Financial Crisis and Volatility Behaviour of Stock Markets of Asia

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Abstract

The study examines the impact of Global Financial Crisis of 2007 onwards on volatility behavior of Asian stock markets using GARCH and TARCH models. The study uses daily closing price data of stock markets of India, China, Hong Kong, Malaysia, Japan, Indonesia and Korea. The results reveal that the Asian stock markets exhibit the persistence of volatility, mean reverting behavior and volatility clustering. The results of GARCH(1,1) and TARCH with dummy variable in variance equation suggest that the recent financial crisis has increased volatility and leverage effect in the Asian stock markets except Korea which seems to be insulated from the crisis.

JEL Classification: G14, C32

Key Words : Volatility clustering, GARCH, TARCH

I. INTRODUCTION

The global financial crisis began in 2007 when subprime mortgage crisis originated in US and spreaded rapidly to most financial markets across the globe. As the crisis deepened, the world stock markets witnessed fall in their asset price and exhibited volatility. Major banks and financial institutions faced acute liquidity problem and government around the world tuned up efforts to offer financial succor.

A considerable amount of research has been devoted to the investigation of stock market volatility ever since the crash of stock market in October 1992 and the Asian Crisis in July 1997. The financial crisis is not a new phenomenon (Allen and Gale, 2007). The crisis of 2007 represents a new challenge for the researcher. The current financial crisis differs from previous crisis in that it is both severe and global (Bartram and Bodnar, 2009). Despite it is regarded as banking crisis, it has become a global financial market crisis. In the era of globalization of investment, the crisis has challenged the investors' perception about equity investment. The crisis has driven down equity levels across the globe and in nearly each country, sector and industry.

Chiang and Doong(2001) examined the time series behavior of seven emerging stock markets namely Hong Kong, Korea, Malaysia, Phillippines, Singapore, Taiwan and Thailand using TAR-GARCH(1,1)-in-mean model. The study found that the GARCH parameter was highly significant in daily data than weekly data. The evidence suggested that the GARCH effect was very little in monthly data. They found that the evolution of volatility was persistent in all the stock markets.

Santis and Imrohoroglu(1997) studied the expected return and volatility in emerging stock markets of Greece, Turkey, India, Korea, Malaysia, Phillippines, Taiwan, Thailand, Argentina, Brazil, Chile, Colombia, Mexico and Venezuela during December 1988 to second week of May 1996. The study also analyzed the volatility of developed stock markets of Germany, Japan, UK and United States. The results revealed that the level of volatility in emerging stock markets was higher than the developed stock markets.

Schewert(1989) analyzed the relationship of stock market volatility with real and macroeconomic volatility, economic activity, financial leverage and stock trading activity using monthly data from 1857 to 1987. It was found that many economic series were more volatile in the Great Depression during 1929-1939.

Dooley and Hutchison(2009) studied transmission of U.S. subprime crisis to emerging markets from February 2007 to February 2009. The study found that the emerging stock markets of Argentina, Brazil, Chile, Columbia and Mexico responded very strongly to the deteriorating situation in US financial system and real economy.

The current Global Crisis is touching everyone including the developing countries (Stigliz, 2009). Volatility in equity market has become a matter of mutual concern in recent years for investors, regulators and brokers. Stock return volatility hinders economic performance through consumer spending[1]. Stock Return Volatility may also affect business investment spending[2]. Further the extreme volatility could disrupt the smooth functioning of the financial system and lead to structural or regulatory changes.

Volatility of stock returns in the developed countries has been studied extensively. After the seminal work of Engle(1982) on Autoregressive Conditional Heteroscedasticity (ARCH) model on UK inflation data and its Generalized form GARCH(Generalized ARCH) by Bollerslev (1986), much of the empirical work used these models and their extensions (See French, Schwert and Stambaugh 1987, Akgiray 1989, Schwert, 1990, Chorhay and Tourani,1994, Andersen and Bollerslev, 1998) to model characteristics of financial time series.

[1] Garner A.C., 1988, Has Stock Market Crash Reduced Customer Spending? Economic Review, Federal Reserve Bank of Kansas City, April, 3-16.

[2] Gertler, M. and Hubbard, R.G.,1989, Factors in Business Fluctuations, Financial Market Volatility, Federal Reserve Bank of Kansas City, 33-72.

The study examining the impact of the recent Global Financial Crisis on stock market volatility of Asia is rarely found. Present study tries to analyze the impact of the global financial crisis on the volatility of stock markets of India, China, Hong Kong, Malaysia, Japan, Indonesia and Korea of Asia using GARCH and Threshold GARCH (TARCH) model. The paper is organized as follows. Section II discusses the research design used in the study. Empirical results are discussed in Section III. Section IV summarizes.

II. RESEARCH DESIGN

Period of study

We collected data on daily closing price of stock price indices of India, China, Hong Kong, Malaysia, Japan, Indonesia and Korea represented by Bombay Stock Exchange(BSE), Shanghai Composite(SSE), Hang Seng(HSI), Kuala Lumpur Stock Exchange(KLSE), Nikkei 225(N225), Jakarta Composite(JKSE) and Seoul Composite(KOSPI) respectively. Global Finance database is used for analyzing volatility behaviour. The data period is from January 1, 2001 to February 3, 2010. The period is most recent one. The crash of American financial markets triggered by subprime crisis has influenced not only USA but also the stock markets across the globe. These changes might have influenced the behavior and the pattern of volatility and therefore it will be instructive to study volatility in this period. We follow Taylor and Williams (2009) in the choice of August 9, 2007 as a starting point of the financial crisis. January 1, 2001 to August 8, 2007 is considered as a period before crisis while August 9, 2007 to February 3, 2010 is treated as the period during crisis.

Methodology

Daily returns are identified as the difference in the natural logarithm of the closing index value for the two consecutive trading days.

Volatility is defined as;

$$\sigma = \sqrt{1/n - 1\sum_{t=1}^{n}(R_t - \bar{R})^2} \qquad \text{Equation 1}$$

where $\bar{R}$ = Average return(logarithmic difference) in the sample.

In comparing the performance of linear model with its nonlinear counterparts, we first used ARIMA[3] models. Nelson (1990b) explains that the specification of mean equation bears a little impact on ARCH models when estimated in continuous time. Several studies recommend that the results can be extended to discrete time. We follow a classical approach of assuming the first order autoregressive structure for conditional mean as follows:

$$R_t = a_0 + a_1 R_{t-1} + \varepsilon_t \qquad \text{Equation 2}$$

where R_t is a stock return, $a_0 + a_1 R_{t-1}$ is a conditional mean and ε_t is the error term in period t. The error term is further defined as:

$$\varepsilon_t = \upsilon_t \sigma_t \qquad \text{Equation 3}$$

where υ_t is white noise process that is independent of past realizations of ε_{t-i}. It has zero mean and standard deviation of one. In the context of Box and Jenkins (1976), the series should be stationary before ARIMA models are used. Therefore, Augmented Dickey Fuller test (ADF) is used to test for stationarity of

[3] A process that combines Autoregressive process (AR) and Moving Average terms (MA) terms. AR process where the present observations depend on the previous observations and MA is a weighted average of the present and the recent past observations of a process.

the return series. It is a test for detecting the presence of stationarity in the series. The early and pioneering work on testing for a unit root in time series was done by Dickey and Fuller (1979 and 1981). If the variables in the regression model are not stationary, then it can be shown that the standard assumptions for asymptotic analysis will not be valid. ADF tests for a unit root in the univariate representation of time series. For a return series Rt, the ADF test consists of a regression of the first difference of the series against the series lagged k times as follows:

$$\Delta r_t = \alpha + \delta r_{t-1} + \sum_{i=1}^{p} \beta_i \Delta r_{t-i} + \varepsilon_t \qquad \text{Equation 4}$$

$$\Delta r_t = r_t - r_{t-1}; r_t = \ln(R_t)$$

The null hypothesis is $H_0: \delta = 0$ and $H_1: \delta < 1$. The acceptance of null hypothesis implies nonstationarity. We can transform the nonstationary time series to stationary time series either by differencing or by detrending. The transformation depends upon whether the series is difference stationary or trend stationary.

One needs to specify the form of the second moment, variance, σ_t^2 for estimation. ARCH and GARCH models assume conditional heteroscedasticity with homoscedastic unconditional error variance. That is, the changes in variance are a function of the realizations of preceding errors and these changes represent temporary and random departure from a constant unconditional variance. The advantage of GARCH model is that it captures the tendency in financial data for volatility clustering. It, therefore, enables us to make the connection between information and volatility explicit since any change in the rate of information arrival to the market will change the volatility in the market.

In empirical applications, it is often difficult to estimate models with large number of parameters, say ARCH (q). To circumvent this problem, Bollerslev (1986) proposed GARCH (p, q) models. The conditional variance of the GARCH (p,q) process is specified as

$$h_t = \alpha_0 + \sum_{j=1}^{q} \alpha_j \varepsilon_{t-j}^2 + \sum_{i=1}^{p} \beta_i h_{t-i} \qquad \text{Equation 5}$$

with $\alpha 0>0$, $\alpha 1$, $\alpha 2$,............ $\alpha q \geq 0$ and $\beta 1$, $\beta 2$, $\beta 3$,........, $\beta p \geq 0$ to ensure that conditional variance is positive. In GARCH process, unexpected returns of the same magnitude (irrespective of their sign) produce same amount of volatility. The large GARCH lag coefficients βi indicate that shocks to conditional variance takes a long time to die out, so volatility is 'persistent.' Large GARCH error coefficient αj means that volatility reacts quite intensely to market movements and so if αj is relatively high and βi is relatively low, then volatilities tend to be 'spiky'. If $(\alpha + \beta)$ is close to unity, then a shock at time t will persist for many future periods. A high value of it implies a 'long memory.' We introduce dummy variable in a variance equation 5. It is specified as follows:

$$h_t = \alpha_0 + \sum_{j=1}^{q} \alpha_j \varepsilon_{t-j}^2 + \sum_{i=1}^{p} \beta_i h_{t-i} + \delta_k D \qquad \text{Equation 6}$$

The dummy variable (D) takes on value zero before August 9, 2007 and values one afterwards. If a coefficient of the dummy variable turns out to be statistically significant and positive, we can say that the financial crisis has increased the volatility. The model is then tested for ARCH effect using ARCH-LM test to judge model adequacy. If ARCH-LM test results are statistically insignificant, the model will be adequate.

TARCH Model

In GARCH models both positive and negative shocks of same magnitude will have exactly same effect in the volatility of the series. TARCH model helps in overcoming this restriction. TARCH or Threshold GARCH model was introduced independently by Zakoian (1994) and Glosten, Jaganathan and Runkle (1993). The generalized specification for the conditional variance is given by:

$$\sigma_t^2 = \alpha + \sum_{j=1}^{q} \beta_j \sigma_{t-j}^2 + \sum_{i=1}^{p} \alpha_i \varepsilon_{t-i}^2 + \sum_{h=1}^{r} \gamma_h \varepsilon_{t-h}^2 d_{t-h} \quad \text{Equation 7}$$

where $d_t = 1$ if $\varepsilon_t < 0$ and zero otherwise.

In this model, $\varepsilon_{t-i} > 0$, good news, and bad news, $\varepsilon_{t-i} < 0$, have differential effect on the conditional variance; good news has an impact of α_i, while bad news has an impact of $\alpha_i + \gamma_i$. If $\gamma_i > 0$, bad news increases volatility, and we say that there is a leverage effect for the i-th order. If $\gamma_i \neq 0$, the news impact is asymmetric. The main target of this model is to capture asymmetries in terms of positive and negative shocks. We have used dummy variable in equation 7 to capture the impact of financial crisis on volatility asymmetries. The equation is given below:

$$\sigma_t^2 = \alpha + \sum_{j=1}^{q} \beta_j \sigma_{t-j}^2 + \sum_{i=1}^{p} \alpha_i \varepsilon_{t-i}^2 + \sum_{h=1}^{r} \gamma_h \varepsilon_{t-h}^2 d_{t-h} + \delta_k Du \quad \text{Equation 8}$$

Here, Du is a dummy variable which is assigned value '0' before August 9, 2007 and value '1' thereafter. The statistically significant and positive coefficient of it, indicates increase in magnitude of asymmetric effect.

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$\lambda^2(k)$

III. EMPIRICALANALYSIS

We present descriptive statistics of the returns of stock markets of India, China, Hong Kong, Malaysia, Japan, Indonesia, and Korea before and during financial crisis. The descriptive statistics for the return series include mean, standard deviation, kurtosis, skewness, Jarque-Bera and ARCH-LM statistics which are exhibited in the Table 1 and Table 2.

Table 1: Descriptive Statistics before Crisis Period- January 1, 2001 to August 8, 2007

Country	Obs. No.	Mean	Standard Deviation	Kurtosis	Skewness	Jarque Bera*	ARCH-LM(5)*
India	1655	0.00081	0.014	8.513	-0.716	2235.740	369.300
China	1593	0.00052	0.015	8.043	0.033	1688.560	55.810
Hong Kong	1640	0.00020	0.012	6.564	-0.337	898.900	74.250
Malaysia	1632	0.00040	0.008	10.380	-0.749	3854.370	222.810
Japan	1626	0.00013	0.014	4.640	-0.098	185.320	119.760
Indonesia	1624	0.00103	0.013	8.090	-0.727	1897.090	75.870
Korea	1635	0.00081	0.016	7.040	-0.500	1180.110	49.320

* The values reported are statistically significant at 1% level.

Note:ARCH LM statistic is the Lagrange multiplier test statistic for the presence of ARCH effect. Under null hypothesis of no heteroscedasticity, it is distributed as $\lambda^2(k)$. Q^2(K) is the Ljung Box statistic identifying the presence of autocorrelation in the squared returns. Under the null hypothesis of no autocorrelation, it is distributed as $\lambda^2(k)$.

Table 2: Descriptive Statistics during Crisis Period- August 9, 2007 to February 3, 2010

Country	Obs. No.	Mean	Standard Deviation	Kurtosis	Skewness	Jarque Bera*	ARCH - LM(5)*
India	605	0.00012	0.024	7.150	0.247	440.400	31.120
China	607	-0.00080	0.024	4.310	-0.100	44.094	14.820
Hong Kong	627	-0.00010	0.026	6.890	0.148	396.760	130.250
Malaysia	604	0.00000	0.017	64.780	-0.110	96054.970	126.340
Japan	604	-0.00080	0.023	8.320	-0.310	722.830	207.320
Indonesia	603	0.00020	0.020	7.440	-0.520	522.580	77.510
Korea	615	-0.00020	0.020	8.040	-0.460	672.550	146.760

* The values reported are statistically significant at 1% level.

The volatility presented by standard deviation is higher for all the markets during the period of crisis than before crisis period. The results suggest that all stock markets become more volatile during crisis period.

Under the assumption of normality, skewness and kurtosis have asymptotic distributions N (0, 6/T) and N (3, 24/T), respectively, where T is number of observations. The mean returns for all the stock markets are very close to zero indicating that the series are mean reverting. The mean returns of all stock markets decline during crisis period as can be seen from the results reported in Table 2. The return distribution is skewed, indicating that the distribution is non-symmetric. Large value of Kurtosis suggests that the underlying data are leptokurtic or thick tailed and sharply peaked about the mean when compared with the normal distribution. ARCH-LM tests result indicate that there is a presence of ARCH effect in all the stock markets. Since GARCH model can feature this property of leptokurtosis, it would be expected that the GARCH model would partially describe the leptokurtosis evidence in the data.

The Jarque-Bera[4] statistics reported in the Table 1 and Table 2 test the assumption of normality and it is an asymptotic, or large sample test. The reported probability is the probability that a Jarque-Bera statistic exceeds (in absolute value) the observed value under the null hypothesis a small probability value leads to rejection of the null hypothesis of normal distribution. For the stock markets, we reject the hypothesis of normal distribution at the 1% significance level.

Stationarity condition of the daily return series of the stock markets are tested by Augmented Dickey-Fuller Test (ADF). The results of this test are reported in the Table 3.

Table 3: Unit Root Testing of Daily Returns of Stock markets

	Before Crisis		During Crisis	
	Level	First Difference	Level	First Difference
India	-1.17(0.69)*	-22.62(0.00)	-0.85(0.99)	-30.16(0.00)
China	-1.35(0.61)	-24.67(0.00)	-2.03(0.99)	-39.44(0.00)
Hong Kong	-1.37(0.60)	-26.35(0.00)	-0.19(0.97)	-40.1(0.00)
Malaysia	-1.07(0.73)	-32.26(0.00)	-0.12(0.95)	-32.86(0.00)
Japan	-1.74(0.41)	-25.96(0.00)	-0.79(0.82)	-41.20(0.00)
Indonesia	-0.98(0.76)	-20.85(0.00)	-0.59(0.99)	-35.64(0.00)
Korea	-1.52(0.00)	-24.56(0.00)	-0.27(0.93)	-39.42(0.00)

*Figures in the parenthesis represent probability values.
Mackinnon asymptotic critical value at 1% level is -3.44.

[4]The B-J teat statistic is T[skewness2/6+(kurtosis-3)2/24]

ADF statistics in level (logarithmic) series shows presence of unit root in the stock markets as their Mackinnon's value do not exceed the critical value at 1% level. It suggests that the price series are nonstationary. It is, therefore, necessary to transform the series to make it stationary by taking its first difference. ADF statistics reported in the Table 3 show that the null hypothesis of a unit root is rejected. The absolute computed values for the indices are higher than the MacKinnon critical value at 1% level. Thus, the results of indices show that the first difference series are stationary.

The significant value of ARCH test at lag length five reported in Table 1 and Table 2 imply clustering of volatility where large changes tend to be followed by large changes and small changes tend to be followed by small changes (Engle, 1982 and Bollerslev, 1986). To explore the nature of volatility, GARCH (1,1) model with dummy variable (equation 6) is applied in the stock markets. The results of the estimated model are reported in Table 4. The GARCH model is tested for their fitness and adequacy using ARCH-LM test. The results are presented in the Table 4. The findings indicate that there is no ARCH effect left after estimating the models because the results of ARCH-LM test statistics at longer length of 15 reported in the Table 4 are statistically insignificant as its probability value is higher than 0.05. It, therefore, suggests that the estimated model is better fit and successfully account for time varying volatility.

Table 4 : Coefficients of GARCH models -January 1, 2001 to February 3, 2010

Coeffcients	India	China	Hong kong	Malaysia	Japan	Indonesia	Korea
α_0	0.000 (0.000)*	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)
α_1	0.158 (0.000)	0.104 (0.000)	0.070 (0.000)	0.225 (0.000)	0.096 (0.000)	0.140 (0.000)	0.082 (0.000)
β_1	0.794 (0.000)	0.876 (0.000)	0.916 (0.000)	0.581 (0.000)	0.891 (0.000)	0.785 (0.000)	0.907 (0.000)
$\alpha_1+\beta_1$	0.952	0.98	0.986	0.806	0.987	0.925	0.989
GARCH Dummy	0.000018 (0.00)	0.0000097 (0.00)	0.0000052 (0.00)	0.000068 (0.00)	0.0000037 (0.039)	0.000011 (0.00)	0.0000013 (0.19)
ARCH-LM Test	11.20 (0.73)	10.71 (0.77)	23.60 (0.07)	2.11 (0.98)	17.06 (0.31)	9.75 (0.84)	9.48 (0.85)

*Figures in the parenthesis represent probability values.

The parameters estimates of the GARCH (1, 1) models in Tables 4 are all statistically significant. The estimates of $\beta1$ reported in Table 4 are always markedly greater than those of $\alpha1$ and the sum $\alpha1+\beta1$ is very close to but smaller than unity. The sum values of $\alpha1+\beta1$ of all stock markets are higher. For all the stock markets, the reported values of the $\alpha1+\beta1$ indicate a long persistence of shocks in volatility. As the lag coefficient of conditional variance $\beta1$ is higher than the error coefficient $\alpha1$ implying that volatility is less spiky in the stock markets. It also indicates that the volatility does not decay speedily and tends to die out slowly.

The coefficient of dummy variables introduced in variance equation is positive and statistically significant except Korean stock market. It implies that the volatility in other stock markets has increased after financial crisis while Korean stock market remains immune from the crisis.

Testing for Leverage (Asymmetry) Effect: TARCH models:

Conditional volatility of returns may not only be dependent on the magnitude of error terms but also on its sign. We checked for asymmetry in the stock markets using TARCH models. The results are presented in the Table 5.

Table 5: Coefficients of TARCH models -January 1, 2001 to February 3, 2010

Coefficients	India	China	Hong kong	Malaysia	Japan	Indonesia	Korea
α_0	0.000 (0.000)*	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)
α_1	0.037 (0.00)	0.066 (0.00)	0.009 (0.34)	0.137 (0.00)	0.035 (0.00)	0.031 (0.00)	0.026 (0.01)
β_1	0.796 (0.00)	0.888 (0.00)	0.908 (0.01)	0.590 (0.00)	0.893 (0.00)	0.734 (0.00)	0.897 (0.00)
(RESID<0) * ARCH(1) (γ)	0.198 (0.00)	0.049 (0.00)	0.106 (0.000)	0.142 (0.00)	0.107 (0.00)	0.211 (0.00)	0.111 (0.00)
$\alpha_1+\gamma$	0.235	0.115	0.115	0.157	0.142	0.242	0.137
Dummy in Variance	0.000024 (0.00)	0.0000081 (0.00)	0.0000092 (0.00)	0.000065 (0.00)	0.0000025 (0.05)	0.000016 (0.00)	0.00000043 (0.69)
ARCH-LM Test	8.15 (0.92)	8.91 (0.88)	32.63 (0.053)	1.52 (0.98)	21.65 (0.11)	9.05 (0.88)	11.53 (0.71)

*Figures in the parenthesis represent probability values.

The leverage term ( ), represented by (RESID<0)* ARCH (1) in Table 5 is greater than zero and statistically significant. This reinforces the assumption that negative and positive shocks have different impact on the volatility of daily returns. Here good news has an impact of α1 while the bad news has an impact of $_1$. The values of bad news represented by $_1$ are higher than the good news in all the stock markets. Thus, it can be said that negative or bad news creates greater volatility than positive or good news in both the stock markets.

The dummy variable results reported in Table 5 indicate that the financial crisis has increased the magnitude of leverage effect in all the stock markets except stock market of Korea as coefficient of its dummy variable is statistically insignificant. The results of ARCH-LM test statistics at even longer lag length of 15 reported in the Table 5 are statistically insignificant as its probability values are higher than 0.05. It, therefore, suggests that the estimated models are better fit and successfully account for asymmetric effect in volatility.

The results suggest that the financial crisis has not impacted the Korean Stock Market. Korea has less than one third of its foreign loans as short-term and it has a comfortable $240 billion of foreign reserves to deal with any unforeseen situation and sound economic fundamentals (Financial Express, 2011). The sound economic fundaments and the reserves could have provided cushion against the global financial crisis. Therefore, stock market of Korea seems to be insulated from the financial crisis. Stock markets of India, China, Hong Kong, Japan and Indonesia found to be more volatile after the crisis. The countries are major foreign trading partners of USA. They are major foreign holders of treasury securities of USA. China ranks first with total holding of 1165.5 billion dollar, Japan stands second with 911 billion dollars, Hong Kong placed eight with 118.4 billion dollars and India ranks seventeen with 38.9 billion dollars of total holding of treasury securities(US department of Treasury, 2011). The countries have strong bilateral trade relationship with USA. Therefore, the changes in the economic environment of USA might have affected the sentiments of the stock markets of the countries, their financial institutions and individual investors. The great, sudden and unexpected crash of the stock prices has also affected the psychology and expectations of participants in the stock markets. Therefore, the changes in economic condition in US especially financial crisis perceived to have negative impact on the stock markets of India, China, Hong Kong, Indonesia, Malaysia and Japan in terms of higher volatility. Globalization and free movements of capital across boundaries of nation have integrated financial markets worldwide. Technological innovations have improved market integration. The integration can also be a potential cause for the transmission of shocks from one market to other stock market (Hoque, 2007).

IV. SUMMARY

The study analyzed the impact of financial crisis on the behavior of the volatility of stock markets. It is found that the volatility in the Asian stock markets exhibits the persistence of volatility, mean reverting behavior and volatility clustering. The study used more than nine years of recent daily data to illustrate these stylized facts, and the ability of GARCH class of models to capture these characteristics. The results suggest that the stock markets have become more volatile during the crisis. Volatility is found to be persistent in all the stock markets. The persistence of volatility is well captured by the GARCH(1,1) model. The stock markets exhibited more volatility persistence during crisis period. The dummy variable analysis suggests that the volatility has increased in all stock markets except Korea as a result of present financial crisis.

Application of TARCH model detected the presence of leverage effects in all the stock markets of Asia before and during the period of crisis. The magnitude of bad news is higher than the good news in all the stock markets. The results also suggest that the present financial crisis has stepped up the magnitude of leverage effect in all the stock market except the stock market of Korea. The reasons could be due to the fact that the emerging market countries like Korea had undertaken reforms that were designed to, and would in fact, insulate them from adverse shocks from the rest of the world. These policies included substantial increases in reserve assets and substantial reductions in net government debt(Dooley and Hutchison, 2009). It could be argued that China, India, Japan, Hong Kong, Indonesia and Malaysia have stronger ties and are integrated with the U.S. market. They, therefore, subject to shocks and are more volatile.

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