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The Heat Waves or Meteor Showers Hypothesis: Test on Selected Asian Emerging and Developed Stock Markets

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Abstract

This paper examines the presence of "meteor shower and heat waves" effects in selected Asian emerging and Asian developed stock markets. The volatility in one market can spillover to another and tends to continue after that market closes and producing volatility in geographically distant markets opening several hours later. This phenomenon has been known as "meteor shower" (Engle et al., 1990). On the other hand, the "heat wave" hypothesis postulates that the volatility in one market continues in the same market next day. In particular, the relationships between selected Asian countries daily stock price index volatility are investigated. The results based on "Seemingly unrelated regression (SURE) and Generalized method of moment (GMM)" indicate slower transmission of information between the markets during the 1991-1993 period. Subsequently the transmissions of information between the selected Asian markets increased and the rapid transmission occurred after the Asian financial crisis. After regulatory changes (Imposing capital control by Malaysian Government), transmission of information in Malaysian stock market becomes insignificant. This finding suggests the "meteor shower" hypothesis is not rejected among the Asian selected countries except Malaysia, especially after the financial crisis.

Key words: Stock market, Volatility spillover, Seemingly Unrelated Regression, Generalized Moment of Method, Financial Crisis, Meteor Shower and Heat Wave hypothesis.

JEL classification: G11, G14, G15, C32.

Introduction

The theory of efficient capital market says that the prices of financial assets equal the discounted value of the expected cash flows that these assets generate. Similarly stock market efficiency implies that stock prices equal the discounted value of expected cash flows from investment in the shares. Therefore it is assumed that investors forecasts future cash flow based on available information. If capital markets are efficient in this sense, changes in stock prices will reflect new information. Moreover, publicly available information is discounted in asset prices as soon as it becomes available in the market.

However, most stock price changes cannot be solely associated with contemporaneous changes in investors expectations of futures corporate profits, as to some extent, stock prices frequently fluctuate in response to variables unrelated to dividend prospects. There are several reasons why returns and volatility of the two equity market may be related. The two economies are related through trade and investment, so that any news about economic fundamentals in one country most likely has implications for the other country. Another possible reason for the international correlation of stock price changes is market contagion. It implies that changes in stock price in one country may be affected by the changes in another country beyond what is expected based on the economic fundamentals. For example, the October 1987 crash in New York set off worldwide stock price decline, which indicates as a bear-market contagion. Thus stock prices in some sense should be more volatile than is consistent with market efficiency. Robert Shiller reported the volatility results in his 1979 and 1981 papers and suggested that stock price volatility is too great to be consistent with market efficiency. This could be due to the closer relation between the world equity market and interdependence of regional as well as the global economy.

The world equity markets are evolving rapidly due to changes in technology, changes in regulation and falling barriers in international trade. Consequently faster information flow makes the equity markets more volatile than the market efficiency assumed.

The volatility in one market can spillover to another and tends to continue after that market closes and producing volatility in geographically distant markets opening several hours later. This phenomenon has been known as "meteor shower" (Engle et al., 1990). On the other hand, the "heat wave" hypothesis postulates that the volatility in one market continues in the same market next day.

Therefore news affecting equity values in one market could also affect the distant markets. It means that news comes in cluster, so that periods of large absolute changes tend to cluster together followed by periods of relative small absolute changes (Baillie and Bollerslev, 1990). The meteor shower hypothesis indicates that markets are unable to fully process enough information and it signals a violation of the market efficiency hypothesis. Kyle (1985) and Admati and Pfleiderer (1988) demonstrate that private information is only gradually incorporated into prices. They indicate that market dynamics cause the continuity of volatility after a shock end and therefore, the meteor showers hypothesis holds together with heat wave hypothesis. None of these studies found any evidence that news in one market could partially predict the mean return in other markets. This study investigates the relevance of "heat wave and meteor shower" hypothesis in selected Asian emerging and Asian developed markets.

Justification of the Study

Though the theoretical research in market microstructure has been impressive, much work remains to be done on empirical testing. It is important to understand the dynamics of market microstructure and the process by which price and bid-ask quotes react to news. Such analysis has important public and institutional policy implications (especially for turbulent Asian emerging markets) for different trading processes as well as better understanding of trading and information cycles crucial for improving market efficiency.

Asian emerging countries experienced three unique growth cycles during last decade. For example, transitional growth from agriculture to industrial economy during 1990 to 1993, booming industrial and financial growth during 1994 to 1996 through liberalization and relaxing the restriction on capital movement and finally declining economy during 1997 to 1999 due to the financial crisis. These three unique growth cycles provide a suitable testing ground for analysis of microstructure effects of information flows on prices and trading activity within and between markets.

Background of the Study

Prices for stocks and other financial assets frequently exhibit large fluctuations on a short and longer term basis. Probably the best known examples are the stock market crashes of 1929, 1987 and 1997 and the more recent turbulence on the regular basis. Recent studies have investigated how news from one national financial market influences the volatility in another market. This is possibly due to international financial integration through rapid globalization of financial markets.

The sharp and widespread fall in regional stock prices witnessed in 1997 is one of the more recent episodes of this phenomenon. Other prominent events include the stock market crash of 1987, the ERM crisis of 1992 and 1993, the 1994-1995 Mexican Peso crisis.

Such episodes have been interpreted by some observers as evidence of a change in the behavior of present day financial markets. In particular, assertions that financial markets are now characterised by higher levels of volatility than in the past and display greater susceptibility to 'contagion and spillover effect' that have considerable prominence in recent years. Another important aspect that makes the spillover effect more relevant for the decision-makers is the regional trading blocks.

Review of Previous Studies

Numerous recent studies have investigated how news from one international stock market influences the volatility processes of other markets. For instance, using return calculated from daily open and close price, Hamao et al. (1990) report significant volatility spillovers in the stock returns from New York to Tokyo, London to Tokyo and New York to London. Similarly, bivariate volatility spillover between New York and Tokyo has been documented by Bae and Karolyi (1994). Shiller, Konya and Tsutsui (1991) found that Tokyo participants are in general influenced

by what happens in New York but not vice-versa. In similar fashion, Hilliard (1979) studied the contemporaneous and lagged correlation in daily closing price changes across 10 major stock markets. Eun and Shim (1989) studied daily stock returns across nine national stock markets, while Barclay, Litzenberger and Warner (1990) examined daily price volatility and volume for common stocks dually listed on the New York and Tokyo stock exchange. They all report evidence of positive correlations in daily close-to-close returns across individual stock exchange.

Therefore the nature of the international transmission of stock returns and volatility has been focus of extensive research. Bennett and Kelleher (1988), Von Furstenberg and Jeon (1989), Becker, Finnerty and Tucker (1992) and David, Richardson and Craig (1993), to name of few, studied on this issue. These articles reported several empirical documents: i) the volatility of stock price is time-varying; ii) when volatility is high, the price changes in major markets tend to become highly correlated; iii) correlations in volatility and prices appear to be casual from the US to other countries, and iv) lagged spillover of price changes and price volatility is found by major markets. This study will link some of these documents on selected Asian emerging and developed countries under rigorous and newly introduced methodological concept, which also include Asian financial crisis into considerations.

Data and Methodology

Heat waves and Meteor shower hypothesis were first developed by Engle *et.al* (1990). The 'heat waves' hypothesis postulates that volatility has only location specific auto-correlation so that a volatile day in KL is likely to be followed by another volatile day in KL but not typically a volatile day in Singapore. Alternatively the 'meteor shower' hypothesis postulates that intraday volatility spills over from one trading center to another so that a volatile day in KL is likely to be followed by a volatile day in Singapore. In this case, first we test the hypothesis on the Asian market in which trading time is approximately similar. For example, the time difference between Malaysia, Singapore, Thailand, Philippine and Indonesia is approximately 30 minutes to 40 minutes. Whereas the time difference between Hong-Kong, Japan, Korea with the above five countries is approximately 1 to 2 hours. It is assumed that this time differences do not affect the analysis on the daily basis and furthermore it is subject to the intraday analysis.

These two hypotheses are tested separately in this paper. First, among the selected Asian emerging markets and second, among the selected Asian emerging and Asian developed markets. Several testing procedures were used for analysis.

Use of GARCH model for the emerging market might not be appropriate as it is more appropriate for the thickly traded or high frequency markets, whereas most emerging markets have thin trading bias. Therefore, this study uses the SURE model and the GMM procedure based on VAR methodology to test the presence of the heat waves and meteor shower hypothesis in the selected markets.

VAR Procedure

Assuming equal information lag in all markets and recongnising the differences in real time, the following VAR system can be obtained:

$$KL_t = a^{kl} + \sum_{i=1}^{n} b_i^{kl} KL_{t-i} + \sum_{i=1}^{n-1} c_i^{sg} SG_{t-i} + \sum_{i=1}^{n-1} d_i^{jp} JP_{t-i} + ... + \sum_{i=1}^{n-1} h_i^{ko} KO_{t-i} + \varepsilon_t^{kl} ,$$

$$SG_t = a^{sg} + \sum_{i=1}^{n-1} b_i^{kl} KL_{t-i} + \sum_{i=1}^{n} c_i^{sg} SG_{t-i} + \sum_{i=1}^{n-1} d_i^{jp} JP_{t-i} + ... + \sum_{i=1}^{n-1} h_i^{ko} KO_{t-i} + \varepsilon_t^{sg} ,$$

$$JP_t = a^{jp} + \sum_{i=1}^{n-1} b_i^{kl} KL_{t-i} + \sum_{i=1}^{n-1} c_i^{sg} SG_{t-i} + \sum_{i=1}^{n} d_i^{jp} JP_{t-i} + ... + \sum_{i=1}^{n-1} h_i^{ko} KO_{t-i} + \varepsilon_t^{jp} ,$$

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$$KO_t = a^{ko} + \sum_{i=1}^{n-1} b_i^{kl} KL_{t-i} + \sum_{i=1}^{n-1} c_i^{sg} SG_{t-i} + \sum_{i=1}^{n-1} d_i^{jp} JP_{t-i} + ... + \sum_{i=1}^{n} h_i^{ko} KO_{t-i} + \varepsilon_t^{ko} ,$$

where KL_t, SG_t, JP_t ….Ko_t represent the return volatility of the respective countries. *KL*, *TH*, *KO*, *Indo*, *Phil*, *SG*, *HK*, *Aus* and *JP* represent Malaysia, Thailand, Korea, Indonesia, Philippine, Singapore, Hong-Kong, Australia and Japan respectively. Here we are choosing eight countries. Three of them are considered as a developed market and other five are considered as an emerging market. The *t* subscripts denote calendar dates. In this context, the heat waves and meteor shower hypothesis are mutually exclusive. The heat waves hypothesis holds for the *KL* if b_i^{kl} is significant but c_i^{sg}, d_i^{jp} .... h_i^{ko} are zero. Similarly, the heat wave hypothesis is supported for the Singapore if b_i^{sg} is significant but all others are not.

Test of heat waves and meteor shower under VAR

Two text procedures can be used for testing heat waves and meteor shower hypothesis: i) SURE model, and ii) GMM procedure.

i) SURE (Seemingly Unrelated Regression):

A system of M equation can be written as

$Y = Z\delta + \varepsilon$; $y = y_1, y_2 \ldots. Y_M$,

$\delta = \delta_1, \delta_2 \ldots. \delta_M$.

All variables (considered as exogenous) are in matrix form X. in the case of SUR model Z= X

The variance and co-variance matrix of disturbance term

$$E(\varepsilon\varepsilon') = \begin{bmatrix} \delta_{11}I & \delta_{12}I & \delta_{1M}I \\ \delta_{21}I & \delta_{22}I & \delta_{2M}I \\ \delta_{M1}I & \delta_{M2}I & \delta_{1MM}I \end{bmatrix} = \sum \otimes I_N$$

First δij is to be estimated from OLS residual

$$\hat{\delta}_{ij} = \frac{1}{\tau}(y_1 Z_i \hat{\delta}_{OLSi})^{/}(y_j - Z_j \hat{\delta}_{OLSj}),$$

where, $\hat{\delta}_{OLSi} = (Z_i^{/} Z_i)^{-1} Z_i^{/} y_i$ and $\tau = N$.

Now, $\sum^{n}$ is consist with individual elements $\hat{\delta}_{ij}$, the SUR estimator is

$$\hat{\delta}_{SUR} = \left[Z^{/}(\sum^{n} {}^{-} \otimes I_N \right]^{-1} Z^{-1}(\sum^{n} {}^{-} \otimes I_N) y$$

The co-variance matrix

$$\left[Z^{/}(\hat{\sum}^{-} \otimes I_N) Z \right]^{-1}$$

Now *q* number of restriction is given. Then $R\delta = r$, where *R* and *r* are (q * p) and (q * 1) matrix respectively.

ii) GMM (Generalized Method of Moment)[1]:

Following Newey and West (1983, 1993) GMM methods, which is, incorporated heteroscedasticity and autocorrelation of the disturbance term. This heteroscedasticity and autocorrelation-consistent covariance matrix of the (3*n*+1) coefficient vector θ^j for market *j* (such as $\theta^{JP} = a^{JP}, b_1^{JP}, \ldots\ldots c_1^{JP}, \ldots\ldots)$ is

$$\hat{\Omega}^j = E[(\hat{\theta} - \theta^j)(\hat{\theta}^j - \theta^j)^{/}]$$

[1] More detail see "Time series Analysis" James D. Hamilton1994, Princeton University Press, Princeton, New-Jersy.

$$= T\left[\sum_{t=1}^{T} x_t^j (x_t^j)'\right]^{-1} \hat{s}^j \left[\sum_{t=1}^{T} x_t^j (x_t^j)'\right]^{-1},$$

where x_t^j is the $(3n + 1)$ vector of independent variables for market j and

$$\hat{s}^j = \hat{\Gamma}^j(0) + \sum_{i=1}^{m} \omega_i \{\hat{\Gamma}^j(i) + \hat{\Gamma}^j(i)'\},$$

$$\omega_i = 1 - i/(m+1), m = 4(T/100)^{2/9},$$

$$\hat{\Gamma}^j = 1/T \sum_{t=i+1}^{T} \hat{e}_t^j \hat{e}_{t-i}^j x_t^j (x_{t-i}^j)'.$$

Then the Wald test statistic will be used (restriction on coefficient) to test heat wave and meteor shower hypothesis.

Another important issue is the measurement of price volatility. The price volatility is measured following Schwert (1990) and Jones *et al*. (1994) procedure. In this approach, first regress daily returns on five or more of its own lags.

$$R_{it} = \alpha_0 + \sum \alpha_1 D_{it} + \sum_{k=1}^{n} b_j R_{i,t-j} + \varepsilon_{it}, \quad (2)$$

where R_{it} is the return of asset i on day t. Fung, Patterson (1999) used day-of-the-week as a dummy variable, where dummy variable coefficient α_{it} measures the first day of the week and the intercept measures the other different days of a week. The short run movement is estimated using conditional expected returns by incorporating 5 and 15 lagged returns as regressors. The absolute values of the regression residuals were used as a proxy for the price volatility. That is, we estimate a measure of daily volatilities $|\varepsilon_{it}|$, that corresponds to the close-to-close returns used in the regressions analysis above.

Result and Discussions

Descriptive statistics

Mean yearly returns of the selected Asian countries are shown in Table 1. It shows that during the crisis returns of all countries are negative except for Australia and the negative returns are highest among the Asian emerging countries. It shows a low correlation of return between Australian market and selected Asian markets.

Table 1

Mean yearly return across the selected Asian countries

Yearly Return	HK Return	Thai Return	SG Return	Manila Return	Korea Return	Indo Return	JP Return	KL Return	Aus Return
1991	0.083	-0.059	0.004	0.085	-0.038	-0.209	-0.062	-0.031	0.078
1992	0.105	0.099	0.012	0.043	0.058	0.042	-0.100	0.059	-0.022
1993	0.305	0.251	0.203	0.366	0.100	0.296	0.019	0.267	0.132
1994	-0.126	-0.069	-0.039	-0.043	0.071	-0.086	0.054	-0.091	-0.045
1995	0.087	-0.016	0.017	-0.020	-0.052	0.041	0.013	0.016	0.056
1996	0.116	-0.156	0.018	0.085	-0.109	0.087	-0.005	0.087	0.039
1997	-0.057	-0.282	-0.096	-0.186	-0.180	-0.157	-0.077	-0.254	0.029
1998	0.012	0.023	0.001	0.051	0.204	0.042	-0.024	0.064	0.022
1999	0.214	0.139	0.232	0.042	0.261	0.227	0.128	0.139	0.058
2000	-0.026	-0.207	-0.085	-0.126	-0.235	-0.176	-0.112	-0.060	0.009

Notes: HK indicates Hong-Kong, Thai – Thailand, SG – Singapore, Manila – Philippine, Indo – Indonesia, JP – Japan, KL – Malaysia and Aus – Australia.

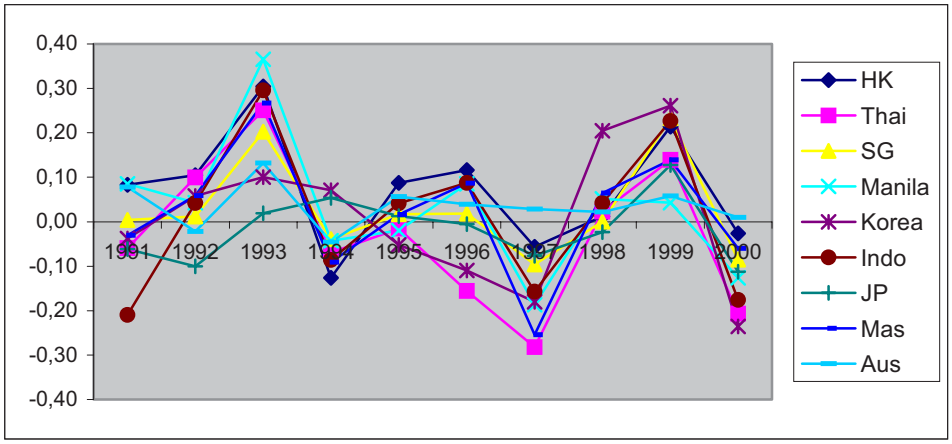

Fig. 1. Mean Yearly return across the selected Asian stock markets

Similarly during the recovery (end of 1998 and 1999) period, all the countries except for Japan showed positive returns. Again during year 2000, all the countries show the negative returns except for Australia. Table (2) also shows the similar trend in terms of total risk, measured by standard deviation of returns. It implies a low correlation of risk between Australian market and selected Asian markets whereas other markets show high correlation among themselves. This study therefore investigates whether the co-movement or correlation of markets caused by the informational spillover from one market to another market.

Table 2

Yearly Standard Deviation across the Selected Asian countries

Yearly STDV	HK Return	Thai Return	SG Return	Manila Return	Korea Return	Indo Return	JP Return	KL Return	Aus Return
1991	1.145	1.555	0.980	1.561	1.400	1.027	1.210	1.095	0.972
1992	1.373	1.583	0.858	1.378	1.896	0.727	1.811	0.744	0.703
1993	1.401	1.260	0.778	1.228	1.169	0.717	1.256	0.990	0.722
1994	1.832	1.592	1.155	1.427	1.043	0.905	1.097	1.684	0.862
1995	1.246	1.217	0.909	1.247	1.111	0.881	1.399	1.172	0.651
1996	1.037	1.329	0.832	1.305	1.166	0.973	0.959	0.803	0.732
1997	2.465	2.233	1.448	1.785	2.445	1.999	1.704	2.317	0.978
1998	2.734	2.867	2.517	2.527	3.192	3.035	1.667	3.780	0.968
1999	1.642	2.163	1.502	1.413	2.450	2.166	1.254	1.697	0.783
2000	1.917	1.843	1.523	1.626	2.756	1.468	1.391	1.333	0.871

Notes: HK indicates Hong-Kong, Thai – Thailand, SG – Singapore, Manila – Philippine, Indo – Indonesia, JP – Japan, KL – Malaysia and Aus – Australia.

It is well known that the links between stock markets vary over time and this study provides further supporting evidence. King and Wadhwani (1990) showed that the correlation between markets rises following an increase in volatility. Therefore, as volatility declines, market links become weaker and price changes are less closely tied together, in support of the contagion theory. The essence of the contagion model is that the trading of stocks in one market per se affects share price in other market, that is, share prices respond both to public information about economic fundamentals and to share price changes elsewhere. Engle, Ito and Lin (1990) divided the contagion model and proposed two hypotheses. The heat wave hypothesis postulates that volatility has only public information about economic fundamental of own country and the meteor

shower hypothesis postulates that share price changes are due to volatility spillover in the other countries. The essence of these two hypotheses is to specify the cause of the daily or intraday volatility of the asset prices.

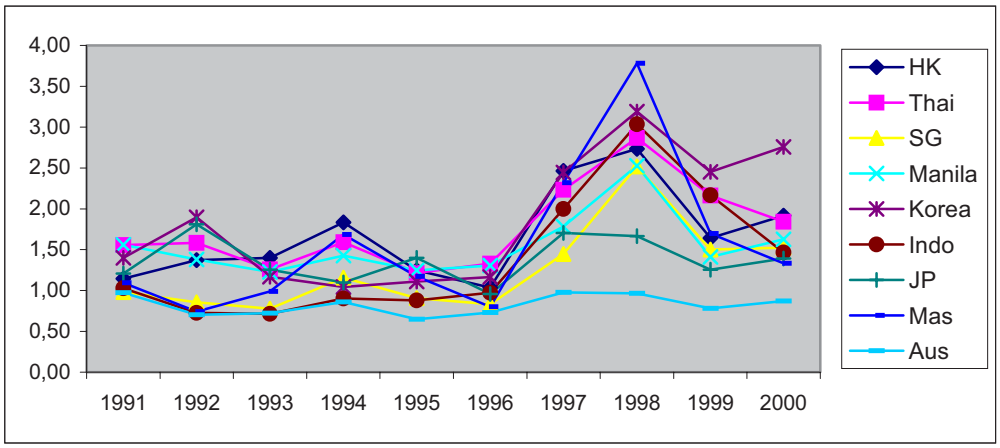

Fig. 2. Yearly standard deviation across the selected Asian stock markets

To date, study of daily or intraday volatility spillover across trading centers has focused on the foreign exchange and stock markets of developed economies, which trades around the clock. There is little research on this issue in the Asian emerging countries. Over the years the volume of trade and capital flows have increased among the Asian countries (especially after the financial crisis in 1997) and this trend will be further enhanced through the implementation of AFTA (ASEAN free Trade Agreement). Therefore this is a good rationale to test daily volatility spillover among Asian emerging and developed countries with similar time zone.

Table 3 shows the results of the period of 1990-1993. Almost all cases F-value (Sure and GMM method) are not statistically significant, which represents the combined effect of volatility on host country. Only country specific coefficients are statistically significant (t-value). Market in Indonesia showed significant volatility spillover from other ASEAN countries in support of the meteor shower hypothesis. Overall, for other country, the findings reject the meteor shower hypothesis in favor of the heat waves hypothesis.

Table 3

Spillover Effect Among the Selected Emerging Asian stock Markets for the period of 1991-1993

	Constant	KL(-1)	TH(-1)	KO(-1)	INDO(-1)	PHIL(-1)	R^2	Dur-Wat	F-Value (SURE)	F-Value (GMM)
KL	.481 (9.37)	.254 (6.93)	-.007 (-.279)	-.008 (-.321)	.063 (1.60)	-.017 (-.650)	.066	2.03	**.387** **(.534)**	**.297** **(.586)**
TH	.692 (8.69)	.166 (2.04)	.234 (6.43)	-.017 (-.501)	.037 (.616)	-.022 (-.561)	.072	2.12	**2.08** **(.117)**	**1.62** **(.203)**
KO	.877 (10.30)	-.004 (-.078)	.031 (.801)	.184 (5.06)	-.018 (-.283)	.034 (-.788)	.036	2.05	**.075** **(.784)**	**.091** **(.762)**
INDO	.310 (6.58)	.086 (2.46)	.005 (.233)	-.024 (-1.20)	.199 (5.51)	.063 (2.65)	.067	2.11	**4.99*** **(.047)**	**4.02*** **(.045)**
PHIL	.836 (11.25)	.055 (1.04)	.003 (.089)	-.017 (-.559)	.134 (1.95)	.043 (2.14)	.012	2.01	**2.47** **(.129)**	**3.57**** **(.067)**

Notes: HK indicates Hong-Kong, Thai – Thailand, SG – Singapore, Manila – Philippine, Indo – Indonesia, JP – Japan, KL – Malaysia and Aus – Australia.

The results for 1994-1996 period are shown in Table 4. It reveals that volatility of host country is influenced by its own previous day volatility as well as volatility from other regional countries. Findings show that there is only a mild spillover effect in Malaysia, Thailand, and Indonesia, as the F-statistic is weakly significant which represents the effect of volatility on host country from other regional countries. Unlike Korea, findings for Philippines, show strong support for meteor shower hypothesis. The results for this period show the information spillover effect among south East countries is much stronger compared to the last period (1991-1993).

Table 4

Spillover Effect Among the Selected Emerging Asian stock Markets for the period of 1994-1996

	Constant	KL(-1)	TH(-1)	KO(-1)	INDO(-1)	PHIL(-1)	R^2	Dur-Wat	F-Value (SURE)	F-Value (GMM)
KL	.426 (6.38)	.221 (5.85)	.048 (1.32)	.065 (1.47)	.088 (1.72)	.079 (2.33)	.093	2.11	**3.89** (.041)**	**6.47* (.011)**
TH	.580 (8.32)	.183 (4.63)	.104 (2.73)	.103 (2.23)	.065 (1.21)	.012 (.338)	.073	2.02	**3.75** (.049)**	**9.67* (.002)**
KO	.756 (13.93)	-.022 (-.728)	.044 (1.49)	.042 (1.18)	-.005 (-.100)	.021 (.761)	.006	1.99	**.598 (.439)**	**.522 (.469)**
INDO	.439 (9.53)	.076 (2.92)	.089 (3.53)	-.051 (-1.69)	.149 (4.22)	-.019 (-.838)	.075	2.02	**4.76* (.029)**	**5.69* (.017)**
PHIL	.539 (7.71)	.095 (2.40)	.028 (.744)	.026 (.562)	.090 (1.68)	.206 (5.76)	.076	2.03	**9.75* (.002)**	**10.54* (.001)**

Notes: * and ** indicate the significance at 1% and 5% respectively. HK indicates Hong-Kong, Thai – Thailand, SG – Singapore, Manila – Philippine, Indo – Indonesia, JP – Japan, KL – Malaysia and Aus – Australia.

Table 5

Spillover Effect Among the Selected Emerging Asian stock Markets for the period of 1997-2000

	Constant	KL(-1)	TH(-1)	KO(-1)	INDO(-1)	PHIL(-1)	R^2	Dur-Wat	F-Value (SURE)	F-Value (GMM)
KL	.555 (4.28)	.383 (11.63)	.010 (1.32)	.038 (1.62)	.185 (3.03)	.075 (1.78)	.216	2.15	**19.23* (.000)**	**3.94** (.039)**
TH	1.11 (10.22)	.066 (2.41)	.148 (4.01)	.052 (1.67)	.041 (1.15)	.066 (1.45)	.061	2.02	**16.21* (.000)**	**11.81* (.000)**
KO	1.48 (11.85)	.048 (1.61)	-.036 (-.837)	.078 (2.17)	.103 (2.47)	.074 (1.40)	.031	2.06	**9.31* (.002)**	**6.80* (.009)**
INDO	.569 (4.21)	.068 (1.71)	.031 (.846)	.148 (4.73)	.186 (5.04)	.251 (3.45)	.160	2.07	**58.03* (.000)**	**19.09* (.000)**
PHIL	.670 (7.62)	.049 (2.22)	.087 (2.90)	.039 (1.53)	.078 (2.69)	.168 (4.52)	.102	2.04	**32.29* (.000)**	**16.56* (.000)**

Notes: HK indicates Hong-Kong, Thai – Thailand, SG – Singapore, Manila – Philippine, Indo – Indonesia, JP – Japan, KL – Malaysia and Aus – Australia.

For the period of 1997-2000, the null hypothesis of heat waves is rejected at the 1% level of significance for all selected emerging countries. The robust F-value (wald statistics) for Malaysia, Thailand, Korea, Indonesia and Philippine is 19.23, 16.21, 9.31, 58.03 and 32.29 respectively. In other words, the daily volatility of stock returns of these markets exhibits intermarket spillover in addition to the previously documented country specific autocorrelation. The results support the notion that financial crisis which started in Thailand and spilled over to other regional markets. This suggests that ASEAN countries integrated more economically than before and this integration will further strengthen after implementation of AFTA.

Table 6

Spillover Effect from Asian Developed Market to Asian Emerging Market (1991-1993)

	Cons	KL(-1)	TH(-1)	KO(-1)	Indo(-1)	Phil(-1)	SG(-1)	JP(-1)	HK(-1)	AUS(-1)	R^2	D-W	SURE	GMM
KL	.433 (9.08)	.213 (5.37)					.064 (1.20)	-.022 (-.971)	.049 (1.75)	025 (.547)	.073	2.00	**2.97**** **(.094)**	**3.47**** **(.062)**
TH	.609 (7.93)		.229 (6.33)				.082 (1.22)	.032 (.279)	.062 (1.48)	-.060 (-.466)	.072	2.12	**4.07*** **(.031)**	**3.60**** **(.056)**
KO	.792 (9.68)			.181 (4.92)			-.071 (-.989)	.050 (1.20)	.017 (.383)	.092 (1.14)	.039	2.05	**.875** **(.350)**	**1.06** **(.301)**
INDO	.420 (9.18)				.210 (5.82)		.071 (1.70)	.008 (.369)	-.019 (-.773)	-.097 (-1.98)	.056	2.09	**.503** **(.478)**	**.711** **(.399)**
PHIL	.954 (12.64)					.055 (1.49)	.049 (.795)	.009 (.266)	-.036 (-.917)	-.086 (-1.31)	.010	2.00	**.585** **(.444)**	**.479** **(.489)**

Notes: * and ** indicate the significance at 1% and 5% respectively.

Table 7

Spillover Effect from Asian Developed Market to Asian Emerging Market (1994-1996)

	Cons	KL(-1)	TH(-1)	KO(-1)	Indo(-1)	Phil(-1)	SG(-1)	JP(-1)	HK(-1)	AUS(-1)	R^2	D-W	SURE	GMM
KL	.451 (7.63)	.116 (2.76)					.084 (1.34)	.057 (1.48)	.247 (6.66)	-.103 (-1.56)	.141	2.11	**12.22*** **(.000)**	**12.26** **(.000)**
TH	.706 (10.89)		.121 (3.09)				.089 (1.64)	-.015 (-.357)	.140 (3.55)	-.069 (-.971)	.062	2.04	**4.01*** **(.036)**	**3.06** **(.081)**
KO	.804 (14.67)			.085 (1.68)			.010 (1.21)	.011 (.911)	.006 (.409)	-.054 (-.295)	.004	1.99	**1.95** **(.144)**	**1.08** **(.300)**
INDO	.445 (10.10)				.151 (4.21)		.122 (3.05)	-.053 (-1.74)	.051 (2.00)	-.017 (-.374)	.065	2.02	**4.09*** **(.031)**	**3.63**** **(.053)**
PHIL	.580 (8.79)					.208 (5.89)	.080 (1.45)	-.021 (-.384)	.114 (2.92)	-.017 (-.238)	.080	2.01	**3.98*** **(.038)**	**2.01**** **(.156)**

Notes: * and ** indicate the significance at 1% and 5% respectively. HK indicates Hong-Kong, Thai – Thailand, SG – Singapore, Manila – Philippine, Indo – Indonesia, JP – Japan, KL – Malaysia and Aus – Australia.

Table 8

Spillover Effect from Asian Developed Market to Asian Emerging Market (1997-2000)

	Cons	KL(-1)	TH(-1)	KO(-1)	Indo(-1)	Phil(-1)	SG(-1)	JP(-1)	HK(-1)	AUS(-1)	R^2	D-W	SURE	GMM
KL	.622 (5.03)	.375 (9.17)					.110 (1.73)	.117 (1.74)	.216 (1.85)	-.296 (-1.05)	.226	2.15	**1.36** **(.243)**	**.723** **(.395)**
TH	1.26 (11.45)		.170 (4.60)				.143 (2.18)	.005 (.081)	-.069 (-1.45)	.134 (1.21)	.045	2.05	**4.12*** **(.031)**	**4.37*** **(.036)**
KO	1.35 (10.62)			.069 (1.91)			.044 (.647)	.074 (1.03)	.037 (.532)	.341 (1.95)	.036	2.04	**7.00*** **(.006)**	**15.43*** **(.000)**
INDO	.789 (7.24)				.193 (5.06)		.185 (2.05)	.061 (1.05)	.073 (1.59)	.123 (1.08)	.128	2.06	**16.36*** **(.000)**	**11.76*** **(.000)**
PHIL	.820 (9.42)					.161 (4.23)	.177 (3.03)	-.005 (-.124)	.031 (.853)	.039 (.431)	.098	2.05	**7.81*** **(.005)**	**8.15*** **(.004)**

Notes: * and ** indicate the significance at 1% and 5% respectively.

In summary a potential explanation lies in the fact that the volatility spillover from one market to another market is much stronger during the 1997-2000 period compared to the earlier period, 1991-1996. This implies that during high economic growth period, most of the emerging market's volatility was country specific due to the high investment opportunity of the local firm and high level of exports (exports to developed countries) oriented industrialisation. During the economic downturn (financial crisis 1997) shortage of foreign portfolio funds and declining export to developed market caused these markets to be more closely correlated in support of the meteor shower hypothesis.

Second objective of this study is to investigate the spillover effect (meteor shower hypothesis) between Asian emerging markets and Asian developed markets. The results in Table 6 for the 1991-1993 period show that spillover from Asian developed market to Malaysia and Thailand is prevalent in a sizable way in this period while findings for Korea, Indonesia and the Philippines clearly reject the meteor shower hypothesis in favor of heat wave hypothesis. It can be argued that economic dependency of Malaysia and Thailand with Asian developed economies (i.e. Japan, Singapore, Hong Kong) is much stronger than that of Indonesia, Philippine and Korea. However, the findings for the period of 1994-1996 in Table 7 show the increasing economic interdependence between Asia's emerging and Asian developed markets. In this period, Malaysia, Thailand, Indonesia and the Philippines showed strong support for meteor shower hypothesis.

Except for Malaysia, all Asian emerging markets (Table 8) show strong meteor shower effect with Asian developed market during 1997-2000 period. In contrast, the stock market volatility in Malaysia is consistent with the heat wave hypothesis, meaning that the Malaysian volatility appears to be country specific. Malaysian government imposed very strict economic policy to minimise the economic disaster compared to the other regional countries that might explain the minimal information flow from other markets during the 1997-2000 period.

In summary, finding shows significant spillover effect from Asian developed market to Asian emerging market after 1997. This is consistent with Kortain and Regan's (1996) findings of strong spillover effect (cross country correlation) in bear market rather than in bull market. The finding also showed that the magnitude of contagion (spillover effect) is not constant but varies over time with spillover becoming most pronounced during episodes of severe financial market turbulence.

Conclusion

This paper investigates the impact of stock price volatility of news revealed in one stock market on the volatility of other stock market (meteor shower) and within each market (heat waves). The analysis was carried out for the period of January 1991 to December 2000 using daily data for the Asian selected emerging countries and selected Asian developed countries stock exchange price index.

Southeast Asian economic boom (Super growth) and sharp decline (during 1997's financial crisis) generated a large number of reports and commentaries on the causes of crisis and largely ignored the question of why markets around the Southeast Asia fell simultaneously. Therefore this study investigates the informational linkage between Asian emerging countries on daily basis during, before and after the financial crisis.

The results provide evidence of strong and significant heat wave effect among the emerging countries as well within Asian developed economies during the high growth period (1991-1996). While during crisis and after the crisis, the results suggest the meteor shower effects among emerging stock market. It implies that from 1997 onwards, linkage between the Asian emerging stock market has became stronger and it is also expected that implementation of AFTA would further strengthen this linkage.

Strong informational linkage also increases the systematic risk of individual market. For example, a world in which investors infer information from price changes in other countries is also one in which a mistake in one market can be transmitted to other market and increase the unnecessary market risk in the host country. Therefore, it can be argued that an increase in market volatility leads to an increase in the size of the contagion effects in future. On the other hand, strong integration (strong correlation) would further restrict the movement of portfolio capital among Asian

emerging countries, as the advantage international diversification will be restricted. But nevertheless short-run (daily basis or intraday basis) interdependence will make the individual market more informationally efficient through adjustment of foreign information.

The findings also imply that there would be even greater competition between the Asian emerging and developed markets to attract international portfolio capital on their national market, as foreign fund managers will consider these markets as one larger market for purpose of diversification.

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