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Impact of Futures Trading on Stock Market Volatility: Evidence from BSE

P. Sakthivel

Assistant Professor, Department of Commerce and Management Studies, SRC, SASTRA University, Kumbakonam, Thanjavur, Tamil Nadu, India

V.Vijay Anand

Assistant Professor, School of Management, SASTRA University, Thanjavur-Tamil Nadu, India

Abstract
This paper empirically examines the impact of derivative trading on volatility of BSE 30 Sensex by employing GARCH framework. Daily closing price of the BSE 30 Sensex were collected from June 15, 2007 to February 28, 2015 and used in analysis. The study also collected daily closing prices five individual stocks namely SBI, SUN PHARMA, TATAPOWER, HEROHONDA and RALIANCE to investigate the effect of derivative trading on volatility of individual stocks. The result of GARCH model reveals that volatility of BSE 30 Sensex returns has increased after introduction of derivative trading. Finally the result suggests that volatilityof most of individual stocks have marginally increased except in case of SBI.

Keywords: Futures Trading, GARCH Model, Volatility and BSE 30 Sensex

Introduction

The effect of of derivatives trading on volatility of volatility of stock market has been an interesting subject for both risk and fund managers because of its implications for risk management. The main argument against introduction of futures trading may increase the spot price volatility. This is due to fact that derivative markets encourage speculation and high degree of leverage. Hence, study madean attempt to re-examine effect of derivative trading on volatility of BSE 30 Sensex.

The main concern how introductionof derivativetrading might influences spot price volatility has been an interesting subject for investors, market makers, academicians and regulators. There are many studies investigated on this issue but these studies have found mixed results. One group of studies argued that introduction of derivative trading tends to stabilizes volatility of the stock market (Baldauf and Santoni, 1991; Antoniou and Foster, 1992; Pericli and Koutmos, 1997; Galloway and Miller, 1997; Dennis and Sim, 1999; Rahman, 2001). In contrast, some studies argued that introduction of derivative trading have increases volatility of stock market(Kamara etal 1992; Aggarawal, 1988; Lee and Ohk, 1992; and Antoniou and Holmes, 1995). Therefore,study madean attempt to examine the effect of derivative trading of volatility of BSE 30 Sensexas well as volatility of individual stocks.

This mixed empirical evidences on the issue of how introduction of derivatives trading impacts volatility of stock market have been interestingsubject for both exchanges and regulators. Many studies argued that introduction of derivative trading might increases in volatility of stock market due to speculative trades. This increased market volatility might increase the cost of borrowing, leading to a reduction in value of portfolio and loss of confidence in stock market. In the light of this background, the present study seeks to empirically investigate whether introduction of index futures trading decreases or increases stock market volatility.

Some Empirical Evidences

RuchikaGahlot (2010) used daily closing prices of S&P CNX Nifty as well as closing prices of five derivative stocks and five non derivative stocks from April 1, 2002 to March 31, 2005. Using GARCH model, they found that there is no significant change in the volatility of S &P CNX Nifty, but the structure of volatility has changed to some extent. However, results show mixed effect in case of 10 individual stocks.

Samanta and Samanta (2007) used GARCH model and data of S&P CNX Nifty, Nifty Junior and S&P 500 to examine the impact of derivatives trading on spot market volatility. The study reveals that there is no significant change in the volatility of spot market, but the changes in thestructuralconditional volatility to some extent. The finally study finds the mixed result in spot market volatility in case of 10 individual stocks. DhananjaySahu (2010) studied effect of futures trading on stock market volatility. Daily closing price of seventy three companies were taken from April 01, 1998 to March 31, 2008 and used in analysis. He found that there is decline in stock market volatility after introduction of derivative trading.

Hasan &Chowdhury (2011) examined the effect of option trading on liquidity and volatility of stock markets in Asia by employing GARCH model. The result shows that liquidityand volatility of Asian stock markets has been increased after introduction of option trading. Abhilash (2008) analyzed effect of derivative tradingon volatility of seventy two stocks. He used both symmetric and asymmetric GARCH models to capture time varying volatility and volatility clustering. He found that volatility of most of stocks have been declined after the introduction of derivative trading.

Gurcharan Singh (2010) exploredthe effect of futures trading on the volatility of stock market in India. The study uses daily closing prices of Nifty Index from 1995-1996 to 2008-09 and used in analysis. The result reveals that volatility of Nifty index has declined after introduction of **derivative** trading in NSE.

Martin et all (2014) analyzed the impact of derivative trading on volatility of spot price in three Asian markets namely China, Singapore and Hong Kong. Daily closing prices of A50, HSCEI and CSI 300are collected from January 3, 2000 to June, 2013. The result shows that volatility of spot price has declined after introduction derivative trading and it has improved market efficiency.

Drimbetas et al (2006) studied the effect of derivatives trading on volatility of the Greek stock market by employing EGARCH model. Daily data were taken from August 1997-to April 2005 and used in analysis. The result shows that theintroduction derivative trading reduces conditional volatility of Greek stock market and same time it has increased market efficiency.

Mallikarjunappa (2008) used Nifty index, Nifty junior and BSE 30 Sensex from 5th October, 1996 to 30th June, 2006 to explore the effect of derivative trading on spot market volatility. They employed GARCH model to capture time varying volatility and clustering volatility in data. They found that introduction index futures have no impact of volatility of spot market.

George (2009) investigated the impact of index futures on volatility of New Zealand and Australian stock markets. Applying Parkinson's efficient variance estimator, the he found that volatility of New Zealand stock market have declined. Finally the result suggests that trading volume has increased and declines in volatility of ASX 200 after introduction of derivative trading.

Kotha Kiran Kumar♣ &ChiranjitMukhopadhyay (2007) used daily closing prices Nifty 50, Nifty Junior and MSCI world index to examine whether the introduction of derivative instruments affects volatility of stock market. They applied ARIMA GARCH model to capture time varying volatility and clustering volatility in Nifty data. The result shows that there is no impact on mean returns and volatility of spot market but it has altered structure of volatility.

The above selected review works shows that evidences are inconclusive. Hence, the present study made an attempt to re-investigate the effect of futures trading on volatility of the spot price.

Data and Methodology

Data Description

The data used in study had been obtained from the Bombay Stock Exchange of India (BSE) website. The daily closing price returns of the BSE 30 Sensex were taken from June 15, 2007 to February 28, 2015 and used in analysis. The study also chosen five individual stocks randomly and collected their daily closing pricesto investigate the effect of derivative trading on volatility of individual stocks. The sample stocks areSBI, SUN PHARMA**,** TATAPOWER, HEROHONDA and RALIANCE. All series are converted natural logarithm to check stationarity process.

Methodology

The study proposes to apply ADF and PP tests to verify whether a series is stationary or non-stationary. The ADF test is based on the estimate of the following regressions:

$$\Delta y_t = \alpha_0 + \gamma_1 y_{t-1} + \sum_{i=1}^{p} \beta_i \Delta y_{t-i} + \varepsilon_t \quad \ldots (1)$$

If hypothesis $\gamma_1 = 0$, is accepted indicates all variables have a unit root and are non-stationary. Hence, if the hypothesis, $\gamma_1 = 0$, is rejected implies that variables does not have a unit root and are stationary.

To investigate the impact of futures trading on the volatility of the BSE 30 Sensex, GARCH framework is used. The important feature of the GARCH framework is that it capturestime varying volatility or heteroscedasticity, mean revision and volatility clustering in present data. The GARCH (1, 1) model can be written as follows:

$R_t = \Phi_0 + \Phi_1 R_{t-1} + \varepsilon_t \quad \ldots (2)$

$\varepsilon_{t-1} | \Psi_{t-1} \sim N(0, h_t)$

where, R_t is the stock returns, ε_t is the error in mean equation and Ψ_{t-1} is the set of information available at time t-1. The conditional variance of GARCH model can written as

$$h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 h_{t-1} \quad \ldots (3)$$

Where $h_t$conditional volatility depends upon lagged squared errors and previous conditional variance.$\alpha_1$and $\beta_1$are news coefficients. α_1 measures the impact of the recent news on current volatility; β_1 measures impact of the less recent or old news on current volatility.

In order to analyze the impact of futures trading on volatility in BSE 30 Sensex as well as in individual stocks volatility, a dummy variable is introduced into conditional variance equation. The modified GARCH (1,1) model can written as follows.

$R_t = \Phi_0 + \Phi_1 R_{t-1} + \varepsilon_t$

$\varepsilon_t | \Psi_{t-1} \sim N(0, h_t)$

$$h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 h_{t-1} + \gamma_1 DF \quad \ldots (4)$$

where DF is the dummy variable which takes the value of the zero for pre-futures and one for post futures. If the co-efficient of the dummy is negatively significant it shows that introduction derivative trading reduces volatility of BSE 30 Sensex. If the co-efficient is positively significant indicates that there is an increase in the volatility of BSE 30 Sensex.

Empirical Results

The result of the unit root tests are presented in Table 1. The results of the ADF test show that presence of unit root for log series of BSE 30 Sensex and selected five individual stocks at level forms. However, log series of BSE 30 Sensex and selected five individual stocks are stationary at first differences since the null hypothesis of a unit root is rejected. Similar results, observed for the Phillips-Perron test are given in same table.

The descriptive statistics are given in table 2. It shows that the mean returns on BSE Sensex are positive. Similarly, the daily mean returns on individual stocks are positive except in the case of Hero Motors Ltd. The standard deviation of Sun Pharmaceutical Industries Ltd is higher among other the stock returns. This implies that higher volatility is observed in this stock compared to with others. The negative skewness coefficient for most stock returns implies that the frequency

distribution of the return series is negatively skewedor has longer tails to the left.

The kurtosis value exceeds more than three for most of the individual stocks, which shows that the distribution of stock returns is leptokurtic or thick-tailed during thesample period. The JB statistics showsstatistically highly significant and reject the null hypothesis. It indicates that most of the stock returns series deviate from normal distribution. LM test shows that squared residuals are auto correlated in almost all stocks thus confirming the presence of ARCH effects in most of individual stocks.

The results of GARCH are presented in Table 3. The empirical results show that co-efficient dummy variable in the conditional variance is positive and significant. It shows that volatility of BSE Sensex returns has increased after introduction of derivative trading. The results show that the effect of introduction of BSE 30 Sensex futures in BSE may have affected volatility of the BSE Sensex returns. This is due to the possibility that higher volatility of BSE 30 Sensex might be influenced by internal as well as external factors.

A dummy variable introduced in the GARCH conditional variance equation to investigates the impact of stock futures on volatility of individual stocks. The results of GARCH model reported in Table 5. It shows that coefficient of dummy variable for four individual stocks are positively significant. It indicates that volatility of four individual stocks has marginally increased after introduction of derivative instruments in BSE. However, stock such as SBI reports the lower volatility after introduction of derivative trading.

Table 1: Results of Unit Root

Name of the Stock	ADF (Level)	ADF (First Difference)	PP (Level)	PP (First Difference)
BSE 30 SENSEX	-1.2980	-32.450	-2.3410	32.841
Tata Steel	-0.3190	-18.569	-1.4501	-19.004
SBIN	-1.3831	-22.568	-1.8390	-23.456
Reliance	-1.0310	-43.567	-3.560	-45.543
Hero Motors Ltd.	-1.6081	-58.230	-0.4520	-57.543
Sun Pharmaceutical Industries Ltd.	-2.290	-15.459	-0.5302	-15.997

Table 2: Descriptive Statistics

Name of the Stock	Mean	S-D	Skewness	Kurtosis	J.B Test	LM Test
BSE 30 SENSEX	0.00072	0.00267	-0.4290	8.5430	843.50	34.780
Tata Steel	0.02501	0.00074	-0.3298	12.532	761.42	23.897
SBIN	0.1345	-0.0032	-0.6410	9.5302	32150.45	67.342
Reliance	0.00018	0.00397	-0.8120	18.5301	278.60	38.940
Hero Motors Ltd.	-0.00910	0.0549	2.0910	23.4510	234.62	34.67
Sun Pharmaceutical Industries Ltd.	-0.000320	0.9754	-0.0210	17.420	432.50	45.781

Table 3: BSE 30 Sensex Futures and Spot Price Volatility with GARCH (1, 1) Model

	BSE 30 Sensex Returns	
Variable	Coefficients	Significance
Constant	0.0970	3.534*
ARCH (1)	0.2190	8.450*
GARCH (1)	0.7891	15.689*
Dummy	0.03479	7.4780*

** Indicates 1 % significance at 1 % level*

Table 5: BSE 30 Sensex Futures and Individual Sock price Volatility

Name of the Stocks	Constant	ARCH(1)	GARCH(1)	Dummy
Tata Steel	0.00045 (3.743)	0.3890 (7.890)	0.6290 (4.897)	0.00278 (3.782)
SBIN	-0.01980 (-7.789)	0.2569 (8.780)	0.7296 (13.457)	-0.3495 (-9.670)
Reliance	0.3490 (8.670)	0.1873 (3.456)	0.8250 (5.670)	0.0086 (2.854)
Hero Motors Ltd.	0.0234 (142.913)	0.4865 (6.782)	0.5196 (18.783)	0.0428 (4.654)
Sun Pharmaceutical Industries Ltd.	4.23E-05 (2.3490)	0.1574 (4.650)	0.8369 (7.590)	1.0569 (6.743)

Final Remarks

The study empirically investigates the effect of derivative trading on volatility of BSE 30 Sensex by employing GARCH framework. Daily closing price of the BSE 30 Sensex were collected from June 15, 2007 to February 28, 2015 and used in analysis. The study also collected daily closing prices five individual stocks namely SBI, SUN PHARMA, TATAPOWER, HEROHONDA and RALIANCE to investigate the effect of derivative trading on volatility of individual stocks. The result of GARCH model reveals that volatility of BSE 30 Sensex returns has increased after introduction of derivative trading. Finally, the result suggests that volatility of most of individual stocks has marginally increased except in case of SBI.

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