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Relationships between Indian and Other South-East Stock Markets

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Abstract

This study examines the vibrant relationship and interdependence between selected South-East countries stock markets and Indian stock market. Stock markets in South-East region are expected to become more open and interdependent. The study is based on secondary data obtained from DATASTREAM database for the period from 1st August, 1991 to 31st July, 2011 with a total of 4992 observations. In the course of analysis, descriptive statistics, correlation matrix, Granger causality test, converging trends and co-integration test has been designed. The results of the Granger causality tests indicate interdependence between South-East market returns. Overall, the results indicate an increase in the integration between the South-East markets after the global financial crisis.

Keywords: Financial Integration, Capital Markets, India, South-East Countries, Granger Causality Test, Converging Trend Test, Co-integration test

1. Introduction

Apart from trade, the openness of an economy can have other dimensions as well, most notably, openness in allowing cross-border capital flows (Virmani, 2001). In economics literature, “financial integration” and “financial openness” have often been used interchangeably. The problems associated with capital mobility or financial openness is ascribed to the “costs” of financial integration. If the costs are too high in net terms, financial integration would induce welfare reduction. An economy pursuing capital account liberalisation is said to be seeking financial integration with the international financial markets through financial openness. In this sense, financial openness is the means, while financial integration is the goal. Although financial openness is a necessary condition for financial integration, it is not a sufficient condition. The composition of capital flows, in particular to emerging economies, has rapidly changed, and portfolio equity and foreign direct investment inflows have become more prominent. Accumulation of official international reserves has recently accounted for a significant portion of the increase in the gross foreign assets of emerging and developing economies (Kose et al, 2006).

Globalisations in capital markets and reduction of restrictions on international cross listings have led to greater flows of capital between economies, easier ownership and trading in securities from around the world. With increased market integration, the current world financial markets have become more closely correlated and interdependent over time. Understanding the information linkages and correlations between markets are important for policy makers and fund managers in their financial decisions in relation to investment and risk management. The existence of low correlation among returns from different national stock markets has been used frequently to justify the international diversification of portfolios. Another reason for investors to consider global investments is return enhancement. Securities issued by countries with higher growth rates are expected to earn higher rates of returns.

A number of studies (e.g. Copeland and Copeland 1998, Janakiramanan and Lamba 1998, Jeong 1999) report significant correlation between international stock markets and established leadership role of the United States (US) equity market on other markets. Longin and Solnik (1995) found covariance of the returns between markets is more pronounced during the down periods. This suggests any dramatic movements in one stock market could have a strong impact on the markets of different sizes, structures and geographical locations across the world. In 2008, the financial meltdown started a wave of contagion

effects, spreading quickly to its neighbouring countries in the East Asian region. Stock markets in the region declined sharply and then partially rebounded. Such an event would affect portfolio allocation and risk evaluation based on historical estimates of relevant returns and variance-covariance matrix.

Rapid economic growth in several East Asian economies prior to the global financial crisis in 2008 brought increased integration to countries in the South-East Asian region, and strengthened its position in the world economy. The main aim of South-East Asian countries are to increase competitive edge in the global market, eliminate intra-regional trade barriers, encourage greater economic integration among member economies, and attract more direct foreign investments into the region.

Study by Hassapis and Kalyvitis (2002) found output growth responds significantly to unanticipated changes in domestic and foreign stock returns. It would be crucial for the financial institution and policy makers to understand how shocks are transmitted across markets. Using weekly and monthly data from January 1988 to February 1999, Manning (2002) found convergence of the South-East Asian equity markets from 1992 to mid-1997 and divergence occurring during the financial crisis. It would be beneficial to examine if there are signs of converging or increased correlation among stock markets in the region after the financial crisis using more recent data sampled at different frequency. This is particularly important as estimates of correlation coefficients tend to increase and may be biased upward during the crisis when markets are more volatile.

The emerging market and developing countries weathered the recent financial storm and are providing the basis for strong global growth in 2008. For the first time, China and India are making the largest country-level contributions to world growth. These two countries together now account for one fifth of world purchasing power parity-adjusted GDP, up from 10 per cent in 1990 (IMF, 2007).

This paper examines the dynamic interdependence of the selected South-East countries (SSEC), namely Indonesia, Malaysia, South Korea, Singapore and Taiwan. Stock markets in the region are expected to become more open and interdependent. The primary focus is to consider the long-run relationships among the South-East market indices including India and whether there are signs of converging or increased cross-market integration after the global financial crisis. The Indian stock market is also included in the study given its significant influence on other markets across the South East.

2. Methodology

2.1 Data and variables

This study examines the five markets in South Asia, namely Indonesia (JSX), Malaysia (FTSE), the South Korea (KOSPI), Singapore (STI) and Taiwan (TSEC) with Indian stock market (NSE). Daily total market-return indices for South-East and the Indian markets are obtained from DATASTREAM database over the period from 1st August 1991 to 31st July 2011. These indices have been adjusted for dividends and provide the longest common sampling data available for the six countries from the same source of database. The whole sample period for each market consists of 4992 daily observations. The daily returns for each stock market are computed as logarithmic differences of daily market indices over the entire sample period. To examine the effect of the Global financial crisis in 2008, the whole sampling period was divided into two sub-periods from 1st August 1991 to 31st July 2007 (3830 observations) and from 1st August 2007 to 31st July 2011 (1162 observations).

2.2 Tools Used

In the course of analysis, statistics tool include descriptive statistics, correlation matrix and econometric tool s include Granger causality test, converging trends and co-integration test has been designed.

2.2.1 Statistical Tools

It is also important to examine the cross-market relationships of the daily percentage returns of the selected South-East indices with India. Table 1 and Table 2 present the descriptive statistics of country daily market returns and their correlation coefficients. Across both the pre- and post- crisis samples, the mean returns for all South-East were generally higher and less volatile during the post-crisis period. As shown in Table 2, the correlations between selected South-East market returns were relatively low which would be ideal for international diversification. However, the correlations between selected South-East returns were trending upward over time. Of particular note was the lower correlation between the returns of the Malaysian and

Singapore markets over the post-crisis period.

2.2.2 Econometric Tools

The present study use three time series methods to test the presence of converging trends and market relationships between Indian stock market and selected South-East Asian countries. The first method examines the direction of Granger causality between returns of two countries and groups of countries using an unrestricted vector auto regression; the second method applies a simple statistical test for market index trends, while the third method applies unit root tests and co-integration analysis to the market index series.

2.2.2.1 Granger Causality Test

Granger causality tests are conducted to test the significance and direction of causality between the market returns. According to Granger (1969), a variable *X* is said to 'Granger cause' *Y* if past values of *X* help in the prediction of *Y* after controlling for past values of *Y*, or equivalently if the coefficients on the lagged values of *X* are statistically significant. On the assumption that all returns are stationary, the equations for pairwise Granger causality tests are given by

$$R_{X,t} = \alpha_0 \quad \sum_{j=1} \alpha_j R_{X,t-j} \quad \sum_{j=1} \beta_j R_{Y,t-j} \quad u_t \qquad (1)$$

$$R_{Y,t} = \alpha_0 \quad \sum_{j=1} \alpha_j R_{Y,t-j} \quad \sum_{j=1} \beta_j R_{X,t-j} \quad \varepsilon_t \qquad (2)$$

where $R_{X,t}$ and $R_{Y,t}$ are daily returns for stock markets *X* and *Y*, respectively, and u_t and ε_t are random disturbances with zero means and finite variances. Equations (1) and (2) are estimated using an unrestricted vector autoregression (VAR). A test of the null hypothesis that returns on *Y* do not Granger cause returns on *X* is obtained using a Wald-test for joint significance of each of the lagged returns on *Y* in equation (1).

2.2.2.2 Test for Converging Trend

In a time series framework, a simple statistical test for converging or diverging trends of a market index series, as proposed by Verspagen (1994), can be written as follows:

$$W_{i,t} = p_{i,t} - p_t^* \qquad (3)$$

Where $p_{i,t}$ is the logarithm of the market index for country *i* at time *t* and p_t^* is the logarithm of average market index for *n* countries in the sample ($p_t^* = \sum_{i=1}^{n} p_{i,t} / n$). It is assumed that, for each time period, W_i changes according to the following process:

$$W_{i,t+1} = \Psi W_{i,t} \quad \eta_{i,t} \qquad (4)$$

If $\Psi > 1$, the market index in country *i* diverges from the sample group; if $\Psi < 1$, convergence of the market index occurs.

2.2.2.3 Co-integration Method

A stochastic definition of convergence requires two data series to follow a stationary process. This definition is applied to test for convergence in market return indices across countries. Bernard and Durlauf (1995) have proposed a time series test for convergence and common trends. The notion of convergence in multivariate market indices can be defined such that the long- term forecasts of market indices for all countries, $i = 1, \ldots n$, are equal at a fixed time *t*:

$$\lim_{k \to \infty} E(p_{1,t+k} - p_{i,t+k} | I_t) = 0, \; i = 1, \qquad (5)$$

where I_t is the information set at time *t*. Applying the concepts of unit roots and co-integration, the convergence test determines whether $p_{1,t+k} - p_{i,t+k}$ in equation (5) is a zero mean stationary process in a co-integration framework. Convergence in market indices for two countries, *x* and *y*, implies that the stock

markets are co-integrated, with co-integrating vector [1, -1].

Empirically, testing for convergence and common trends in a co-integration framework requires the individual market index series to be integrated of order one. The following augmented Dickey-Fuller (1981) (ADF) test is used to determine the order of integration for market indices in the selected South-East countries:

$$p_{i,t} = a_{0i} + a_{1i} + t + \beta_i p_{i,t-1} \quad (6)$$

$$\sum_{j=1} \delta_j + p_{i,t-j} + \varepsilon_{i,t}$$

where $p_{i,t}$ approximates the rate of return on stock market, t is the deterministic trend, n is the order of the autoregressive process, and $p_{i,t-j}$ is included to accommodate (possible) serial correlation in the errors.

The rank of the co-integrating matrix in a multivariate framework can be estimated using the following VAR representation (Johansen, 1991):

$$P_t = \Gamma(L) P_t + \Pi P_{t-k} + \mu + \varepsilon_t , \quad (7)$$

where P_t is a $n \cdot 1$ vector of the logarithms of total market indices for n South-East countries, Π represents the long-run relationships of the co-integrating vectors, $\Gamma(L)$ is a polynomial of order $k - 1$ to capture the short-run dynamics of the system, and ε_t are independent Gaussian errors with zero mean and covariance matrix Ω. The reduced rank ($0 \leq$ rank $(\Pi) = r < n$) of the long-run impact matrix is formulated as follows:

$$\Pi = \alpha\beta \quad (8)$$

Where β is the $n \cdot r$ matrix of co-integrating vectors and α is the $n \cdot r$ matrix of adjustment coefficients.

Applying the Johansen maximum likelihood estimation method, convergence in multivariate market indices, as defined in equation (5), would require $r = n - 1$ co-integrating vectors for n South-East countries of the form [1, -1] (i.e. one common long-run trend for the individual market index series in P_t). The Johansen procedure permits hypothesis testing of the co-integrating relations and their adjustment coefficients, using the likelihood ratio test which follows a chi-squared distribution. This method is necessary to determine whether the r co-integrating vectors are of the form [1, -1], which requires a unit restriction imposed on all the coefficients of the r co-integrating vectors.

3. Empirical Results

The paper applies time series tests to daily total market return indices in natural logarithms (LMI) for Indian and selected South-East countries from 1st August 1991 to 31st July 2011. All estimation results are derived using the EViews 6.0 software.

3.1 Granger Causality

Testing the direction of Granger causality between returns of South-East and the Indian markets is conducted using a VAR of order 10. The chi-squared test statistics for joint significance of each of lagged returns on individual South-East returns are reported in Table 3. The results of the Granger causality tests indicate interdependence between South-East market returns. Overall, there has been an increase in cross-market interdependence over the post-crisis period, particularly the Indonesian market returns. Similar to other studies, returns on the Indian market have significant influence on returns of all South-East markets with relatively higher test statistics than any individual South-East markets.

3.2 Converging Trend

Using the simple statistical test of Verspagen (1994) for converging or diverging trends of the LMI series

(see equations (3) and (4)), estimation results are reported in Table 4. Among the South-East countries, Indonesia and Singapore are the two diverging countries, whereas the remaining three countries converge towards the South-East mean LMI level. Comparing the pre-post crisis periods, Indonesia and Singapore are diverging over the pre-crisis and post-crisis periods, respectively.

On the other hand, the market indices of Indonesia and the Philippines are two South-East countries diverging from the Indian market index. Overall, all South-East market indices that diverged from the Indian market index during the pre-crisis period are converging during the post-crisis period.

3.3 Co-integration Results

Before testing for convergence based on the method of Bernard and Durlauf (1995), it is essential to determine the order of integration for each of the market index series. ADF tests are used to test for the presence of unit roots in the logarithms of total market return indices in the Indian and selected South-East countries. Although detailed results are not reported to save space, the ADF t- statistics do not reject the null hypothesis of a unit root for the six LMI series, implying that each is non-stationary. Upon taking first differences of the series which indicate stationarity of the transformed series, the ADF tests indicate all six LMI series are integrated of order one.

Based on the definition in Bernard and Durlauf (1995), the six LMI series are tested for convergence between each South-East country. The Schwarz information criterion is used to determine the order of the VAR model, with the test statistics and choice criteria indicating a VAR model of order two. If the LMI for two countries are co-integrated, the restriction [1, -1] is imposed on the co-integrating vector. Assume no deterministic trend in the data and restricted intercept in co-integrating equation. Table 5 reports the trace statistic of the stochastic matrix to determine the number of co-integrating vectors (r) that are significant at the 5% level.

The trace statistics reject the existence of a long-run co-integrating relationship between the Indian market and each of the South-East markets, with the exception of Indonesia in the pre-crisis period. As shown in Table 5, there are five and two long-run relationships between South-East market indices in the pre- and post-crisis periods, respectively. Of the 10 co-integrating vectors given in Table 5, the likelihood ratio test rejects the null hypothesis of a unit restriction for three co-integrating vectors (namely, the Philippines with Indonesia, Malaysia and Singapore, respectively) at the 5% significance level. The results indicate convergence in two pairs of South-East market indices across the entire sample and both periods before and after the financial crisis.

For the South-East countries, tests for the presence of a common long-run trend for individual LMI series in the group are also undertaken. The test statistics indicate the existence of at least one long-run co-integrating relationship among the South-East market indices in the pre-crisis period and at least two long-run co-integrating relationships in the post-crisis period. The results indicate the number of common trends reduced from four to three which suggests a partial convergence of the indices.

4. Conclusion

This paper examines the dynamic interdependence and long-run relationships between the South-East stock markets, and whether there are signs of converging or increased cross-market integration after global financial crisis. An examination of the South-East stock market returns indicates higher average returns and correlations over the post-crisis period. The Granger causality results also indicate an increase in the

integration between the South-East markets after the financial crisis with minor changes in directions of Granger causality between pairwise South-East returns across the pre- and post- crisis periods. Consistent with past studies, the Indian market returns are found to have significant influence on the returns of selected South-East markets.

Among the South-East markets, Indonesia and Singapore are two diverging countries, whereas the remaining three countries converge towards the group average using the statistical test for converging trend. However, selected South-East has shown signs of converging with the Indian market in the post-crisis period. Using the co-integration method, convergence of selected South-East market indices was not supported, except for convergence in two pairs of South-East markets. Apart from Indonesia, none of the South-East had a long-run co-integrating relationship with the Indian market. Reduction of common trends among South-East markets in the post-crisis period suggests a partial convergence of the indices. Overall, there is some evidence of an increase in the level of integration and interdependence between the South-East markets after the financial crisis.

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Table-1: Descriptive Statistics (daily stock market return)

	Full Sample		Pre-Crisis Period		Post-Crisis Period	
Country	Mean	SD	Mean	SD	Mean	SD
JSX	-0.005	2.822	0.001	2.474	0.060	2.268
FTSE	0.028	1.728	0.053	1.207	0.065	1.627
KOSPI	0.023	1.589	0.054	1.479	0.035	1.464
STI	0.032	1.218	0.031	0.962	0.061	1.219
TSEC	0.023	2.057	0.035	1.813	0.063	1.905
NSE	0.043	0.098	0.069	0.711	0.019	1.139

Table-2: Correlation matrix of stock market returns: pre- and post-financial crisis

Country	JSX	FTSE	KOSPI	STI	TSEC	NSE
JSX	1.00	**0.27**	**0.30**	**0.36**	**0.33**	**0.02**
FTSE	0.17	1.00	**0.17**	**0.26**	**0.20**	**-0.02**
KOSPI	0.10	0.22	1.00	**0.32**	**0.29**	**0.04**
STI	0.14	0.64	0.24	1.00	**0.45**	**0.15**
TSEC	0.08	0.35	0.15	0.35	1.00	**0.06**
NSE	0.01	0.12	0.03	0.15	0.08	1.00

Note: The bottom and top (bold) diagonals display the correlation coefficients over the pre- and post- crisis periods, respectively.

Table-3: Granger causality tests on daily stock market returns using a VAR (10) model

	Full Sample	Pre-Crisis	Post-Crisis
Indonesia			
FTSE	75.21*	24.36*	31.73*
KOSPI	15.90	12.86	15.46
STI	9.19	4.49	21.48*
TSEC	34.74*	6.24	24.32*
NSE	109.20*	14.75	110.58*
Malaysia			
JSX	22.46*	20.95	14.44
KOSPI	14.18	19.19*	22.46*
STI	27.05*	7.48	37.55*
TSEC	19.41*	18.97*	18.84*
NSE	193.05*	102.99	134.72*
South Korea			
JSX	49.89*	12.23	19.64*
FTSE	40.35*	22.16*	65.51*
STI	26.28*	22.59*	10.53

TSEC	78.62*	37.84*	48.73*
NSE	242.82*	59.00*	196.08*
Singapore			
JSX	41.89*	28.82*	14.50
FTSE	42.69*	11.88	65.05*
KOSPI	8.03	25.23*	11.73
TSEC	22.74*	9.60	18.37*
NSE	482.86*	146.93*	338.21*
Taiwan			
JSX	34.84*	22.22*	12.13
FTSE	36.44*	13.83	26.47*
KOSPI	19.10*	36.57*	11.86
STI	47.45*	20.40*	22.44*
NSE	174.69*	58.46*	115.58*

Note: * denotes significance at the 5% level.

Table-4: Test results for converging trend

Country	JSX	FTSE	KOSPI	STI	TSEC
Selected South-East Countries	1.0000*	0.9971	0.9998	1.0000*	0.9989
NIFTY	1.0001*	0.9999	1.0000*	0.9999	0.9999
Pre-Crisis Period					
Selected South-East Countries	1.0001*	0.9989	0.9994	0.9997	0.9995
NIFTY	1.0002*	1.0001*	1.0000*	1.0017*	1.0001*
Post-Crisis Period					
Selected South-East Countries	0.9999	0.9976	0.9999	1.0000*	0.9975
NIFTY	0.9999	0.9997	0.9999	0.9995	0.9997

Notes: * indicates that the LMI of the country diverge from the South-East market or the Indian market index.

Table-5: Trace Statistics for the VAR (2) Model

	Full Sample	Pre-Crisis	Post-Crisis
Indonesia			
FTSE	–	24.45*	–
KOSPI	–	22.10	–
STI	–	24.97*	–
Nifty	–	30.00*	–
TSEC	30.01*	–	15.58*
South Korea			
JSX	–	24.93	–
STI	–	35.65	–
TSEC	24.10*	–	–
Singapore			
JSX	–	–	22.30*
Selected South-East Countries	78.58	84.12	57.91**

Notes: * denote a unit restriction is not rejected at the5% level of significance.

** denotes significance at the 5% level for H_0: r=1 and H_a: $r \geq 2$.