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Volatility Estimation in Emerging Markets: A Study of India's and China's Stock Markets

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Abstract

Volatility is the change in returns from their mean, its estimation plays an important role in continual performance and capability of the financial market. The literature on Volatility is vast but majority of it has focused on the developed markets and empirical results from such studies can be used in discernment of those markets. Fewer studies have taken forward the developing stock markets therefore the challenges faced by them are less identified. This study makes an attempt to model the volatility of two fastest growing emerging economies i.e. India and China. These have different ideologies and market structures. The data has been employed for the period starting 2006 to 2015 for both Nifty and SSE composite. The tool used for analysis are Unit root test namely Augmented Dickey Fuller Test which assists in identification of stationarity of the series. Later conditional variance model GARCH (1,1) which captures time varying volatility, is employed. The study models the volatility of both indices i.e. Nifty and SSE.

Keywords: Conditional variance, GARCH, Nifty, SSE Composite, Time Varying Volatility.

1. Introduction

Substantial literature is dedicated for modeling of volatility. Initially it was the mature markets that were scrutinized later on Emerging markets also became a subject of empirical studies. Mandelbrot (1963) found the time varying feature of stock market returns. Engle (1982) started the ball rolling for the (ARCH) model and later on Bollerslev (1986) generalized it into (GARCH) model. Various extensions have emerged since then, such as EGARCH, TGARCH, SPLINE GARCH. Pandey (2005) mentions volatility clustering and other stylized facts can be acknowledged with conditional models.

GARCH class models have been used in Indian context by many studies like Kaur (2002) determined the stock market volatility in Indian context and also of some individual stocks to get a bigger picture of variability of returns. Kaur (2004) determined that whether the volatility of Indian stock markets vary with time and the significance of any particular day or Month on trading of securities. Kumar and Singh (2008) studied commodities like soybean and gold to determine seasonality in their returns. Batra (2004) examined time varying volatility in Indian markets. Handa and Ray (2002) studied the stocks are that listed in Indian as well as in the markets of United States to analyze the spillover of volatility from NSE to Indian indices

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This study is motivated to dissect two emerging markets Indian stock market and the stock market of China to determine how volatile these two markets are. Khanna (2003) states that although both the economies are growing at a fast pace but India has one advantage over its neighbor as there is no growth of private companies in China to compete in the global markets. Therefore it would be interesting to examine performance of stock markets of two countries with different ideologies.

2. Literature Review

Schwert (1989) identifies the factors which affect the overall soundness of an economy and then determined their relationship with the stock market volatility with the use of VAR model. Then these factors are studied with respect to their effect on volatility of the stock market.

Inclan Aggarwaland Leal (1995) determine the volatility of emerging stock markets and then associate the volatility with the events that occurred during the time of crisis in equity markets. They have divided the events into the ones that happen within a country and the other which happen throughout the world. To test this empirically they used iterated sums of squares logarithm.

Baig and Goldfajn (1999) undertake to explain the Asian crisis by empirically identifying the source of this major crisis. They also examine that whether the news across borders played any role in aggravating this crisis. The conclusion of study states that there was no major contagion in stock markets.

Berument and Kiymaz (2001) study the trading days in the stock market to identify the return and volatility among them using GARCH models so that a better understanding can be achieved as to whether any particular day has high return or high volatility associated with it.

Kaur (2004) investigated persistence of volatility with indices such as S&P CNX Nifty and SENSEX and employed GARCH class of models and also whether any day of a week or month of a year has a significant impact on the level of volatility of these indices, she also studies the effect of volatility of NASDAQ exchange on these Indian indices.

Kumar and Singh (2008) study the S&P CNX Nifty index returns and Commodities like Gold and Soybean to measure volatility; they also investigate that is there any particular Month that has higher returns than the average returns or lower returns than the average returns. For their analysis they use GARCH class of models.

Engle *et al* (2009) used the findings of previous studies pertaining to macroeconomic variables to further extent by separating components of volatility into long term and short term by focusing on industrial production growth and inflation only out of other economic variables. They have used the MIDAS GARCH model for this purpose and conclude that industrial production and inflation contain much information about future volatility.

Thenmozhi and Chandra (2013) apply the India VIX index to apprehend volatility in Indian stock market. They highlight importance of this as compared to model based estimators of volatility like ARCH/GARCH class of models. They sum up their study after applying regression analysis that the index is more capable of predicting volatility.

Morck *et al* (1999) state empirically that co movement between the developing economies is more in sync with each other than developed economies. With regression they try to establish that few features of an economy are related to pieces that are exhibited by stocks in exchanges.

3. Research Gap and Scope

The overview of literature states that although there have already been numerous studies on volatility in Developed markets, not many have concentrated on the Developing markets. These

Developing economies are less organized in comparison with their counterparts but their impact on world markets is immense. In the past we have seen numerous severe economic crisis stemming from the Developing economies like the Asian crisis, Peso Crisis, that went on to affect almost all the major economies of the world. Recently the Chinese stock markets experienced volatility which affected several other economies as well. Therefore it would be interesting as well as significant to determine Volatility in the two biggest Emerging markets.

4. Hypothesis of the Study

a. H0: There is no existence of volatility in Indian stock market.

b. H0: There is no existence of volatility in China stock market.

5. Research Methodology

The empirical analysis uses daily returns of Nifty from 1 January 2007 to 31 December 2016. The data for Shanghai stock exchange (SSE) is also for the same time frame. SSE composite is a stock market index that incorporates A shares and B shares that are available for trading at shanghai stock exchange. Observations included for Nifty and SSE are 2485 and 2490 respectively. The daily returns are calculated with the help of closing prices without bonus, right issue and dividend adjustments. Large sample data is used to remove thin trading bias. The returns are calculated with the help of following equation:-

$$Rt = \ln (Pt/Pt-1)*100$$

The tool used for analyzing the stock market volatility of both countries is GARCH (1,1) model which is parsimonious and efficient in the modeling.

The forecast by this conditional volatility model includes parameters of the model on the returns of the selected period.

6. Empirical Analysis

Unit Root Test of Stationarity for Nifty

Table 1: Unit Root Test of Stationarity for Nifty

			t-Statistic	Prob
Augmented Dickey-Fuller test statistic			-46.52903	0.0001
Test critical values:	1% level		-3.43279	
	5% level		-2.862504	
	10% level		-2.567328	

Table 1 shows the computed Augmented Dickey Fuller test. The test statistic is smaller than critical values i.e. -3.433832, -2.862965 and -2.567575 at 1 percent, 5 percent and 10 percent level of significance respectively; therefore the null hypothesis is rejected. This implies that return series of Nifty doesn't have a unit root problem and is stationary at 1 percent, 5 percent and 10 percent level of significance.

Unit Root for SSE Composite

Table 2 demonstrates the computed Augmented Dickey Fuller test for SSE. The probability is 0 % with T value of -22.36. Therefore the null hypothesis is rejected. This indicates that return series of SSE doesn't have a unit root problem and the series is stationary significance.

Table 2: Unit Root for SSE Composite

			t-Statistic	Prob
Augmented Dickey-Fuller test statistic			-22.36483	0
Test critical values:	1% level		-3.432788	
	5% level		-2.862503	
	10% level		-2.567328	

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GARCH Analysis of Nifty

Table 3: GARCH Analysis of Nifty

Variable	**Coefficient**	**Std. Error**	**z-Statistic**	**Prob.**
C	2.80E-06	4.62E-07		
RESID(-1)^2	0.097366	0.007895	3.427189	0.0006
GARCH(-1)	0.893306	0.008043		

Table 3 represents the parameter estimates of GARCH (1, 1) model for the returns of Nifty. Since ót2 is called the conditional variance. This conditional variance equation is a function of three terms viz. a constant term (C), news about volatility from the previous period, measured as the lag of the squared residual from the mean equation (ε2t-1), and the last period's forecast variance (ó2t-1). It is observed from the table that all the GARCH parameters are statistically significant. The estimated GARCH coefficients in the conditional variance equation are considerably larger than ARCH coefficient. The implication is that the market has a memory of

longer than one period and that volatility is more sensitive to its lagged values than it is to new information. As the sum of both the terms GARCH (0.89) and ARCH (0.09) is less than 1, hence volatility is of decaying nature.

GARCH Analysis of SSE Composite

Table 4: GARCH Analysis of SSE Composite

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	2.06E-06	4.40E-07	4.688244	0
RESID(-1)^2	0.05753	0.005064	11.36089	0
GARCH(-1)	0.936819	0.005222	179.3847	0

Table 4 exemplifies the parameter estimates of GARCH (1, 1) model for the returns of SSE Composite. As it is visible from the table that all the GARCH parameters are statistically significant. The estimated GARCH coefficients in the conditional variance equation are considerably larger than ARCH coefficient. Which means that the market has a memory of longer than one period and that volatility is more sensitive to its lagged values than it is to new information. In this case also total of both the terms is less than 1(0.93+0.05). The sum indicates towards volatility of decaying nature.

7. Conclusion

This study has the purpose to model the volatilities of two emerging economies namely India and China. To determine this the Generalized Autoregressive Conditional Heteroskedasticity model was employed with (1,1) specification. This model is parsimonious and efficient in the analysis. For Volatility measurement Nifty returns and SSE Composite returns were extracted over a period of 2006 to 2015. To check the stationarity of the data Augmented Dickey Fuller test was conducted and it was found that the series were stationary. Later Garch model was used for predicting the volatility. The results showed that the Arch term of the model is lower than Garch term implying previous information will affect the current period's information. Moreover, total of GARCH and ARCH is less than one means shocks would be decaying in the future. The results may be extremely useful for the investors.

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