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Financial Market Integration in Asia: Empirical Analysis on Selected Asian Stock Index Futures Markets

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Abstract: This study investigates the long run and short run relationships among selected Asian stock index futures markets namely (Malaysia, Singapore, Taiwan and Hong Kong). Johansen's cointegration test is used to study the long run relationships. The study found the existence of a long run equilibrium relationship among the four stock index futures markets. Hence, the potential for risk reduction from diversifying across these markets is minimal for investors with long holding periods. However, the error correction term and impulse response analysis revealed that when there is disequilibrium in the short run, the stock index futures series exhibit slow convergence towards the long run equilibrium. This posits that there is avenue for the short-term investors to diversify portfolio risks effectively across these markets. The Taiwan stock index futures market plays the leading role in driving the movements of the other markets towards the long run equilibrium. This posits that the Taiwan stock index futures market can be used to predict the movements of the other three markets (namely, Malaysia, Singapore and Hong Kong).

Key words: Index futures, stock market, Malaysia, Asian

INTRODUCTION

In recent years, most financial markets across the globe are reported to share long run relationships. The linkages among financial markets can be attributed to the rampant stage of globalisation and deregulation in the world capital markets. However, some studies noted segmentation among financial markets over the long run (Chan *et al*., 1992; Dawson and White, 2002). The number of studies on linkages among different stock index futures markets in Asia does not commensurate with the vast amount of literature on stock market linkages. Since stock index futures markets impose lower transaction costs as opposed to their stock market counterparts, it is interesting to note the linkages among these markets for portfolio diversification purposes.

Many studies have examined the interdependence among Asian stock markets and considerable debate exists on the relationships among these markets. Chan *et al*. (1992) found no long run co-movement among stock prices in Hong Kong, South Korea, Singapore, Japan and Taiwan. Pan *et al*. (1999) came to the same conclusion as Chan *et al*. (1992) for the Asia-Pacific equity markets. On the contrary, Manning (2002) found interdependence among the South East Asian equity markets. Manning's (2002) conclusion was supported by Kwan *et al*. (1995) in the context of Hong Kong, Taiwan, Singapore, Japan and South Korea equity markets.

A few important studies in this line based on Asian stock index futures markets are Booth *et al*. (1996), Chou and Lee (2002) and Roope and Zurbruegg (2002). Booth *et al*. (1996) investigated both the short run and long run dynamics of similar Nikkei stock index futures contracts traded on three international exchanges, i.e., Osaka Securities Exchange (OSE), Singapore International Monetary Exchange (SIMEX) and Chicago Mercantile Exchange (CME). They found the three markets to be sharing a long run relationship. One of the strengths of Booth *et al*. (1996) study is that the linkages of the futures markets were examined in detail. Chou and Lee (2002) examined the relationships between Taiwan Index futures traded on the Singapore Exchange (SGX) and Taiwan Futures Exchange (TAIFEX) in terms of price execution efficiency. The authors concluded that the SGX and TAIFEX index futures series were cointegrated. Roope and Zurbruegg (2002) came to the same conclusion as Chou and Lee (2002).

As evident from the literature cited earlier, fewer studies have been carried out to understand market cointegration for stock index futures markets in East Asia

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as compared to the research on the underlying stock market linkages. Hence, this study attempts to fill in the research gap by examining linkages among Asian stock index futures markets (i.e., Malaysia, Singapore, Taiwan and Hong Kong).

MATERIALS AND METHODS

This study is based on secondary data, which includes the prices of Kuala Lumpur Composite Index futures (FKLI), the Singapore Exchange's (SGX) MSCI Singapore Index futures (SiMSCI), SGX's MSCI Taiwan Index futures (TiMSCI) and SGX's MSCI Hong Kong Index futures (HiMSCI). FKLI is traded on the Malaysian Derivatives Exchange (MDEX), whereas SiMSCI is traded on the Singapore Exchange (SGX). Both TiMSCI and HiMSCI are also traded on the SGX and it represents the behaviour of Taiwan and Hong Kong stock index futures markets, respectively. All data is transformed into natural logarithm prior to analysis. In order to examine the linkages among these stock index futures markets, daily closing futures prices are used. The sample period for this study spans from November 23, 1998 to December 31, 2002. The spot month stock index futures contract is used to analyse the linkages among these four markets. If any of the four markets is closed for a whole day due to holidays, the observations of all the other three markets on that particular day are skipped for a proper comparison. The total remaining observations are 1003. In order to provide robust results which are not sensitive to the treatment of exchange rate, the indices of the four stock index futures markets are analysed both in terms of their respective currency units and in terms of Malaysian Ringgit (i.e., common currency for all the markets).

This study employs the Johansen's cointegration method to scrutinize the long run relationships among the four stock index futures markets. Linkages among the four stock index futures markets are empirically examined in four stages. The first stage tests the unit root hypothesis on the futures indices in its levels and its first differences in order to assess the stationarity and the order of integration of the four individual series. If each of the four futures index series is non-stationary in its levels and is integrated of the same order, the study proceeds to the second stage. In the second stage, a multivariate Vector Auto Regression (VAR) system is constructed and the concepts underlying Johansen's (1988) maximum likelihood test (which is used to determine the number of cointegrating vectors) are examined. If the four series are cointegrated, the next step is to examine the dynamic causal relations among the series within the Vector Error-correction Model (VECM). Since the inferences drawn from the t- and F-statistics in the VECM are sensitive to departures from standard statistical assumptions, residual diagnostic tests of the estimated VECM are carried out before scrutinizing the causal relations among the variables. Once the model is well specified, the estimates of the causal relations are derived from the VECM.

RESULTS AND DISCUSSION

To examine the stationary properties of each of the four stock index futures series, the Augmented Dickey-Fuller (ADF) unit root test is employed. The ADF unit root test is performed on model with and without time trend. Table 1 presents the unit root test results, for both levels and first differences, based on Malaysian Ringgit values of the index futures series. As evident from Table 1, each of the four stock index futures series is non-stationary in its levels and is integrated of order one [i.e., I (1)] (the results for indexes denominated in local currency units also indicate that each of the four stock index futures series is non-stationary in its levels and is I(1)).

Before examining the cointegration relations among the series, a vector autoregressive (VAR) model comprising of the four series is formulated. The time series properties of each variable has been examined as a model selection guide in order to determine whether to include a linear time trend or constant or both in the VAR model. The mean of each index future series is approximately equal to zero, which gives evidence that there is no linear deterministic time trend in each of the four stock index futures price series over the sample period of investigation. Intercept (constant term) is generally needed to account for the units of measurement of the

Table 1: ADF unit root results

	Level		First Difference	
Variables	t_μ	$T\tau$	t_μ	$T\tau$
FKLI	-2.5604	-2.7024	-5.4866*	-5.5426*
(lag)	(5)	(5)	(24)	(24)
SiMSCI	-0.859	-2.545	-8.6153*	-8.7081*
(lag)	(0)	(0)	(11)	(11)
TiMSCI	-1.0045	-2.5305	-5.4534*	-5.5428*
(lag)	(25)	(25)	(27)	(27)
HiMSCI	-1.5926	-2.2565	-5.7207*	-5.9233*
(lag)	(1)	(1)	(28)	(28)

	1% Critical values	5% Critical values	10% Critical values
t_μ	-3.43	-2.86	-2.57
T_τ	-3.96	-3.41	-3.13

*Denotes rejection of the null hypothesis of unit root at the 1% significance level. t_μ and T_τ represent the test statistics for unit root model with a constant term and for model with a constant term and a time trend, respectively; the figures in brackets ( ) represent the lag length for each series under the ADF unit root test

Table 2: Johansen's cointegration tests of stock index futures markets in Malaysia, Singapore, Taiwan and Hong Kong

Maximal eigenvalue test statistics

Hypothesis				Critical values (CV)		
H_0	H_A	Eigenvalues	λ_{max}	5% CV	10% CV	Conclusion
r = 0	r = 1	0.032737	33.3180**	28.2700	25.8000	Reject H_0
r = 1	r = 2	0.020302	19.5312	22.0400	19.8600	Do not reject H_0
r = 2	r = 3	0.0060126	6.0368	15.8700	13.8100	N/A
r = 3	r = 4	0.0018180	1.8215	9.1600	7.5300	N/A

Trace test statistics

Hypothesis				Critical alues (CV)		
H_0	H_A	Eigenvalues	λ_{max}	5% CV	10% CV	Conclusion
r = 0	r>0	0.032737	61.7075**	53.4800	49.9500	Reject H_0
r≤1	r>1	0.020302	28.3895	34.8700	31.9300	Do not reject H_0
r≤2	r>2	0.0060126	7.8583	20.1800	17.8800	N/A
r≤3	r = 3	0.0018180	1.8215	9.16000	7.5300	N/A

** Denotes rejection of the null hypothesis at the 5% significance level. The rank of estimated matrix is r, which represents the number of cointegrating vectors; H_0 and H_A refers to null and alternative hypothesis, respectively; the critical values for λmax and λ trace statistics are from Osterwald-Lenum (1992); N/A = not applicable

Table 3: Coefficients of cointegration vectors and tests of zero-loading restrictions

Variable	Coefficient	H_0	Test statistics: χ^2
FKLI	1.00	FKLI = 0	21.1956 [0.000]*
SiKSCI	-0.49946	SiKSCI = 0	5.8284 [0.007]*
TiMSCI	-0.16397	TiMSCI = 0	9.4151 [0.002]*
HiMSCi	0.20179	HiMSCI = 0	8.1325 [0.004]*
Intercept	-9.0362	C = 0	17.6006 [0.000]*

*Denote rejection of the null hypothesis at the 1% level of significant. The cointegrating vector for each model is normalized on the Malaysian stock index futures series; H_0 refers to the null hypothesis that the coefficient is statistically equivalent to zero; $\chi^2(1)$ = chi-square with one degree of freedom; C = intercept; figures in square brackets [ ] represent the probability values, which indicate the level of significance of the test statistic

Table 4: Residual diagnostic tests for each equation in the estimated VECM

	Dependent variable			
Test Statistics	FKLI	SiMSCI	TiMSCI	HiMSCI
Serial correlation test	0.026326 [0.871]	0.74091 [0.389]*	0.10117 [0.750]	1.2983 [0.255]
Ramsey's reset test	0.0001167 [0.991]	0.0061023 [0.938]	0.6509 [0.416]	0.014828 [0.903]
Normality Test	302.9983 [0.000]*	63.1719 [0.000]*	801.1169 [0.000]*	188.5073 [0.000]*
Heteroscedasticity test	20.7055 [0.000]*	9.2627 [0.002]*	54.8235 [0.000]*	3.5927 [0.048]**

*and ** Denote statistical significance at 1 and 5% level, respectively. Figures in square brackets represent the probability values

variables (Harris, 1995). Accordingly, the constant term is incorporated in the VAR model. The next important step is to determine lag lengths for the model. There are number of methods to determine the lag lengths for a model. Microfit 4.1 automatically generates the AIC and SBC values as well as a sequence of log-likelihood ratio statistics for each lag length specified in the VAR model. The selection procedure involves choosing the VAR model with the highest value (in absolute terms) of the AIC or the SBC. The uniform lag structure for the multivariate VAR model is selected by maximizing the absolute value of the AIC. The next step is to test for the presence of cointegrating vector.

Results of Johansen's cointegration test are presented in Table 2. From Table 2, it is evident that the maximum eigenvalue and trace statistics reject the null hypothesis of no cointegration (i.e., r = 0) at the 5% significance level. Nevertheless, the null hypothesis that there is one cointegrating vector (i.e., r = 1 for the maximal eigenvalue statistic) or at most one cointegrating vector (i.e., r≤1 for the trace statistic) is not rejected at the 5% level of significance (results for indexes denominated in local currency units also indicate that there is one cointegrating vector among the four stock index futures series). Hence, one cointegrating relation ties the movements of the four stock index futures series together in the long run.

Having established the presence of a single cointegration vector for the system of four stock index futures series, the Johansen and Juselius (1990) procedure allows the testing of the significance of each of the variables in the co-integrating vector by way of imposing restrictions on the coefficients of each of these variables. Likelihood Ratio (LR) test statistic, which is asymptotically distributed chi-square with one degree of freedom is used to test the significance of each of the four stock index futures series in the cointegration relation. The LR test statistic is associated with the null hypothesis that the coefficient is statically equivalent to zero. If the null hypothesis is rejected, it indicates that the stock futures price is significant in the cointegrating relationship. The LR test statistics is presented in Table 3.

The results from Table 3 provide evidence that the null hypothesis (i.e., the long run coefficient is equals to zero) is rejected at the 1% significance level for Malaysian, Singapore, Taiwan and Hong Kong stock index futures markets. This implies that these four stock

Table 5: Summary of causality results based on vector error-correction model after correcting for heteroscedasticity in the residuals using White's test

	Independent variables					
	(F-statistics)				ECT_{t-1}	
Dependent variable	ΔFKLI	ΔSIMSCI	ΔTIMSCI	ΔHIMSCI	coefficient	t-statistics
ΔFKLI	-1.0243 [0.306]	-0.42791 [0.669]	0.77531 [0.438]	0.18148 [0.856]	-0.024689	-3.9559 [0.000]*
ΔSIMSCI	0.40348 [0.687]	-0.70373[0.482]	-0.058589 [0.953]	-0.78832 [0.431]	-0.037359	-2.6095 [0.009]*
ΔTIMSCI	0.23570 [0.814]	-1.9823 [0.048]**	-3.7754 [0.000]*	2.8586 [0.004]*	-0.0042587	-0.15149 [0.880]
ΔHIMSCI	0.80865 [0.419]	1.2204 [0.223]	0.56453 [0.573]	-2.6775 [0.008]*	-0.065064	-3.1300 [0.002]*

*, ** and *** denote statistically significant at the 1, 5 and 10% significance level, respectively. Δ = first-difference of a variable; ECT_{t-1} = lagged error correction term; the figures in square brackets [ ] represent the probability of rejecting the null hypothesis of no causal relationships

index futures markets enter into the cointegrating vector at a statistically significant level. Intercept is also significant in the cointegrating relation at the 1% significance level.

The evidence of a long run equilibrium relationship among the four stock index futures markets has few implications. First, international portfolio diversification will be less effective among these four stock index futures markets in the long run because the investment risk cannot be diversified away. Secondly, it guarantees some significant Granger (1988) causality in the system which gives avenue for developing profitable forecasting tool that will be useful for speculators. In addition, the degree of integration among the four stock index futures markets provides pertinent information on the appropriate choice of monetary policies.

Since the four stock index futures markets are cointegrated, the causal relations among these variables are examined within the Vector Error-correction Model (VECM), which allows the combination of short run and long run dynamic adjustments among these variables. Before examining the causal relations, it is imperative to ascertain that the residual of the individual equations in the VECM adhere to certain statistical properties, since inferences drawn from t-test and F-test in the VECM are sensitive to the behaviour of residuals. Hence, diagnostic tests are performed on the residuals of each of the four equations in the estimated VECM prior to scrutinizing the causal relations. The residual diagnostic test for each of the four equations in the VECM is given in Table 4.

Table 4 shows that the residuals for FKLI SiMSCI, TiMSCI and HiMSCI equations are free from problems of serial correlation. The Ramsey's RESET test indicates that the null hypothesis of no specification errors in the equation is not rejected for all the four equations, which posits that these equations are correctly specified. On the contrary, the null hypothesis of normality in the residuals is rejected for all the four equations. However, according to Pesaran and Pesaran (1997), the normality assumption in the residuals is important in small samples, but it is not generally required when the sample size is large enough (i.e., 1003 observations in this study). The residuals of all the four 10 equations are also found to exhibit heteroscedasticity. According to Pesaran and Pesaran (1997), the assumption that the conditional variance of the residual is constant (i.e., homoscedastic) is often violated in analysis of financial time series data. However, for efficient estimator, the residuals are corrected using White's test (1980). In general, the VECM is reasonably well specified, except for non-normality and heteroscedasticity in the residuals for each of the four equations. The VECM regression results after adjusting for heteroscedasticity in the residual by using White's test is reported in the Table 5.

Short run casual relations: As evident from Table 5, the F-statistics for short run causal relations from lagged ΔSiMSCI and lagged ΔHiMSCI (independent variables) to ΔTiMSCI equation are significant. This indicates unidirectional causality from Singapore and Hong Kong Stock Index futures markets to Taiwan stock index futures market. This finding is consistent with the findings of study done by Alexakis and Siriopoulos (1999). In addition, the lagged values of ΔTiMSCI are found significant in its own equation, which shows that the short run movement in Taiwan stock index futures is explained by its own lagged movements. The short run causal relations among these three markets are attributed to the fact that SiMSCI, TiMSCI and HiMSCI contracts are traded on the same exchange (i.e., Singapore Exchange). On the other hand, the short run movements in the Hong Kong Stock index futures market are explained only by the lagged movements in its own market. The F-statistics for all the other markets are not significant, indicating that there is no short run causal relations.

Long run casual relations: The long run causal relationships among the variables are indicated by the significance of the t-statistics of the lagged error correction term (ECT_{t-1}). Since there is one significant cointegration vector, there is only one error correction term. Table 5 shows that ECT_{t-1} is significant for all the three equations except for the equation of ΔTiMSCI. Hence, it is noted that only ΔTiMSCI does not adjust to clear the disequilibrium when there is a deviation from the long run equilibrium relationship. Therefore, ΔTiMSCI is exogenous in the system in the long run, which indicates that this market is the initial receptor of any exogenous shocks to the long-term equilibrium relationship. In other words, Taiwan stock index futures market leads in picking up the information first and then passes them on to the other three markets in the system. On the other hand, FKLI, SiMSCI and HiMSCI are endogenous in the system since these series adjust to clear disequilibrium from the previous period. There are several reasons for the leading role of Taiwan stock index futures market in transmitting information to the other markets. Due the same time zone in these four countries, the futures contracts are traded almost simultaneously, except that TiMSCI contracts are traded for longer hours (i.e., the market closes at 7 PM) as compared to the other three markets. The Malaysian and Singaporean markets close at 5.15 PM whereas the Hong Kong Market closes at 4.15 PM. The longer trading hours of TiMSCI contracts enable it to impound more information to drive the movements of the other three markets. The other reason for the leading role of Taiwan stock index futures market is that TiMSCI has the greatest liquidity in terms of contract turnover volume as compared to the other three stock index futures markets. Masih and Masih (1999) postulated that the greater the liquidity of a market (in terms of the trading volume transacted), the more leading the market is expected to be in the information context.

The coefficient of the significant ECT_{t-1} indicate that the convergence towards the long run equilibrium is slow, which posits that after any shock that forces the series from their long run values, it takes a longer time for the prices to return to their equilibrium values if there is no opposite shock to counter the initial shock. The economic intuition from this finding is that although the benefits from portfolio diversification is limited in the long run, the benefits can be increased in the short run due to the slow adjustment process towards the long run equilibrium state.

CONCLUSIONS

The long run relationship among the stock index futures markets in Malaysia, Singapore, Taiwan and Hong Kong is supported by the fact that the underlying stock markets in these countries are interdependent as well (Cheung, 1995; Masih and Masih, 1999; Manning, 2002). Besides that, the rampant stage of deregulation and liberalisation in the Asian financial markets along with the advent of computerised trading system justifies the presence of a long run relationship among the four stock index futures markets.

Results of this study will be particularly useful for corporate firms building portfolios that are made up of financial products across and within national border as one of their investment strategies to minimize the exposure to risk. Since, the lower transaction costs in stock index futures markets makes it as an attractive tool to achieve portfolio diversification at a cost-effective way, deciding on which stock index futures markets to invest in is a crucial management decision. The presence of a long run equilibrium relationship among the four stock index futures markets implies that the benefit of risk reduction from international portfolio diversification across these four markets is greatly limited for investors with long holding periods. Nevertheless, since these markets take a long time to converge to the long run equilibrium state, short-term investors will be able to enhance the benefits from portfolio diversification across these markets. The results of this study are also relevant to the policy makers, whereby the interdependence among these markets constraints the latitude to pursue independent domestic monetary policy in the respective markets. Overall, it can be concluded that although the stock index futures markets in Malaysia, Singapore, Taiwan and Hong Kong are interdependent and exhibit stable long run relation, these markets deviate from each other in the short run. Nevertheless, investors' tastes and preferences, market forces and government regulations bring them back to their long run equilibrium state. It is conjectured that if the markets liberalise further and reduce transaction tax, the convergence towards the long run equilibrium will be faster.

REFERENCES

Alexakis, P. and C. Siriopoulos, 1999. The international stock market crisis in 1997 and the dynamic relationships between Asian stock markets: Linear and non-linear Granger causality tests. Managerial Finance, 25: 22-38.

Booth, G.G., T.H. Lee and Y. Tse, 1996. International linkages in Nikkei stock index futures markets. Pacific-Basin Finance J., 4: 59-76.

Chan, C.K., B.E. Gup and M.S. Pan, 1992. An empirical analysis of stock prices in major Asian markets and the US. Financial Rev., 27: 289-307.

Cheung, A.C.S., 1995. The UK stock market and economic factors: A new approach. J. Busi. Finance Accounting, 22: 129-142.

Chou, R.K. and J.H. Lee, 2002. The relative efficiencies of price execution between the Singapore Exchange and the Taiwan Futures Exchange. J. Futures Markets, 22: 173-196.

Dawson, P.J. and B. White, 2002. Interdependencies between agricultural commodity futures prices on the LIFFE. J. Futures Markets, 22: 269-280.

Granger, C.W.J., 1988. Some recent developments in a concept of causality. J. Econ., 39: 199-211.

Harris, R.I.D., 1995. Using Cointegration Analysis in Econometric Modelling. London, UK: Prentice Hall, Harvester Wheatsheaf.

Johansen, S., 1988. Statistical analysis of cointegrating vectors. J. Econ. Dynam. Control, 12: 231-254.

Johansen, S. and K. Juselius, 1990. Maximum likelihood estimation and inference on cointegration: With application to the demand for money. Oxford Bull. Econ. Stat., 52: 169-210.

Kwan, A.C.C., A.B. Sim and J.A. Cotsomitis, 1995. The causal relationships between equity indices on world exchanges. Applied Econ., 28: 33-37.

Manning, N., 2002. Common trends and convergence? South East Asian equity markets, 1988-1999. J. Intl. Money Finance, 21: 183-202.

Masih, A.M.M. and R. Masih, 1999. Are Asian stock market fluctuations due mainly to intra-regional contagion effects? Evidence based on Asian emerging stock markets. Pacific-Basin Finance J., 7: 251-282.

Osterwald-Lenum, M., 1992. A note with quantiles of the asymptotic distribution of the maximum likelihood cointegration rank test statistics. Oxford Bull. Econ. Stat., 54: 461-472.

Pan, M.S., Y.A. Liu and H.J. Roth, 1999. Common stochastic trends and volatility in Asian-Pacific equity markets. Global Finance J., 10: 161-172.

Pesaran, M.H. and B. Pesaran, 1997. Working with Microfit 4.0: Interactive Econometric Analysis. Oxford: Oxford University Press.

Roope, M. and R. Zurbruegg, 2002. The intra-day price discovery process between the Singapore Exchange and Taiwan Futures Exchange. J. Futures Markets, 22: 219-240.

White, H., 1980. A heteroscedasticity-consistent covariance matrix estimator and a direct test for heteroscedasticity. Econometrica, 48: 817-838.