures relationship among the levels of price which are lost when other techniques are used because of the differences which has to be done in order to achieve stationarity of variables.

Assuming that each series has the same number of unit roots, the cointegration test using OLS regression can be applied by using the equation below:

$$Y_t = c + \alpha X_t + \mu_t \qquad \textbf{(1)}$$

where α is the estimator for independent variable X and c is the intercept. The μ_t is white noise error term and can be considered as temporary deviations from long-run equilibrium. There are two procedures in testing the cointegration. First, the study applies the above regression and examines its Durbin-Watson (DW) statistic. If the DW test statistic exceeds the critical value, the null hypothesis of non-cointegration is rejected. Second, the residual terms from the cointegration regression μ_t is tested employing Dickey-Fuller and Augmented Dickey-Fuller procedure. The ADF estimation is as follows:

$$\Delta\mu_t = \alpha_0 + \phi_1 \mu_{t-1} + \sum_{i=1}^{n} \delta_i \Delta \mu_{t-i} + \varepsilon_t \qquad \textbf{(2)}$$

where α_0, ϕ_0 and δ are coefficients to be estimated, n is the number of lagged terms and ε_t is a white noise disturbance. The significance of the estimated ϕ_0 will be estimated. If the *t*-statistic on the ϕ_0 coefficient exceeds the critical value, (i.e. $\phi_0 \neq 0$) then the μ_t errors from the cointegration regression are stationary, and the variables X and Y are cointegrated. The tabulated distribution in Fuller (1976, p.373) is applied to interpret the t-ratio. In applying regression of equation 2, it should be noted that the number of lags n chosen must be sufficient enough to ensure that the error term, ε_t, is strictly white noise. The study estimated with a variety of lags and the optimal result is reported.

The Johansen (1988) cointegration tests rely primarily on two test statistics. They are trace test statistic and maximum eigenvalue test statistic. Both methods test for the nonzero characteristic roots. The trace test formulation is as follows:

$$\lambda_{trace}(r) = -T \sum_{i=r+1}^{k} In(1-\lambda_t^{/})$$

where T is the number of observations and $\lambda_t^{/}$ is the eigenvalues. The second test, the maximum eigenvalue formulation, is represented by:

$$\lambda_{\max}(r, r+1) = -TIn(1-\lambda_t^{/})$$

The trace formulation tests the null hypothesis that the number of r-cointegrating vectors of r = 0, that is, there are no cointegrating vectors in the system. If it is rejected, then sequential testing of $r \leq 1, r \leq 2, \ldots.$ is used. The maximum formulation tests the null that the number of cointegrating vectors is r against the alternatives hypothesis of r + 1 cointegrating vectors. Johansen and Juselius (1990) provide critical value for the two statistics.

If the series are cointegrated, then the study will use the ECM since it is appropriate formulation to be employed.

ERROR CORRECTION MODEL (ECM)

Granger's theorem argues that when cointegration exist between two variables, it provides the basis for construction of error correction model (ECM). In ECM, it allows the introduction of past disequilibrium as explanatory variables in the dynamic behaviour of current variables thus enables to capture both the short-run dynamics and long-run relationships between the indices. Thus, the validity of an error correction model with the described properties can be used as an alternative test for cointegration. The bivariate ECM autoregression can be expressed as follows:

$$\Delta Y_t = \alpha_0 + \phi_0 \mu_{t-1} + \sum_{i=1}^{m} \beta_i Y_{t-i} + \sum_{j=1}^{n} \delta_j X_{t-j} + \upsilon_t \qquad \textbf{(3)}$$

where μ_{t-1} is the lagged value of the error correction term derived from the long-run cointegration regression equation 2, *m* and *n* are the optimal number of lags for the lagged dependent and lagged independent variables, respectively, and υ_t is the residual. The results of equation 3 provide a test of the relationship between changes dependent variables Y_t and lagged change in the independent variable X_t. Similarly, by reversing the role of *X* and *Y*. it is possible to test the impact of lagged Y on changing X using the same equation. For an issue concerning selection of an appropriate for lag length for the lag variables of Y_{t-i} and X_{t-j}, the study follows the criteria of minimising the mean square of error of prediction [Akaike (1974]. Akaike's final prediction error (FPE) test is as follows:

$$FPE = [(T + g + 1)/T - g - 1)](SSE/T)$$

where T is the number of observations, and g is the number of lags in the autoregression. This criterion has been widely used in the literature [Hsiao (1981) and others].

One important implication of the above model described in literature (Engle and Granger 1987), is that prices in an efficient speculative market cannot be cointegrated. If it they are cointegrated, then it implies that the market is inefficient since there must be 'Granger causality running in at least one direction. In otherwords, return of one variable can be used to forecast the other return, even after taking into consideration the lagged values of the forecast price. Two sources of temporal causality can be derived Granger (1988) and Miller and Russek (1990). First, the sum of the coefficients of the lagged return variables derived from the as standard Granger tests. Second, the coefficient of the lagged error correction term derived from the ECM. In theory, temporal 'causality' can occur through the error correction term alone.

4. EMPIRICAL RESULTS.

Results for the unit root test for level and the first difference of all indices using the testing procedures of Dickey Fuller (DF) and Augmented Dickey Fuller (ADF) are not reported here.[1] The unit root tests for raw data fail to reject the null hypothesis of unit root for all indices at five percent level. However, when the unit root tests are applied on the first differenced series, the results reject the hypothesis of a unit root. The results indicate that all indices series are individually integrated in the first order I(1) and thus allows the use of the cointegration and error correction model testing procedures.

RESULTS OF COINTEGRATION TEST

Next, the study tests the residuals (ε_t) from equation 1 applying the augmented Dickey-Fuller regressions estimation. The minimum final prediction error (FPE) criterion suggested

[1] Results are available on request.

by Akaike (1969) to determine the appropriate lag length (*n*) is used. The results show that three (2) lagged variables are appropriate in ensuring that the residuals ε_t of each series is white noise. Since the statistics exceed the critical value as reported in table 2, the results of the DF and ADF test confirms the presence of cointegration for all indices previously documented in the cointegration regressions and thus are causally related. In other words, information about the spot prices in one market can be used in predicting spot prices in another.

TABLE 2: UNIT ROOT TESTS APPLIED TO THE RESIDUALS OF THE COINTEGRATING REGRESSIONS

ASIAN EQUITY MARKET	DF	ADF
AUS/HS	-51.37	-36.21
HS/AUS	-39.55	-25.12
NK/HS	-41.41	-29.44
HS/NK	-40.50	-25.59
CI/HS	-30.66	-20.14
HS/CI	-40.44	-25.99
NK/AUS	-40.32	-28.81
AUS/NK	-51.21	-36.19
CI/AUS	-29.96	-19.77
AUS/CI	-51.28	-36.25
CI/NK	-30.38	-19.80
NK/CI	-40.95	-29.18

Note: 1) AUS= Australia All Ordinaries, HS= Hang Seng Index, NK= Nikkei 225, CI= Composite Index.
2) The critical value at the 5% significance level is –3.41 for both DF and ADF statistics

RESULTS OF JOHANSEN COINTEGRATION TESTS

As mentioned earlier, the Johansen Cointegration tests use to determining whether there exists a long-run relationship among equity markets. We choose to include a drift term in the cointegration equation. The results of our study shows that the maximum eigenvalue test favours the hypothesis of one cointegration equation at the 5 percent significant level, as reported in table 3. To further support the findings, the trace test is also employed. Similar results are established by the trace test at either the 1 percent or 5 percent level.

Table 3: JOHANSEN COINTEGRATION TESTS RESULT

	Variables	Null	Alt	Statistic (maximum eigenvalue)	Statistic (trace)
AUS	HS	r = 0 r<= 1	r = 1 r = 2	104.7* (0.013)	80.4* (0.013)
	NK	r = 0 r<= 1	r = 1 r = 2	109.1* (0.044)	106.2* (0.035)
	CI	r = 0 r<= 1	r = 1 r = 2	102.1* (0.045)	98.0* (0.039)
HS	AUS	r = 0 r<= 1	r = 1 r = 2	121.7* (0.049)	114.5* (0.040)
	NK	r = 0 r<= 1	r = 1 r = 2	125.7* (0.049)	113.4* (0.036)
	CI	r = 0 r<= 1	r = 1 r = 2	119.2* (0.048)	112.9* (0.040)
NK	AUS	r = 0 r<= 1	r = 1 r = 2	109.8* (0.044)	106.2* (0.035)
	HS	r = 0 r<= 1	r = 1 r = 2	131.7* (0.049)	121.4* (0.036)
	CI	r = 0 r<= 1	r = 1 r = 2	126.9* (0.045)	121.3* (0.035)
CI	AUS	r = 0 r<= 1	r = 1 r = 2	122.1* (0.045)	118.0* (0.039)
	HS	r = 0 r<= 1	r = 1 r = 2	134.2* (0.048)	111.9* (0.040)
	NK	r = 0 r<= 1	r = 1 r = 2	116.9* (0.045)	96.3* (0.035)

Notes: GBP = Great Britain pound, DEM = Germany Deutsche mark, JPY100 = Japan yen, CHF = China yuan, SGD = Singapore dollar. For the tests based on maximal eigenvalue of the stochastic matrix, when the null hypothesis is r=0, the critical value at 5% significant level = 11.03 and at 10% significance level = 9.28. When the null hypothesis is r<=1, the critical value at 5% significance level = 12.71 and at 10% significance level = 6.31. For the tests based on the trace of the stochastic matrix, when the null hypothesis is r=0, the critical value at 5% significance level = 12.30 and at 10% significance level = 10.25. When the null hypothesis is r<=1, the critical values are the same with tests based on maximum eigenvalue of the stochastic matrix.

RESULTS OF ERROR CORRECTION MODEL

This model allows a test for both short-term and long-term relationship between equity markets. The error correction test results are reported in table 4. The long-run relationship between equity market indices captured by coefficient, Φ, are all positively significant at 5% level. As for the short-run relationship captured by coefficient, δ, only three cases are significance. They are between Hong Kong and Japan, Kuala Lumpur and Hong Kong, and Japan and Kuala Lumpur.

In summary, the bivariate test results indicate that all markets are related in the long-run. However, for the short-run, equity markets in Asian are related to each others for nine of twelve cases. Australian equity markets appears to be affected by the information from the north. The insignificant (isolation) of the Australian markets may be partially due the location factors. Since Australia is located away from these three markets (i.e. far down under) the news from up north might contain more information than the other way round.

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TABLE 4: ERROR CORRECTION MODEL (Bivariate)

$$Y_{t-1} = \alpha_0 + \phi_0 \mu_{t-1} + \sum_{i=1}^{m} \beta_i Y_{t-i} + \sum_{j=1}^{n} \delta_j X_{t-j} + \upsilon_t$$

EQUITY MARKET	*a0*	Φ	δ	R²	R-SQ (ADJ)
HS/NK	0.00018 (0.10)	0.235 (5.85)*	-0.0001 (-2.24)*	0.041	0.39
NK/HS	-0.00095 (-0.34)	0.155 (5.66)*	-0.0001 (-2.12)*	0.035	0.33
HS/CI	0.0004 (0.38)	0.408 (10.61)*	-0.0001 (-2.12)*	0.118	0.116
CI/HS	-0.0007 (-0.831)	0.408 (10.61)*	-0.00001 (-2.48)*	0.112	0.11
CI/NK	-0.0006 (-0.71)	0.13602 (4.07)*	-0.0001 (-1.99)*	0.002	0.017
NK/CI	0.000132 (-0.15)	0.141 (4.32)*	-0.000005 (-6.61)*	0.065	0.063
AUS/HS	0.00018 (0.10)	0.235 (5.55)*	-0.0001 (-0.11)	0.031	0.29
HS/AUS	-0.00095 (-0.34)	0.155 (5.36)*	-0.0001 (-2.10)*	0.034	0.31
NK/AUS	0.0004 (0.38)	0.408 (10.51)*	-0.0001 (-3.13)*	0.117	0.117
AUS/NK	-0.0007 (-0.831)	0.408 (10.61)*	-0.00001 (-0.09)	0.111	0.110
CI/AUS	-0.0006 (-0.71)	0.13602 (4.07)*	-0.0001 (-2.99)*	0.002	0.017
AUS/CI	0.000132 (-0.15)	0.141 (4.32)*	-0.000005 (-0.31)	0.005	0.003

Notes: 1) α = constant of the error correction model, δ = coefficient of the independent variable, Φ = coefficient of the error correction term. 2) The critical value of the F-test at 5% significance level is 3.11
3) Figures in brackets are standard errors.4) The '*' denotes statistically at the 5% level.

RESULTS OF GRANGER CAUSALITY

The granger causality test is based on the standard F-statistics, which is calculated for each equation using the unconstrained form of each equation. On the basis of cointegration test results, we conclude that all indices are cointegrated and therefore causally related. The F-statistics from the Granger-causality test results are presented in panel A and B of table 5. The test results suggest bi-directional causality for Hong Kong-Japan, Hong Kong-Kuala Lumpur and Japan-Kuala Lumpur. However, unidirectional are found from Hong Kong to Australia, Japan to Australia and Kuala Lumpur to Australia.

TABLE 5: ESTIMATION RESULTS OF THE GRANGER CAUSALITY TEST OF FULL MODEL

PANEL A	Information flow of Asian Equity Market			
EQUITY MARKET	**FPE lags**	**R^2**	**F-TEST**	
AUS⇒HS	3,3	0.3332	1.2550	
AUS⇒NK	2,3	-0.1277	1.2550	
AUS⇒CI	1,3	0.3482	2.5100	
HS⇒NK	1,1	0.35272	202.4785*	
HS⇒CI	1,1	0.45701	314.0946*	
NK⇒CI	1,2	0.56048	700.2980*	

PANEL B	Information flow of Asian Equity Market			
CAUSALITY	**FPE lags**	**R^2**	**F-TEST**	
HS⇒AUS	1,2	0.2503	5806.1858*	
NK⇒AUS	1,1	0.8269	794.7378*	
CI⇒AUS	1,1	0.8269	794.7378*	
NK⇒HS	2,2	0.0012	794.9976*	
CI⇒HS	2,1	0.2183	794.6865*	
CI⇒NK	1,2	0.6866	794.7265*	

Note: 1) AUS= Australia All Ordinaries, HS= Hang Seng Index, NK= Nikkei 225, CI= Composite Index
An asterisk indicates significance at the 5% level.

5. Summary and Concluding Remarks.

This paper employs the cointegrations, error correction and Granger causality testing procedures to examine for short-term and long-term relationships among four Asian-Pacific equity markets for the period 1997 to 2000. Three of these markets are considered as developed, i.e. Hong Kong, Japan and Australia while Malaysia is categorized as emerging market.

Cointegrating testing procedures are employed to establish long-term relationships among these markets while Granger causality techniques are used to measure causal relationships in the short-term together with an error-correcting model (ECM). The empirical results reported indicate, as shown in many studies, that the Asian-Pacific equity markets are highly integrated during the period of study. There are several possible reasons for these phenomena, which includes long-standing trends in trade and investment interaction among the countries under studies and also the microeconomic reform undergone by the government following the financial crisis.

The results from the study have obvious implications particularly to the fund managers and individual investors. The benefit might come through the international portfolio diversification among major players in the Asian-Pacific equity markets. In fact, the results suggest that opportunities for diversification exist, both in larger markets as well as smaller markets.

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