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Impact of global financial crisis on stock markets: Evidence from Pakistan and India

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Recent devastating global financial crisis started from United States, spread all over the world and adversely affected real and financial sectors of developed as well as developing countries. This crisis is called the first largest crisis after the recession of 1930s. The prime aim of this study is to envisage the impact of recent global financial crisis on stock markets of Pakistan and India. For this purpose, daily data from 1st January 2003 to 31st August 2010 of KSE-100 and BSE-100 indices, representing stock markets' indices of Pakistan and India respectively, are used. To find volatility, EGARCH model is applied. This study empirically reveals that negative shocks have more pronounced impact on the volatility than positive shocks. These stock markets also faced persistent volatility clustering. Recent global financial crisis made mild negative impact on stock returns and enhanced volatility in Pakistani and Indian stock exchanges but this impact is stronger on Indian stock market.

Keywords: Volatility; EGARCH; Financial crisis; Pakistan; India

INTRODUCTION

Financial system is an integral part of any economy in the modern world which is beneficial for the transfer of funds from surplus entities – savers to deficient entities – investors. Equity market is one of the important ingredients of this system. Ample evidence is available about positive impact of stock market developments on economic growth (Levine and Zervos 1996; Levine, 2002; Nieuwerburgh et al., 2006; Enisan and Olufisayo 2009). The role of stock markets is beneficial for providing finance to lacking sectors, helpful to vibrate private sector and sharing risk (Omet 2002). The functions of stock exchange are complicated and therefore, different aspects of stock markets are analyzed in literature on stock exchange.

These markets are sensitive to national and international events (distasteful or agreeable) and react immediately after their occurrence. Stock exchanges are generally called yardstick and barometer that respond to political, economic, regional, national and international environment. Negative incidences or events that occur

internally or externally enhance volatility in this market that makes negative impact on its performance and shatters the confidence of investors due to increase in financial risk as fluctuations in asset prices affect the wealth and assets of the shareholders. Volatility is an important input for taking decisions about diversification in portfolio and hedging plans (Hameed and Ashraf, 2006). Sometimes, persistent higher negative volatility due to negative shock compels the looser investors to quit the market. Therefore, the question regarding the impact of major national and/or international positive or negative shocks on the stock markets has reasonably been addressed in financial literature. Recent global financial crisis is a major turmoil event which permeated all over the world irrespective of developed or emerging developing countries. This crisis is quite different from Asian financial crisis in 1997 and is more contagious and deeper than Asian crisis. Probably, it is the largest crisis after great recession of 1930s that has affected both real and financial sectors (Llanto and Badiola, 2010). This crisis originated in United States in second half of 2007 with the spark of subprime mortgage crisis and got worst momentum in the year 2008. The contagion of the crisis in the world was due to technological advancement and globalization. Developing countries also faced negative repercussions of this crisis and experienced adverse

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impact on their economies via the channel of finance and trade. Net capital inflows from developed countries to developing countries shrunk drastically from the beginning of this crisis. This crisis badly affected FDI, portfolio investment and exports of the developing countries (Iqbal, 2010). Like other sectors, world's stock markets also affected by this storm and faced steep declining trend from the first month of 2008 (Usman, 2010).

Pakistan and India are two important countries in the Indian subcontinent. There are three stock exchanges in Pakistan – Karachi stock exchange, Lahore stock exchange and Islamabad stock exchange. Karachi stock exchange is a leading and the oldest stock exchange which was established in 1947. Lahore stock exchange and Islamabad stock exchange were established in 1970. More than 60 percent trading occurs in Karachi stock exchange (KSE) which makes this a prominent and leading stock market in Pakistan (Zaidi 2009). KSE-100 index is considered a benchmark of Karachi stock exchange. Mumbai stock exchange (formerly called Bombay stock exchange) is an apex and the oldest stock exchange in India. This stock exchange is also probably the oldest stock market in Asia and was formed with the name 'Native Share and Share Broker Association' in 1875. This stock exchange has dominant role in Indian equity market (Gupta and Basu 2007).

The purpose of this paper is to find the impact of recent global financial crisis on Karachi stock exchange (KSE) of Pakistan and Bombay stock exchange (BSE) of India in order to see which stock exchange was affected badly or not? Besides this study also explores asymmetry information relation in both stock markets and for this purpose E-GARCH model is used. To get to these objectives we use daily data from January 2003 to August 2010 of these stock markets.

The rest of the paper is structured as follows. Review of relevant literature is presented in section II. Methodology and data issues are discussed at section III. Empirical results are given at section IV and last section contains concluding remarks.

LITERATURE REVIEW

Vast literature has emerged addressing different aspects of the stock market. We briefly review few studies having bearing on the volatility analysis of stock markets as well as the issue of financial crises impact on the stock markets. Conventional econometric models are based on the assumption that the disturbance term has a constant variance. This assumption is called homoscedasticity and it is this assumption that is the focus of ARCH/GARCH models. How volatility could be modelled so that it responds to different shocks. Engle (1982) answer to this question is an ARCH

(autoregressive conditional heteroscedasticity) process. After Engle (1982), a family of ARCH models has been developed which have been extensively used to examine volatility in stock markets.

Hussain (1998) used GARCH model to examine the effect of the Islamic holy month ramadhan on the stock market of Pakistan and concluded that there was no effect on stock return whereas the volatility of stock return reduced during the ramadhan. Javed and Ahmad (1999) used ARCH model to see the response of KSE to nuclear detonations made by Pakistan and India. They argued that the Indian nuclear detonation made adverse impact on stock return and its volatility of the Indian stock market whereas Pakistan's nuclear test only increased the volatility of stock return and trade volume. Pyun et al. (2000) show that in Korean stock exchange, volatility of large firms is affected by the shock of small firms and vice versa. However, the effect from large firms to small firms is stronger. Miyakoshi (2002) used GARCH and EGARCH models to examine the information based effect on conditional volatility in Japanese stock market. The results show that ARCH effect is eliminated from conditional volatility of concerned stock prices when trade volume is included in the model. Omet et al., (2002) examined the efficiency and volatility of Jordanian stock market and conclude no validity of efficient market hypothesis and clustered volatility prevalence. Hameed and Ashraf (2006) evaluated the impact of 9/11 event on KSE of Pakistan by using GARCH model augmented with a dummy for this event and reported that the incidence reduced volatility of stock returns in Pakistan. Alsubai and Najand (2009) investigated the response of conditional variance to the information available within the stock market of Saudi Arabia and demonstrates that intra-day, overnight and trade volumes are good predictors of conditional volatility. This study also shows that volatility spillover effect from large to small firms is pronounced.

The effect of different financial crises during the last two decades on stock markets has also been explored by different researchers. Some of the studies considered contagion impact among different stock markets in the wake of Asian financial crisis 1997. Alper and Yilmaz (2004) investigated this relationship for Istanbul and other prominent stock markets with particular reference to financial crisis that began in Turkey in 1994, Asian financial crisis 1997 and Latin America crisis during 1998 - 2001. This study confirms that international contagion prevails among stock markets. Lim, et al., (2008) explored the efficiency of the eight Asian stock markets in order to find the effect of Asian financial crisis 1997 with divisions of period from pre to post financial crisis and found that during financial crisis 1997, efficiency of the Asian stock markets deteriorated of which Hong Kong stock market was the major victim of the crisis.

Global financial crisis that started from United States after mid 2007 is considered the world's largest crisis after 1930s recession. Of course, this crisis also penetrated to world's stock markets and adversely hit them. Considering this, few studies also assess the impact of this crisis on stock markets. Using EGARCH model Olowe (2009) studies the response of stock return and its volatility of Nigerian stock market to this recent global financial crisis. The results of the study show that stock returns and its volatility in Nigeria are free from the severity of this crisis. In contrast to this study, Adamu (2010) takes same objective for Nigerian stock market with conventional statistical analysis i.e. standard deviation and variance analysis and divided the data into pre and post crisis period. This study empirically revealed that during the financial crisis period, volatility in Nigerian stock market increased. Ravichandran and Maloain (2010) found that during recent financial crisis, stock markets of six Gulf countries faced negative pressure but these markets become strengthened during post crisis period.

METHODOLOGY

To find volatility, Autoregressive Conditional Heteroskedasticity (ARCH) type models are in vogue in financial literature. ARCH model developed by Engle (1982) was supplemented by GARCH, GARCH-M, and TGARCH models. Exponential GARCH (EGARCH), proposed by Nelson (1991) is an important model which is not only helpful to find volatility but also copes with the situation of asymmetry information analysis. Asymmetric/leverage effect means whether negative shock of bad news is more pronounced than positive shock of good news for stock markets or vice versa?. Therefore, this study also used this test while analyzing the impact of global financial crisis on stock return as well as volatility of Karachi and Mumbai stock markets. The specifications of EGARCH model are presented below:

$$R_t = \alpha + \beta'X_t + \varepsilon_t \quad (1)$$

$$\varepsilon_t | \Omega_{t-1} \sim iid N(0, h_t) \quad (2)$$

$$\log(h_t) = \delta + \sum_{j=1}^q \theta_j \log(h_{t-j}) + \sum_{i=1}^p \theta_i \left| \frac{\mu_{t-i}}{\sqrt{h_{t-i}}} \right| + \sum_{k=1}^r \gamma_k \quad (3)$$

Equation 1 contains a regressand R_t , in our case it is stock return, which depends on α stands for drift term, X_t is/are exogenous variable(s) and β is/are coefficient(s) of

respective exogenous variable(s). Like other econometric models, ε_t is error term and subscription 't' is denoted for time series data. This equation is generally called conditional mean equation and is the foremost step for empirical analysis. Equation 2 is a mathematical narration of error term i.e. residuals should be independently distributed to zero mean and its variance should also be constant. Equation 3 is called conditional variance equation where h_t is the variance of stock return which depends on numbers of explanatory variables mentioned in the equations.

Usually, the conditional mean equation of GARCH type model contains ARMA(p,q) or AR(p) as regressors of dependent variable. One of the beauties of GARCH, EGARCH type models is that explanatory or dummy variables can be added in conditional mean and variance equations according to the objective of the study. Kanas (2002); Miyakoshi (2002) and Olowe (2009) included exogenous variables in both the equations of EGARCH as per their research requirement. Following them, this study also included an explanatory variable of global financial crisis in conditional mean and variance equation with intention to find the impact of global financial crisis on the stock returns and volatility. For our empirical analysis purpose, equation 1 is transformed with ARMA (1,1) representation along with a dummy variable CRISIS and equation 3 also contain CRISIS variable, therefore, changed equations according to the need of this study are as follows:

$$R_t = \alpha + \beta_1 AR(1) + \beta_2 MA(1) + \lambda CRISIS_t + \varepsilon_t \quad (4)$$

$$\log(h_t) = \mu + \sum_{j=1}^q \theta_j \log(h_{t-j}) + \sum_{i=1}^p \theta_i \left| \frac{\mu_{t-i}}{\sqrt{h_{t-i}}} \right| + \sum_{k=1}^r \gamma_k \frac{\mu_{t-k}}{\sqrt{h_{t-k}}} + \varphi CRISIS \quad (5)$$

Conditional mean equation 4 contains ARMA specification based explanatory variables along with a dummy variable CRISIS to ascertain the effect of financial crisis on the stock returns. The selection of ARMA or only AR representation depends on correlogram and other model selection criteria. In addition to that, to find the impact of crisis on volatility of the stock exchanges of Pakistan and India, the same dummy variable is included into conditional variance equation 5. Dependent variable of this equation is conditional variance of the respective stock returns whereas, δ coefficient of lagged conditional variances explains density of volatility, γ coefficient shows leverage impact provided that $\gamma \neq 0$. If sign of this coefficient is negative and significant then negative shock is more pronounced than the positive shock. On the other side, if

Table 1: Stock Returns Statistics of KSE and BSE

	KSE-Stock Return	BSE-Stock Return
Mean	0.000689	0.000915
Median	0.001342	0.002080
Maximum	0.115286	0.154901
Minimum	-0.106201	-0.119364
Std. Dev.	0.016641	0.017744
Skewness	-0.123594	-0.298062
Kurtosis	7.729931	10.19257
Jarque-Bera	1767.561	4149.711
Prob.	0.000	0.000

sign is positive then it can be concluded that the impact of good news is more relevant than negative news. Besides that, ϕ coefficient depicts the effect of crisis on conditional variance of stock markets.

Data

We use daily data of KSE-100 index and BSE-100 indexⁱ of Karachi and Mumbai stock exchangeⁱⁱ respectively for the period 1st January 2003 to 31st August 2010. Data of Karachi stock exchange and Mumbai stock exchange contain 1893 and 1913 daily observations respectively and the data were gathered from Karachi and Mumbai stock exchange websites. Following (Omet et al., 2002, Alsubaie and Najand 2009) stock return is calculated as: $R_t = \ln P_t - \ln P_{t-1}$ (6) Where R_t stands for stock return, \ln represents natural log, P_t is stock market index at time t and P_{t-1} is stock market index at time $t-1$.

The aim of this study is to find the impact of global financial crisis on stock markets of Pakistan and India, therefore, a dummy variable is prepared which is meant as 1 for the period from January 2008 to June 2009 defined as financial crisis period otherwise 0.

Adverse impact of this crisis on the growth momentum of developed economies became visible at the last of the year 2007ⁱⁱⁱ. Usman (2010) unveiled that first steep decline in the world stock markets including London stock market was observed in the month of January 2008. Moreover, Adamu (2010) also selected the same month while analyzing the effect of recent global crisis on the Nigerian Stock Market. Keeping in view the discussions, this study also used starting period of crisis as January 2008. Earlier months of 2009 witnessed recovery of world economies from hampering

effect of this devastating financial crisis^{iv}, therefore, we have selected June 2009 as the end period of this of crisis.

Table-1 shows that KSE and BSE contain same comparable trend and usually these trends are common features of financial series. Mean values in these stock exchanges are almost zero and difference between minimum and maximum values is also the same. Standard deviations show variation in stock returns in both markets. The values of skewness carry negative signs which confirm that returns in both markets are negative. Skewed and demonstrates that asymmetry prevails in both series.^v Kurtosis values are very large^{vi}, which show that the returns in both markets follow leptokurtic distribution. It means that KSE and BSE faced large or medium changes frequently. Jarque-Bera tests also highly significant which confirms that both the series are not normally distributed. To have further understanding about market returns in these countries, graphs of these returns are presented at Figure 1 and 2. Graphs also dictate that non-normality exists in the series as confirmed from statistical analysis and inertia of volatility clustering also prevails in the markets.

EMPIRICAL RESULTS

To meet the objectives of this study, we exercised EGARCH model which is based on conditional mean and variance equations and in this model conditional mean equation is important because of its explanatory variables.

This equation needs to be solved with ARMA representation, therefore, this study also focused on ARMA specification with the help of correlogram of each

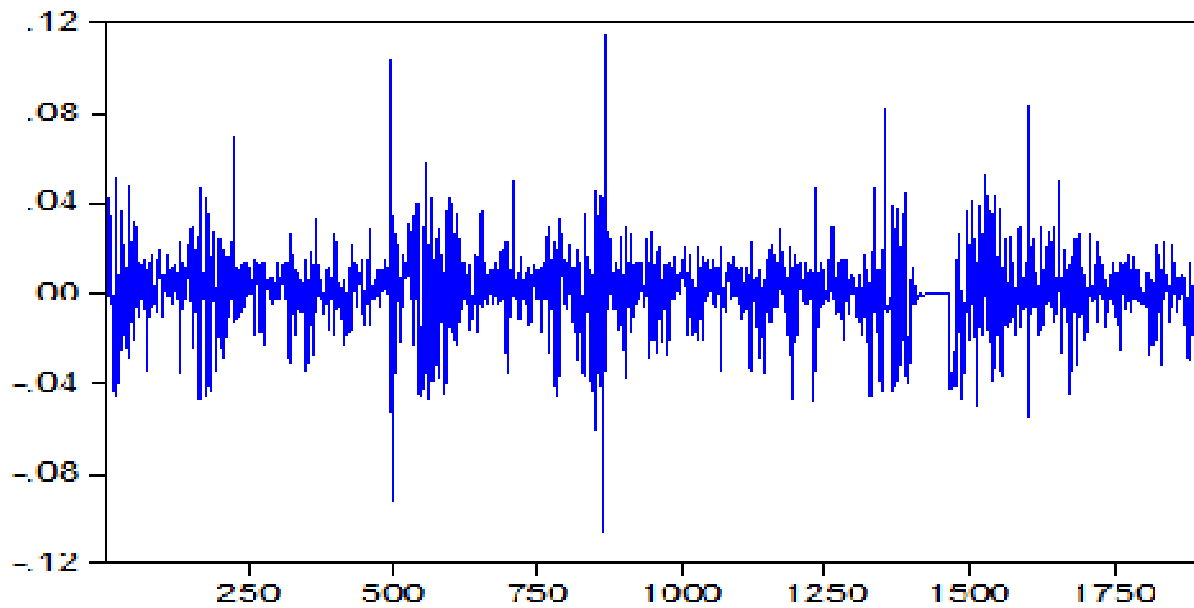


Figure 1: Stock returns of KSE

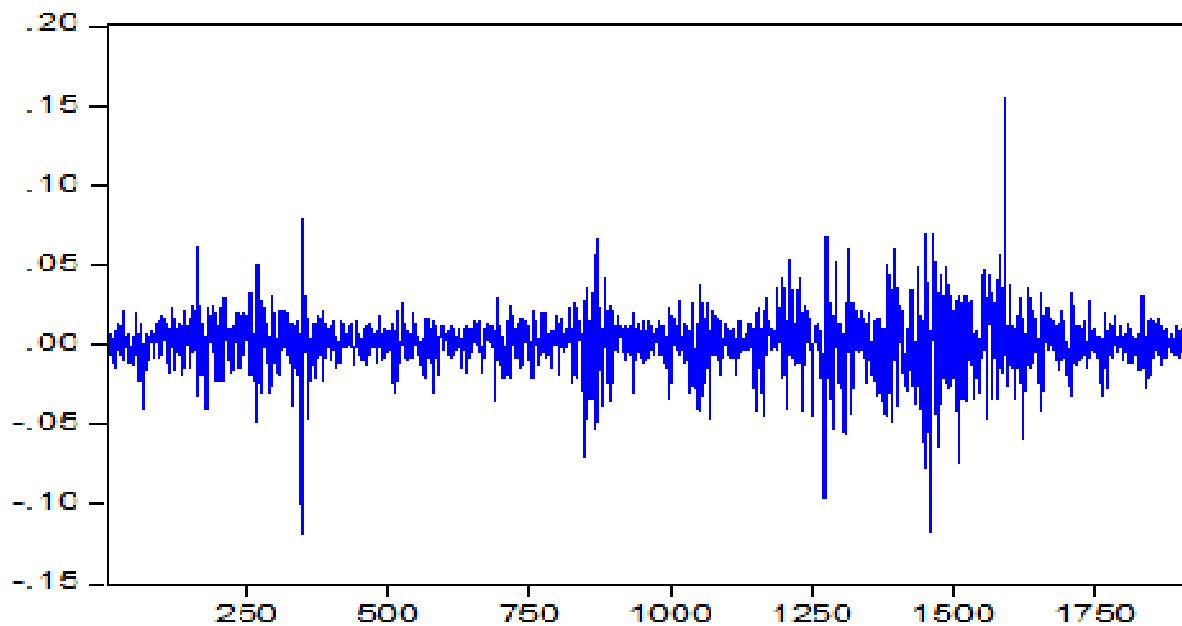


Figure 2: Stock returns of BSE

stock return series and subsequently the significance of the ARMA representation for the sake of parsimonious model. In addition to that, other diagnostic tests are also considered to finalize the models of each series. For stock return case of KSE, conditional mean equation is based on ARMA (1, 1) along with a dummy of CRISIS to capture the effect of global financial crisis on stock returns but for BSE's stock return case, this equation

contain only AR(1) as explanatory because MA(1) was insignificant for this case.

Table 2 shows the results of EGARCH about the stock returns of KSE and BSE. In first and second parts estimation, the results of conditional mean and variance equations are presented whereas bottom part shows diagnostic results about the models. The results of means equation for Pakistan confirms that past value of

Table 2: Results of EGARCH Models

Variables	KSE	BSE
Mean equation		
α	0.0020* (0.0004)	0.0013* (0.0003)
β_1	0.8774* (0.0564)	0.1269* (0.0014)
β_2	-0.8266* (0.0675)	-
λ	-0.003* (0.0007)	-0.0026*** (0.0014)
Variance equation		
μ	-1.3956* (0.0967)	-1.0026* (0.0947)
δ	0.8709* (0.0101)	0.9092* (0.010)
θ	0.4015* (0.0267)	0.2639* (0.0244)
γ	-0.0849* (0.0192)	-0.1428* (0.0166)
φ	0.0360** (0.014)	0.1559* (0.0214)
Diagnostic tests		
F-Stat	2.399**	2.406**
SIC	-5.646	-5.635
Q-Stat (up to 36 lags)	All insignificant	All insignificant

Note: (i) *, **, *** denote for significant at 1%, 5%, 10% level.; (ii) Values in () are standard errors of respective coefficients.

stock return predict the current stock return as the coefficient of AR(1) is significant. Coefficient of CRISIS is significant and contains negative sign but its effect is negligible which only 0.3 percent is. It means there is very thin negative impact of global financial crisis on the stock return in Pakistan. As far as conditional variance equation is concern, value of δ shows the effect of past variance on the current variance and shows magnitude of volatility clustering. The value of this coefficient is 0.871 and also highly significant which shows that persistence volatility clustering prevails in KSE. This volatility clustering reveals that once volatility persists it takes long time to become smooth. Value of γ is significant and has negative sign which shows that asymmetry information impact does exist in this stock market and negative shock has more strong impact on the volatility than the positive shock. Last coefficient of this model is concerned with recent global financial crisis which is also significant and has positive impact. This evidence confirms that recent financial crisis positively

hit the volatility of stock return by 3.6 percent. The results of some diagnostic tests are mentioned in the bottom part of the table. These results show that this model is free from autocorrelation as Q-Stat values up to 36 lags are insignificant.

Second model shows the results regarding BSE which is given in the last column of Table. 2. Results of mean equation show that market returns of BSE can be predicted by the previous day's return because the lag of stock return is significant at 1% level. The coefficient of crisis is significant at 10% level of significant also has negative sign which unveils that there is mild hampering impact of crisis on stock return because the crisis reduced only 0.26 percent market return. The results of conditional variance equation shows that lagged conditional variance is highly significant and contains 0.909 value which illustrate high volatility clustering persist in this stock markets and volatility take long times to decay. BSE also faces asymmetric effect in volatility of stock return.

The coefficient γ is significant with negative sign which demonstrates that the effect of bad news is more pronounced. The coefficient of crisis is also significant with positive impact on volatility. This illuminates that recent global financial crisis enhanced 15 percent volatility of stock return in Indian stock markets. Comparison of the results for Pakistani and Indian stock exchanges illuminate that both the markets almost face same type situations. Stock returns of previous day predict current returns as lagged value of return is significant and make positive impact on present returns in these markets. It has also been observed that leverage and asymmetric impact prevail which confirm that negative shocks creates deepen effect than positive shocks in both stock exchanges. Recent global financial crisis is one the worst crisis in the world during the last more than half century. This crisis hit stock markets of both countries but the effect of crisis to Indian stock market is stronger as compare to Pakistani stock market.

Conclusion

The prime aim of this study is to find the response of Pakistani and Indian stock markets to global financial crisis which started from last half of 2007 got severity in 2008. This crisis occurred in United States and later on spread in thunder storm way all over the world. Besides developed countries, developing countries also came into the grip of this devastating incidence which not only created fluctuations in financial markets but also made hampering impacts on real economies of developing countries.

To assess the impact of this crisis on Pakistani and Indian stock markets, we have used daily stock prices from January 2003 to August 2010 of Karachi stock exchange and Mumbai stock exchange, formerly called Bombay stock exchange. Statistical analysis illustrates that stock returns of these markets are not normally distributed. EGARCH model is applied for econometric analysis which illuminates that inertia of volatility clustering prevails in the stock markets of both countries. This inertia claims that volatility take long time to decay. Besides that, both stock exchanges also face asymmetry information impact i.e. bad news make more pronounce impact on the volatility than good news. Recent financial crisis make negative significant impact on stock return in these markets although this effect is not so strong. This crisis positively contributed to volatility in stock returns of these markets but stock return of Indian stock return volatility is more affected by this crisis than Pakistan stock markets. This difference between Pakistani and Indian stock markets may be due to the fact that India is a big economy than Pakistan and its stock markets are more open than Pakistani stock markets hence the impact of global financial crisis is more pronounced on Indian stock market.

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End notes

ⁱ BSE-100 index was formally called BSE national index.

ⁱⁱ Although the name of Bombay stock exchanged has been changed into Mumbai stock exchange but still its index is written as BSE.

ⁱⁱⁱ See State Bank of Pakistan (2008-09) Financial Stability Review

^{iv} see footnote 1

^v For normal distribution, the value of skewness is zero.

^{vi} The value of Kurtosis should be 3 for normal distribution.