Regional Integration of Emerging Stock Markets in Asia: *Implications for International Investors*

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The last couple of decades have seen an increasing interest in emerging markets in the context of international portfolio investments. A major reason why emerging markets have achieved significant importance in global portfolios is their ability to generate superior returns. Researchers have shown that emerging markets have offered returns much superior to those of even developed markets (see for instance, Harvey [1995], Bekaert, Erb, Harvey, and Viskanta [1998], and Peter and Kannan [2007]). Another major reason parallel to the superior returns argument is the relative isolation of emerging markets from each other as well as from the developed economies—in other words, their segmentation property (Harvey [1994], Cha and Cheung [1998], Gunduz and Omran [2001], Neaime [2002], and Lin and Wu [2006]). Marketplaces are said to be segmented when their returns are not affected by factors other than domestic ones. Such markets thus satisfy the much-followed Markowitz theory of portfolio diversification (Markowitz [1952]), which proves that combining an asset that has negative or low correlation with other assets in a portfolio provides superior risk-adjusted returns. The much-thought-of segmented emerging market assets are therefore expected to provide superior risk-adjusted returns. Such segmentation is observed in the context of emerging markets on account of excessive regulations that restrict larger volumes of economic activities to domestic territories. However, in the current business environment such restrictions do not sustain for long, and even emerging markets tend to expand their economic activities across the borders. And as these emerging economies establish stronger trade ties with other emerging or developed economies, international factors become more and more influential in determining their market returns (see, for example, Dekker, Sen, and Young [2000], Forbes and Chinn [2003], and Worthington, Katsuura, and Higgs [2003]). Recent years in fact have seen an increasing trend toward regionalism in achieving economic goals of emerging market countries. According to UNCTAD [2007], intraregional trade is growing more rapidly than extraregional trade. A number of countries have reduced their dependence on traditional export markets such as the U.S., Japan, and the European Union, and are instead focusing on emerging markets. Such trade ties have a tendency to synchronize the movements in stock markets in these countries. Additionally, with the developments in information technology and market micro-structures, the information transmission across the markets takes place easily, thereby influencing their returns. The result of these developments is the integration of otherwise segmented markets with other markets, and such integrated markets may no longer provide diversification benefits. A closer examination of international market

movements on a day-to-day basis indicates that there exists a high degree of comovement among international stock markets. In fact, as Eun and Shim [1989] put it, unexpected developments taking place in international markets seem to have become important news events that influence domestic markets.

This article focuses on the issue of stock market integration in Asia. A special reason for selecting Asian emerging markets is the substantial interest of international investors in these economies. Asia attracts huge volumes of capital inflows (see Exhibit 1) compared to other emerging market regions. The average gross capital flows to the Asian region have been much higher at $67.54 billion than the $20 billion for the Latin American market and $9.19 billion for the European and CIS markets. Besides, the region is home to some of the fastest growing and largest economies, including India and China. While dealing with asset allocation among such competing markets, it is imperative to know the extent to which these markets get influenced by other markets within the region. A relatively higher allocation can be made to a market that is not integrated with other markets. Given the fact that platforms like ASEAN successfully operate in the region, examination of possible stock market integration is useful from the international investors' viewpoint. Specifically, we address the following research issues that are of significant interest to international portfolio managers: 1) What proportion of movements in one Asian stock market can be explained by innovations (unexpected developments or news) in other Asian markets? 2) How rapidly do the stock price movements in a particular Asian market transmit to other Asian markets? 3) Do the significant economies in Asia, like China and India, influence other Asian markets significantly?

EXHIBIT 1
Gross Capital Inflows to Emerging Markets (in US$ billions)

Year	Asia	Europe & CIS	Latin America
1990	1.19	0.68	2.53
1991	12.6	0.71	25.18
1992	35.56	3.21	31.88
1993	95.38	6.47	51.04
1994	108.08	3.62	73.37
1995	70.71	4.17	6.91
1996	100.04	4.77	48.69
1997	82.16	8.31	34.13
1998	0.02	0.15	32.37
1999	88.32	5.03	10.59
2000	79.82	–5.18	5.7
2001	26.66	–0.3	–3.74
2002	15.28	5.14	–9.47
2003	78.63	6.35	–2.97
2004	86.96	33.32	–4.51
2005	122.9	35.89	35.32
2006	143.79	43.9	3.01

Source: International Monetary Fund.

DATA AND METHODOLOGY

This study uses daily stock market index data from six Asian markets for the period January 1, 1998, through December 31, 2007. The six markets (and market indices) selected for the study are China (Shanghai Composite), India (S&P CNX Nifty), Thailand (SET Index), Malaysia (KLSE Composite), Indonesia (JKSE Composite), and South Korea (KOSPI Composite). The required data series have been collected from ISI Emerging Market Database. All the local currency-denominated stock indices are converted into dollar-denominated indices by using daily exchange rate data between each of the countries in the sample and the U.S. dollar. The dollar-denominated stock indices take into account the effect of exchange rate risk, which is an important factor in determining asset allocation strategies of international portfolio investors. Finally, consistent with convention, the daily stock market index data used in the study have been transformed by taking natural logarithms of the data.

For each country, we compute daily returns *RET* as the first difference of the natural logarithms of stock price indices (*P*) multiplied by 100.

$$RET_t = (\ln P_t - \ln P_{t-1}) * 100 \qquad (1)$$

To address the issue of segmentation and integration properties of Asian stock markets, the VAR (vector autoregressions) methodology developed by Sims [1980] is employed, as it provides a multivariate framework where changes in a stock market index are related to

changes in its own lags and to changes in other variables and the lags of those variables. The VAR model thus can help in identifying main channels of interaction and simulate the responses of a given market to innovations in other markets.

The VAR model can be expressed in its standard form as

$$RET_t = C + \sum_{k=0}^{p} A_k R_{t-k} + \varepsilon_t \qquad (2)$$

where RET_t is the $m \times 1$ column vector of daily returns on the market indices at time t, C is the $m \times 1$ column vector of constant terms, A_k are $m \times m$ matrices of coefficients such that the (i, j)th component of A_k measures the effect of change in the jth market on the ith market after k periods, and ε_t is an $m \times 1$ column vector of unobserved disturbances assumed to satisfy the usual assumptions of the errors from an OLS regression. Equation (2) assumes a return generating process where the return of each market is a function of a constant term, its own lagged returns, the lagged returns of other variables in the system, plus an error term ε_{it}, which is serially uncorrelated but can be contemporaneously correlated. In other words, the returns of a market incorporate not only its own past information, but also the past information of other markets.

Once we develop our six Asian markets VAR, we trace out the dynamic responses of each market to innovations in a particular market using simulated responses of the estimated VAR system (impulse response functions); additionally, the contribution of one market to the k-step forecast error variance of other markets can be computed (forecast error variance decomposition).[1] Before implementing the VAR methodology, we test for stationarity of return variables to avoid the problem of spurious regression (Granger and Newbold [1974] and Phillips [1986]). The results based on an augmented Dickey-Fuller (Dickey and Fuller [1979]) test and Phillip-Perron (Phillips and Perron [1998]) test (Exhibit 2) indicate that all the return series are stationary at levels or integrated of order zero, i.e., $I(0)$. Therefore, we construct the VAR model with level series.

EXHIBIT 2
Results of Stationarity Test

	ADF Test	*Phillips-Perron Test*
***Variable* (*at Levels*)**	**t-stat**	**Adj t-stat**
LJKSERET	–39.46147	–38.95072
LKLSERET	–22.60292	–47.57199
LKOSPIRET	–48.01525	–47.92627
LSETRET	–32.86044	–46.80945
LSSECRET	–50.43709	–50.44643
LNIFTYRET	–47.88627	–47.88420

Notes: i) The variables represent logarithmic transformation of respective market return series (JKSE—Indonesia, KLSE—Malaysia, KOSPI—South Korea, SET—Thailand, SSEC—China and NIFTY—India); ii) ADF is Augmented Dickey Fuller test; iii) MacKinnon [1996] critical values are used for rejection of hypothesis of a unit root. Test critical values are –3.43266, –2.8624, and –2.5672 at the 1%, 5%, and 10% significance levels, respectively.

CORRELATION STRUCTURE OF ASIAN MARKET RETURNS

Exhibit 3 shows simple correlations of daily logarithmic returns giving preliminary insight into market integration phenomena. It can be observed that all the Asian markets' returns share positive but low correlations. Within that, the Chinese stock market exhibits substantially low correlations with the rest of the markets in the Asian region. Though China is the biggest economy in the region, the Asian markets show insignificant correlations with it. On the other hand, the markets exhibit greater correlation with India. The Thailand market shows high correlation with Indonesia (0.34), Malaysia (0.38), and South Korea (0.34). Overall, the correlation structure indicates that Asian markets' returns are weakly linked with each other, though complete isolation of markets cannot be concluded.

CONTRIBUTION OF INDIVIDUAL ASIAN MARKETS TO VARIANCE IN OTHER MARKETS

Exhibit 4 presents the results of 1-, 2-, 5-, 10-, and 15-days-ahead forecast error variance of Asian stock

EXHIBIT 3
Correlation Matrix for Selected Asian Emerging Markets

	LJKSERET	LKLSERET	LKOSPIRET	LSETRET	LSSECRET	LNIFTYRET
LJKSERET	1.00					
LKLSERET	0.30	1.00				
LKOSPIRET	0.27	0.24	1.00			
LSETRET	0.34	0.38	0.34	1.00		
LSSECRET	0.05	0.06	0.06	0.07	1.00	
LNIFTYRET	0.18	0.16	0.26	0.21	0.07	1.00

Note: Correlation coefficient calculated on logarithmic values of daily market returns between January 1, 1998, and December 31, 2007.

market returns into fractions that are accounted for by the innovations of different markets.[2] Exhibit 5 gives the proportion of domestic and foreign innovations in forecast variance of a given Asian market. The Asian markets are found to be largely driven by their own innovations and therefore exhibit greater opportunities for portfolio diversification. At the same time, the six markets are not completely isolated or segmented. The Chinese market is the most exogenous market in the region, with over 99% of the forecast error variance of the market returns due to its own innovation at all the horizons. The total contribution of foreign market innovations remains at a meager 0.82% even after accounting for delayed response to foreign market innovations. Besides, China has insignificant influence on forecast error variance of other markets in the region (maximum of 0.38% for India). The South Korean market exhibits the behavior of leading markets wherein its error variance is explained largely by its own innovations (100% at day 1 and over 97% at days 5–15), but has a sizeable contribution in explaining error variance in all the other markets in the region except China. South Korea explains over 5% of error variance in Malaysia, around 7% in India, and more than 8% in Indonesia. The South Korean market has the greatest influence on the Thailand market, where it accounts for more than 11% and 12% of the market's error variance at 1 day and 5–15 days, respectively. However, its influence on the Chinese market is very weak, like other markets in the region (less than half percentage at all the horizons).

Thailand is the most endogenous market in the region. Innovations from foreign markets explain 22.38% of this market's error variance at day 1, which further increases to over 25% at subsequent horizons. Thailand is significantly influenced by South Korea and Malaysia, which together account for over 80% of the total foreign market contribution to its forecast error variance at 2–15 days. The next most endogenous market in the region is Indonesia, where innovations in foreign markets explain more than 11% at day 1 and subsequently more than 15% of its error variance. Again, like the Thailand market, South Korea and Malaysia play significant roles in explaining the error variance in the Indonesian market. These two markets account for over 95% of the total foreign market contribution in the Indonesian market on all the horizons.

With reference to the Indian market, 9.60% of its error variance is explained by other Asian markets at day 1, increasing to more than 10% for a horizon of 2 to 15 days. The Indian market exhibits a significant degree of comovement only with the South Korean market, which has a share of about 6.64% in the total foreign market innovations in India at day 1 and about 7% for days 2 to 15. The significant influence of the South Korean market on the Indian market can be viewed in the light of increasing competition between South Korea and India in attracting FII investment. According to the Institute of International Finance in Washington, over the six-year period of 1999–2004, India was a close second to South Korea in growth in FII inflows. Though China is the strongest and nearest competitor to India, it accounts for less than half a percent of the total foreign market contribution to the error variance in the Indian market.

SPEED OF TRANSMISSION OF INNOVATIONS AMONG ASIAN MARKETS

Having understood the explanatory power of individual Asian markets in causing innovations in other regional markets, we turned the focus to examining the

EXHIBIT 4

Contribution of Individual Asian Market to Innovations in Other Markets in the Region

Period	LKOSPIRET	LSSECRET	LKLSERET	LJKSERET	LSETRET	LNIFTYRET
Variance Decomposition of LKOSPIRET:						
1	100.0000	0.000000	0.000000	0.000000	0.000000	0.000000
2	98.38288	0.020538	0.543476	0.116956	0.869319	0.066831
5	97.93412	0.064486	0.782374	0.215516	0.912837	0.090670
10	97.93378	0.064486	0.782658	0.215565	0.912838	0.090674
15	97.93378	0.064486	0.782658	0.215565	0.912838	0.090674
Variance Decomposition of LSSECRET:						
1	0.252548	99.74745	0.000000	0.000000	0.000000	0.000000
2	0.366588	99.41188	0.081058	0.053530	0.027102	0.059842
5	0.382246	99.18201	0.081962	0.061610	0.121474	0.170694
10	0.382274	99.18195	0.081973	0.061617	0.121493	0.170695
15	0.382274	99.18195	0.081973	0.061617	0.121493	0.170695
Variance Decomposition of LKLSERET:						
1	5.686243	0.247864	94.06589	0.000000	0.000000	0.000000
2	5.782995	0.363955	93.41565	0.200854	0.212942	0.023609
5	6.744071	0.367403	91.07667	1.353600	0.233320	0.224931
10	6.745203	0.367412	91.07320	1.355362	0.233516	0.225309
15	6.745203	0.367412	91.07320	1.355362	0.233516	0.225309
Variance Decomposition of LJKSERET:						
1	6.153221	0.047216	5.057643	88.74192	0.000000	0.000000
2	7.931811	0.063581	6.792464	84.73202	0.463806	0.016314
5	8.070943	0.077408	6.747886	84.40487	0.583050	0.115841
10	8.070938	0.077442	6.747980	84.40463	0.583150	0.115856
15	8.070938	0.077442	6.747980	84.40463	0.583150	0.115856
Variance Decomposition of LSETRET:						
1	11.01933	0.219413	8.430816	2.707054	77.62339	0.000000
2	11.99197	0.238433	8.261118	3.734557	75.76093	0.012989
5	12.49291	0.373717	8.204665	3.968978	74.93742	0.022309
10	12.49299	0.373729	8.204645	3.969119	74.93719	0.022330
15	12.49299	0.373729	8.204645	3.969119	74.93719	0.022330
Variance Decomposition of LNIFTYRET:						
1	6.638194	0.323729	0.969562	0.883559	0.785136	90.39982
2	6.967412	0.323712	1.065663	0.876986	0.826266	89.93996
5	6.952988	0.383870	1.067736	0.884163	0.831805	89.87944
10	6.952988	0.383874	1.067741	0.884164	0.831806	89.87943
15	6.952988	0.383874	1.067741	0.884164	0.831806	89.87943

Note: Each entry denotes the percentage of forecast error variance of given market explained by markets listed in the top row in a given period measured in number of days.

efficiency with which these innovations are transmitted between markets with the help of impulse response functions. If markets are inefficient in the transmission of new information, investors may be able to profit on the lag between leading and lagging markets. Further, the magnitude of the market's response indicates how influenced that market is. Exhibit 6 indicates graphically the response of different Asian markets to innovations (shock of one standard error) in a particular market. Again it reveals that all the Asian markets respond substantially

EXHIBIT 5

Proportion of Domestic and Foreign Innovations in Forecast Error Variance of Given Asian Market

Period	Domestic/Own Innovations (%)	Foreign Innovations (%)	Period	Domestic/Own Innovations (%)	Foreign Innovations (%)
	S. KOREA			CHINA	
1	100.00	0.00	1	99.75	0.24
2	98.38	1.62	2	99.41	0.59
5	97.93	2.07	5	99.18	0.82
10	97.93	2.07	10	99.18	0.82
15	97.93	2.07	15	99.18	0.82
	MALAYSIA			INDONESIA	
1	94.07	5.93	1	88.74	11.26
2	93.42	6.58	2	84.73	15.27
5	91.08	8.92	5	84.40	15.60
10	91.07	8.93	10	84.40	15.60
15	91.07	8.93	15	84.40	15.60
	THAILAND			INDIA	
1	77.62	22.38	1	90.40	9.60
2	75.76	24.24	2	89.94	10.06
5	74.94	25.06	5	89.88	10.12
10	74.94	25.06	10	89.88	10.12
15	74.94	25.06	15	89.88	10.12

and instantaneously to the domestic shocks. The size of responses of a particular Asian market to a shock in the domestic market is substantially large (between 1.54 to 2.23 on day 1, i.e., the same day). However, the response to domestic shocks gets quickly diluted the next day in most of the markets, as indicated by a substantial fall in the magnitude of response. Consistent with findings in FEVD analysis, the Chinese market shows a negligible response to shocks in other markets. Also, while all the markets show a significant response to shocks in the South Korean market, shocks originating in these markets are not absorbed by the South Korean market. The biggest impulse response to a South Korean shock is in the Thailand market (0.62).

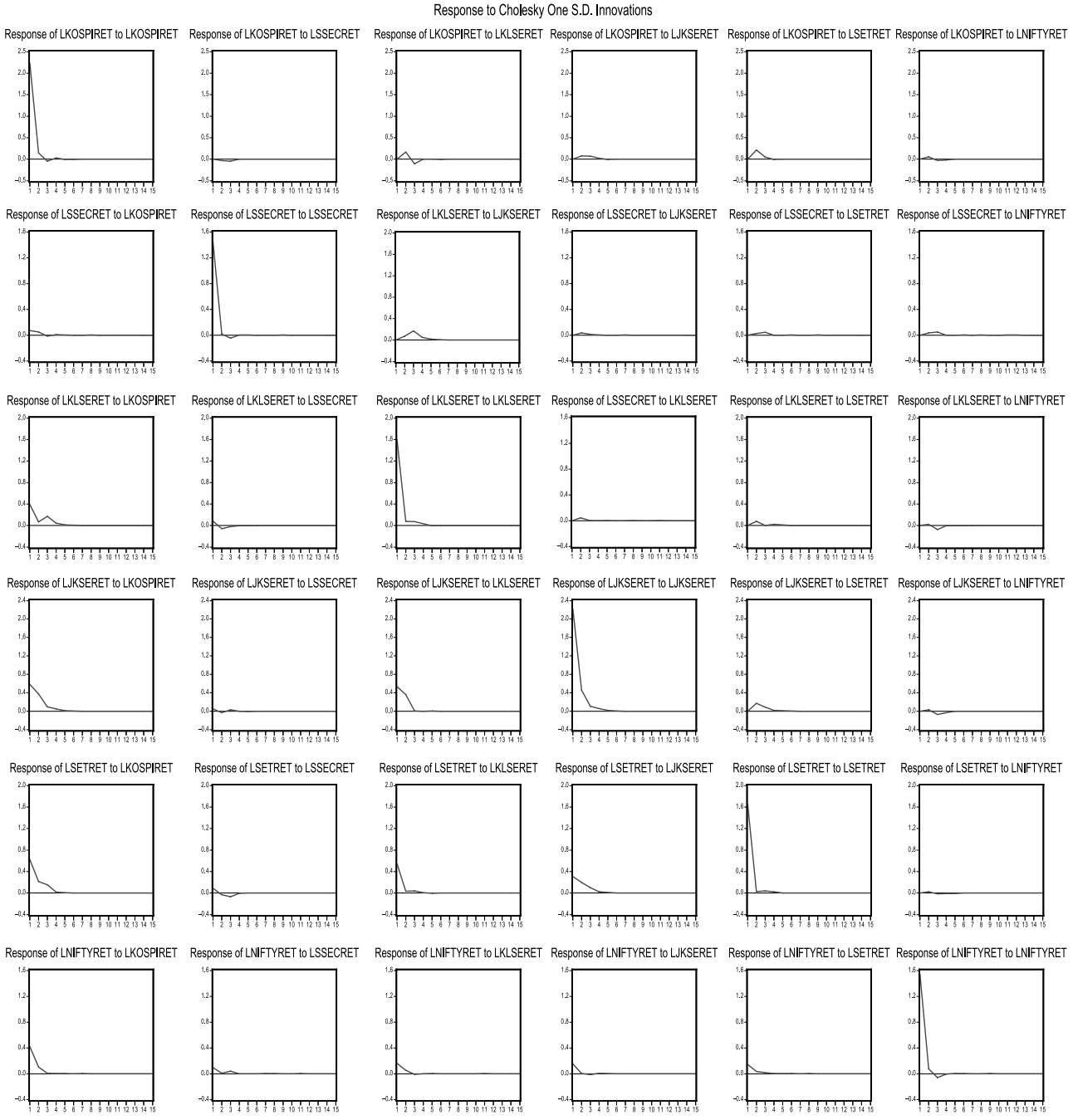
The shocks originating in South Korea, Malaysia, and Indonesia are significantly absorbed by the Thailand market on the same day. In fact, the response nears zero only after three days. Within that, the magnitude of response of Thailand to South Korea remains high during all three days (0.62, 0.21, and 0.15 on days 1, 2, and 3, respectively). Shocks originating in South Korea and Malaysia also remain significant in the Indonesian market for 2 days. The magnitude of response of Indonesia to shocks in the South Korean market is 0.59 and 0.37 on days 1 and 2, respectively, while the response to shocks in the Malaysian market is 0.53 and 0.36 on days 1 and 2, respectively. Further, the Indonesian market shows a delayed response (0.16) to shocks in the Thailand market on day 2.

The Indian market shows a much broader response as it is efficient in absorbing shocks originating in all the other Asian markets. However, the response is not significant for most of the markets. The magnitude of response by the Indian market is highest for shocks in South Korea (0.42 on day 1) and least for shocks originating in China (0.09 on day 1). The response of the Indian market to shocks in other markets is between 0.14 to 0.16 and dilutes substantially the next day with the exception of the response to shocks in the South Korean market (0.10 on day 2).

The stock market integration dynamics of the six Asian economies are summarized in Exhibit 7. Panel A of Exhibit 7 lists the markets (in column 2) that significantly

EXHIBIT 6

Response of Different Asian Markets to Innovations (Shock of 1 Standard Error) in a Particular Market



impact a given Asian market (column 1). Clearly, the South Korean market emerges as the leading market in the Asian region that influences all other markets (except China) but no other market influences it. Panel B lists the markets (in column 2) that are significantly impacted by a given Asian market (in column 1). It can be observed that the equity markets of the two biggest and fastest growing economies in the region, India and China, do not impact the smaller markets in the Asian region. Exhibit 7 highlights the fact that markets involved in the Asian crisis of 1997 still share significant interlinkages even a decade after the crisis.

EXHIBIT 7
The Integration Dynamics of Asian Stock Markets

Panel A	
Market	**Other Asian Market Impacts Significantly**
China	None
India	South Korea
South Korea	None
Malaysia	South Korea
Indonesia	South Korea, Malaysia
Thailand	South Korea, Malaysia, Thailand
Panel B	
Market	**Other Asian Market Impacted Significantly**
China	None
India	None
South Korea	All (except China)
Malaysia	Indonesia, Thailand
Indonesia	Thailand
Thailand	None

CONCLUSIONS

Emerging markets have gained significant importance in international portfolios. However, inclusion of this asset class in portfolios requires careful examination of their integration dynamics, as the very essence of the emerging markets is their continued efforts to reform and interact with the outside world. This interaction makes these markets' returns vulnerable to developments in other markets and thus may wipe out portfolio diversification benefits. In the context of Asian emerging markets, we found that the region does provide scope for portfolio diversification as all the markets in the region are largely affected by their own innovations. However, there is evidence of a differential magnitude of capital market integration within the Asian region. The Chinese market is significantly isolated from the rest of the group despite the fact that it is the largest economy in the region. Stricter restrictions on participation of foreign investors in Chinese markets is probably one main reason for complete segmentation of this market. Though the Indian market absorbs shocks in several of the Asian markets, a significant linkage is observed only with the South Korean market. This is because South Korea has emerged as a strong alternative to India in respect to portfolio investments by FIIs (foreign institutional investors). Interestingly, no significant linkages exist between China and India. The prominent BRIC economies in Asia thus provide tremendous opportunity for portfolio diversification to global investors on account of their high growth rate and significant segmentation from the rest of the markets in the region.

While investing in the Asian region, global investors need to focus on developments in the South Korean market, which has a significant impact on all the other markets in the region (except China). On the other hand, portfolio investors need to be extra cautious while investing in Thailand, which is the most endogenous market in the region followed by Indonesia and Malaysia. Even a decade after the Asian crisis, the tiger economies show significant comovement with each other. One reason for this could be the strong economic ties established between the three countries under the ASEAN platform. The study reveals that international investors can get maximum diversification benefits by investing in China, India, and South Korea, while Thailand, Malaysia, and Indonesia are relatively riskier markets on account of their greater degree of integration with several markets within the region.

The integration of Asian economies and, therefore, stock markets is still evolving. Countries like China and India, which until recently had limited trade and investment interests in most of the Asian countries, are expanding their economic ties with several countries in the region. The China-ASEAN free trade agreement (FTA) is expected to be fully implemented in 2010, and ASEAN is also negotiating a FTA with India. Another emerging bloc in the region was formed by the Asia-Pacific Trade Agreement, which combines the leading economies of China, India, and the Republic of Korea together with other Asian countries. Recent years have also seen greater cross-border acquisitions within the Asian region. These expanding trade ties and firm-level effects are expected to have a direct effect on stock market linkages within the Asian region, and research subsequent to these developments should give a clear idea of portfolio diversification benefits in the Asian region.

ENDNOTES

[1]For a more detailed description on the VAR model and computation of impulse response functions (IRF) and forecast error variance decomposition (FEVD), refer to Sims [1980].

[2]The term "innovations" is used for residuals in equations for each of the selected markets, since it is that component of market return that is "new" in the sense of not being predicted from past values of variables in the system. More specifically, the innovations in Equation (2) are defined as,

$$\varepsilon_t = RET_t - P[RET_t \mid RET_{t-1}, \mathrm{RET}_{t-2}, \ldots]$$

where P denotes the linear least squares projection of RET_t in the space spanned by $[RET_{t-1}, \mathrm{RET}_{t-2}, \ldots]$. The moving average

representation of Equation (2) enables us to trace out the reactions of international stock markets to news, ε_t, in the form of unexpected developments in a national stock market. These innovations in Equation (2) may be contemporaneously correlated such that the covariance matrix of innovations is not diagonal. Such contemporaneous correlation implies that a shock in one market may transmit to other markets through the innovations. It is customary to transform these correlations by orthogonalizing the innovations in the VAR system by Cholesky decomposition according to pre-specified causal ordering so that the covariance matrix of the resulting innovations is diagonal. Following Janakiraman and Lamba [1998] we order the Asian markets in the VAR system according to the market closing time, with market closing being given first priority in the system. Further, the VAR system is built with two lags, though Schwartz information criterion suggested a lag of one. Eun and Shim [1989] also find that price changes in one market are transmitted to the other markets within a maximum of 48 hours.

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