FINANCIAL DERIVATIVES AND SPOT MARKET VOLATILITY

Balaji

Associate Professor in Commerce, P.G. Department of Commerce, Sathya College of Arts and Science, Margabandhu Nagar, Rasathupuram, Kil Visharam – 632 509 Vellore District, Tamil Nadu

Abstract

This study is made to examine the empirical relationship between derivative products like index futures, index options, stock options at futures and the Nifty spot market volatility. There are two contradicting schools of thoughts with regard to this: one advocates that the derive products demobilize the spot market, while the other opposes this. Ever since the introduction of derivative products in various markets all over the world, numerous studies have been carried out upon the effects of futures and options listing on cash market volatility. The study focuses on capturing the impact of the reduction of denies trading on spot market volatility, in the Indian market. The empirical evidence is mixed and the results suggest that there has been an enhancement in the volatility of spot-market index in the post-derivatives period.

Introduction

The Indian capital market has witnessed radical changes, especially during the last decade. Having discarded the age-old practices like open outcry trading system, physical form of shares and new settlement procedure, and others, the markets are now operating with world-class practices and products. The reforms in the capital markets have helped to improve efficiency m many aspects, namely, the dissemination of information, transparency in operations prohibiting unfair trade practices.

The most certain thing about the markets is uncertainty, which leads to risk. One such risk is financial risk, due to the changes in stock market prices. To manage such risks, financial instruments, known as financial derivatives, have been developed and introduced into the Indian capital markets as well as across the globe, over: a period of time. Based on the recommendations of L.C. Gupta Committee, SEBI permitted the stock exchanges viz, BSE and NSE in India to introduce financial derivatives in June 2000. The first product was futures on indices followed by options ort indices, individual stock options and futures.

The term derivative implies that it has no independent value. Its value is derived from the value of the other asset. According to the L.C. Gupta Committee's Report, derivative means a forward, future or option contract for a predetermined-fixed duration: linked for the purpose of contract fulfillment to value of specified real or financial asset or to an index security.

The impact of derivatives on the cash market volatility is a much debated and widely studied research topic. Ever since the Chicago Board of Trade introduced the commodity futures in 1865. Various markets have been studied at different time periods.

The concern over how trading in index futures and options affect the spot market has been an interesting subject for investors, academicians, regulators and exchanges. Financial derivatives were introduced in India, mainly as a risk management tool for both institutional and retail investors. The two main functions of derivative market are: Price discovery and hedging. Derivative markets are also known to have a stabilizing effect on the underlying stock market (Raju and Karnade, 2003).

The available literature offers two different kinds of arguments. Some authors like Shenbagaraman (2003), Thenmozhi (2002), Gupta and Kumar (2002), Golaka C Nath (2003) found that the overall volatility of the underlying stock market was reduced after introduction of derivative contracts on indices in India. The other side of the argument is that the entry of new speculators in the market could constitute a negative factor that would increase the volatility of the spot market Stein (1987). Similarly Hodgson and Nicholls (1991) reaffirm that trip volatility of the spot market could increase with the derivative products because of speculation and arbitrage strategies. In this background the present paper attempts to study the impact of introduction of index futures, index options, stock options and stock futures on the underlying spot market volatility i.e. Nifty.

Review of Literature

A good number of studies have been carried out to find out the impact of financial derivatives on the underlying spot market volatility. Different arguments have been developed over the years about this topic. A comprehensive literature survey is done to find out the methodologies adopted by various authors. It was found that the most commonly used statistical tools are simple analysis of variance, standard deviation measurement of volatility, linear regression or advanced statistical models like Generalized Auto Regressive Conditional Heteroskedasticity (GARCH).

Raju M T (2003) examined the price discovery between the S&P CNX Nifty and its corresponding futures using co-integration analysis. This analysis measures the extent to which two markets have achieved long run equilibrium. They also examined the effect of introduction of S&P CNX Nifty index futures on the underlying spot market by using the ARCH family of models to study volatility, between June 2000 and October 2002. They found that both the cash and the futures markets are integrated; information flows from one market to another, with information being reflected First in the futures market, and the results indicated that the volatility was reduced after the introduction of index futures.

Premalata Shenbagaraman (2003) examined the impact of the introduction of NSE Nifty index futures and options on Nifty. She considered daily closing prices between October 5,1995 to December 31, 2002 and used univariate GARCH (1,1) model to examine the impact of index futures and options contracts on volatility. To remove the effects of economic factors like inflation rates, growth forecasts and exchange rates, the author used

Nifty junior as a perfect control variable to isolate market-wide factors and thereby focus on the Nifty volatility.

Further the lagged S&P 500 index returns is also introduced into the conditional mean equation so that the effects of global price movements are nullified. The author tested the volatility before and after the introduction of derivative products. The results indicate that derivatives introduction has had no significant impact on spot market volatility. By using pre and post futures period analysis, the author concluded that the effect of information was persistent over a time period before futures where this is not true after futures introduction.

Golaka C Nath (2003) studied the behavior of stock market volatility after derivatives for indices, as well as individual stocks. The study captured the impact of the introduction of derivatives trading over a longer period of time, i.e., from January 1999 to October 2003. The author has used two bench mark indices, S&P CNX Nifty, S&P CNX Nifty Junior and 20 selected stocks, 13 of which have single stock futures and options. The study revealed that volatility, as measured by standard deviation came down for most stocks after derivatives. He concluded that changes in the micro structure, robust risk management practices to contain volatility, and introduction of derivative products might have led to the reduction of volatility.

Thenmozhi M (2002) analyzed the volatility of spot market before and after introduction of the stock index futures, and also the lead lag relationship between stock index futures and spot index returns with the help of data between June 15, 1998 and July 26, 2002. The standard deviation of daily returns has been used to assess the impact of derivatives on spot market volatility. The author felt that GARCH model is not relevant for measuring volatility, since the study period is short. The author concluded that volatility in the post-futures period has been on the decline. In this study NSE-50 Junior was used as a proxy to capture market wide influences on price volatility, as it is not very highly correlated with NSE-50 index.

The study proves that there is a possibility of increase in the information flow that has influenced the market returns in the post futures period.

Ali F Darrat et al. (2002) examined the role of futures trading in spot market fluctuations. The Exponential Generalized Autoregressive Conditional Heteroskedasticity (EGARCH) was used to measure the relationship between volatility in the spot and futures markets for the period between November 1987 and November 1997. Deviating from other studies, which considered daily closing prices, Ali F Darrat et al considered month-end daily closing prices. The results proved that volatility in the futures market is an outgrowth of the turbulent cash market. They argued that index futures trading may not be blamed for volatility in the spot market because in an excessively volatile cash market, the fear among investors motivates them to engage in more hedging activities in the futures market.

Benilde Maria et al. (2001) studied the impact of futures market's introduction on the Portuguese stock market, between December 1992 and 1998, using the daily closing data of the PSI-20 index (Portuguese Stock Index). They used the GARCH (Generalized Auto Regressive Conditional Heteroskedasticity) model to measure the futures impact on spot market volatility. The results of the study revealed that the introduction of the PSI-20 index futures increased volatility in the Portuguese stock market, without any improvement in the market efficiency. Interestingly, this argument is not consistent with a majority of other international studies. However, they felt that the inconsistency could be due to the limitations such as lack of control over the other influences on the volatility and maturity levels of the market.

Objective of the Study

The introduction of derivative products in Indian capital markets has not been very old, but today the notional trading values in the futures and options segment are ahead of cash market. Sometimes, notional trading value of the derivatives is higher than the cash market trading values. The purpose of the study is to examine the impact of introduction of derivative products viz., (i) Index futures (ii) Index options (iii) Stock options and (iv) Futures on individual stocks on the underlying spot market volatility, i.e., Nifty.

Data and Sampling

The data for the study period consists of S&PCNX Nifty and S&P CNX Nifty 500 broad-based index for the Indian market which has been collected from the National Stock Exchange (NSE). The returns are calculated for (Nifty and Nifty 500) between June 7, 1999 and December 31, 2005. The CNX Nifty is an index of 50 stocks traded on the NSE and represents approximately 60% of the total market capitalization as on June 30, 2006. The average total traded value for the last six months of all Nifty stocks is approximately 54.64% of the traded value of all stocks on the NSE. S&P CNX Nifty is a well diversified index accounting for 23 sectors of the economy. The first index futures in India was introduced on the CNX Nifty on June 12, 2000, followed by index options on June 4, 2001, options individual stocks in July 2, 2001 and finally futures in individual stocks on November 9, 2001. The daily closing prices are taken into consideration to measure the impact of derivative products on the spot market volatility. The returns are calculated by using the following formula: $Rt_n = \log (p_t / p_{t-1}) 100$

where P_t and P_{t-1} are the prices at time t and *t*-1 respectively and Rt_n is the return for time *t*.

Methodology

The study was carried out using ordinary linear regression. The impact of the introduction of derivative products on the volatility of Nifty the spot market under study is

determined by comparing its volatility before and after the introduction of derivative products. This can be done by calculating the descriptive statistics, after eliminating the effect of various factors. For instance, to nullify the effect of various market-wide factors, Nifty 500 is taken into account, which is a broad-based index for the Indian capital market; similarly to eliminate the yesterday's impact on the today's market, Lag Nifty has also been included in the regression equation. In this study, the Nifty volatility is regressed with Nifty 500, Lag Nifty and a dummy variable. The dummy variable assumes the value of '1' for the post-derivative products period and '0' for the pre-derivative products period. The sign of the dummy coefficient signifies a fall or rise in the volatility with the inception of derivative products. The data has been analyzed using ordinary least square technique. To examine the impact of derivative products on the volatility of the spot market, the following regression model has been used:

$N_t = \beta_o + \beta_1$ Nifty 500 $+ \beta_2 , D_t + \varepsilon_t$

N_t is the standard deviation of Nifty return series

Nifty 500 represents the standard deviation of Nifty 500 return series

D_t is the dummy variable.

Hypothesis

Using the above methodology, the following hypothesis was tested.

H_o: Derivative products like index futures, index options, stock options and stock futures influence the underlying spot market volatility, i.e., Nifty.

H_1: Derivative products like index futures, index options, stock options and stock futures, do not influence the underlying spot market volatility, i.e., Nifty.

Scheme of Chapterisation

This paper is divided into four sections. The first section deals with the introduction to the topic where survey of literature, objectives, data period, methodology and hypothesis are discussed. The second section deals with the descriptive statistics of the study. The impact of financial derivatives analysis is dealt with, in the third section. Last section deals with the conclusion of the study.

Descriptive Statistics

The descriptive statistics, in Table 1, indicate that the Nifty return series follows a normal distribution. It is observed that the values of the standard errors for skewness and kurtosis lie between -2 to +2, conforming to the normal distribution pattern. It deals with the descriptive statistics of Nifty before and after derivative products introduction. The standard deviation, which is considered to be a measure of volatility, reveals that for all the four derivative products, viz., index futures, index options, stock options and stock

futures has come down after the introduction of derivative products. Hence, it can be inferred that volatility has come down after introduction of derivative products. But drawing conclusions based only on the descriptive statistics may prove to be incorrect. Hence, there is a need to further investigate the impact of financial derivatives on the underlying spot market volatility. The following section deals with the further investigation of the impact of derivative products on the underlying spot market volatility.

Table 1 Descriptive Statistics of the Nifty

Particulars	Values
Minimum	-13.05
Maximum	7.97
Mean	0.0543
Standard deviation	1.512
Skewness	-0.628
Standard Error	0.0060
Kurtosis	5.958
Standard error	0.120
Number of observations	1651

Impact of Financial Derivatives on the underlying Spot Market Volatility

This section of the paper deals with the assimilation of information in the market, with reference to introduction of derivative products and also the impact of derivative products on the Nifty volatility.

1. Assimilation of Information and Spot Market Returns

The change in volatility of Nifty due to Nifty futures can be determined by using the regression model. Since the spot market volatility may be due to market factors, their influence should be removed in order to isolate the impact of financial derivatives on the underlying spot market volatility. For this purpose, the Nifty 500, which is a broad-based index of Indian capital market, was used as a proxy variable. The following regression model is used to determine the extent to which market wide information is assimilated:

$N_f = \alpha_0 + \alpha_1 N500 + \mu_t$

N_f = NSE 50 index returns

N500 = Nifty 500 returns

α_0 = Constant

α_1 = Coefficient of Nifty 500 returns.

α_1 deals with the market-specific information that affects the volatility of Nifty returns. If α, is statistically significant, it can be concluded that market wide information has been captured.

The regression analyses for the pre and post-introduction periods are shown in Table 2 and Table 3, respectively. The tables indicate the assimilation of information into the markets. It is observed that the value of α_1, has improved from 0.832 in the pre-index futures period to 0.881 in the post-index period. The t-statistic is also significant at 1% level in both cases. The value of R^2 has increased from .832 to .881, which indicates the assimilation of information from pre-derivatives period to post-derivatives period. Hence it can be inferred that the information flow has been increased from .832 to .881, which indicates the assimilation of information from pre-derivatives period to post-derivatives period.

Table 2 Pre-Index Futures Period Market Information

Model Summary					
R	**R^2**		**Adjusted R^2**	**Std. Error of the estimate**	
0.912	0.832		0.831	0.81904	
Coefficients					
1. Model	**Unstandardized coefficients**		**Standardized Coefficients**	**t-Value**	**significance**
	β	**Std. Error**	**β**		
2. Constant Nifty	0.002	0.051		0.044	0.965
3. Nifty 500	0.814	0.023	0.912	35.382*	0.000
Note :* Significance at 1% level					

Table 3 Post-Index Futures Market Information

Model Summary				
R	**R^2**	**Adjusted R^2**	**Std. Error of the estimate**	
0.939	0.881	0.881	0.48503	
Coefficients				
4. Model	**Unstandardized Coefficients**	**Standardized Coefficients**	**t-Value**	**significance**
	β	**Std. Error**	**β**	
5. Constant Nifty	-0.006	0.013		-0.479	0.632
6. Nifty 500	0.874	0.009	0.939	101.806*	1.000
Note: * Significance at 1% level					

Hence it can be inferred that the information flow has been assimilated in the market at a faster rate, the spot market has to be tested for the impact of financial derivative products on the underlying spot market volatility. The following section deals with it.

Impact on the underlying Spot Market Volatility

The following regression model has been used to find out the impact of derivative products on the Nifty volatility.

$N_t = \alpha_0 + \alpha_1 \ N500 + \alpha_2 \ lagN + \alpha_3 \ D_t \ + \mu_t$

N_t is the Standard deviation of Nifty return series. N500 is the standard deviation of Nifty 500 return series. LagN is the standard deviation of Lag Nifty return series. D_t is the dummy variable for derivative products, whose value is taken to be '0' before the introduction period and '1' after the introduction period.

α_1, α_2, α_3, are the coefficients.

The above equation helps to find the impact of derivative product inception on the underlying market, i.e., Nifty volatility. The coefficient of α_1 has been used as proxy to capture market wide information, the coefficient of α_2, to eliminate the impact of yesterday's market. Now the impact of derivative products alone on the volatility of Nifty can be assessed. If the coefficient of α_3 is statistically significant, it can be conclude that it has made an impact on the spot market volatility.

Table 4 Impact of Index on the Nifty Volatility

Particulars	Coefficient	t-value	Significance
Constant	0.024	0.995	0.000
Nifty 500	0.109	13.397*	0.000
Lag Nifty	0.866	86.286*	0.000
Index Futures Dummy	0.002	0.582**	0.051
Note: * Significance at 1% level. ** Significant at 5% level R^2 = 0.992			

The impact of index futures on Nifty volatility has been depicted in Table 4. Both Nifty 500 and lag Nifty are significant at the \°a level, hence it can be inferred that they are influencing the Nifty volatility. Similarly the index futures coefficient is significant at 5% level thereby it can said that the Nifty volatility is affected by the introduction of index futures. Since the dummy coefficient of index futures is positive, it can be inferred that it has helped in the enhancement of the volatility of Nifty.

Table 5 deals with the index options impact on Nifty volatility. Nifty 500 and lag Nifty are both significant at \% level; hence it can be concluded that they are influencing the Nifty volatility. The index options coefficient is significant at 1% level; hence it can be inferred that the Nifty volatility is affected by the introduction of index options.

Table 5 Impact of Index Options on the Nifty Volatility

Particulars	Coefficient	t-value	Significance
Constant	-0.001	-0.161	0.872
Nifty 500	0.144	15.521*	0.000
Lag Nifty	0.835	78.610*	0.000
Index Options Dummy	0.025	7.336*	0.000
Note: * Significance at 1% level. R^2 = 0.992			

Since the dummy coefficient of index options is positive, it can be concluded as that it has helped in the enhancement of the volatility of Nifty.

The stock options impact on the Nifty volatility has been depicted in Table 6. Nifty 500 and lag Nifty are both significant at 1% level; hence it can be inferred that they are influencing the Nifty volatility. Similarly, the coefficient of stock options is significant at 1 % level, thereby indicating that the Nifty volatility is affected by the introduction of index futures.

Table 6 Impact of Stock Options on the Nifty Volatility

Particulars	Coefficient	t-value	Significance
Constant	-0.001	-0.227	0.820
Nifty 500	0.144	15.250*	0.000
Lag Nifty	0.834	77.625*	0.000
Stock Options Dummy	0.024	6.906*	0.000
Note: * Significance at 1% level. R^2 = 0.992			

Since the dummy coefficient of index futures is positive, it can be concluded that it has helped in the enhancement of the volatility of Nifty.

Table 7 deals with the stock futures impact on the Nifty volatility. Nifty 500 and lag Nifty are both significant at U level, hence it can be concluded that they are influencing the Nifty volatility. The coefficient of stock futures is significant at l% level, hence it can inferred that the Nifty volatility is affected by the introduction of stock futures.

Table 7 Impact of Stock Futures on Nifty Volatility

Particulars	Coefficient	t-value	Significance
Constant	0.002	0.412	0.680
Nifty 500	0.148	15.879*	0.000
Lag Nifty	0.830	77.477*	0.000
Stock Futures Dummy	0.025	7.974*	0.000
Note: * Significance at 1% level. R^2 = 0.992			

Since the dummy coefficient of stock futures is positive, it can be inferred that it has helped in the enhancement of the volatility of Nifty.

This regression analysis shows that the introduction of derivative products influences the Nifty volatility, as their coefficients have a significant, positive value. Thereby the null hypothesis should be accepted, i.e., derivative products like index futures, index options, stock options and stock futures influence the underlying spot market volatility, i.e., Nifty.

Conclusion

This study has examined the impact of index futures, index options, stock options and stock futures on the volatility of Nifty. A regression analysis has been done to examine the changes in volatility with the help of dummy variables. The coefficients of the dummy variables are positive, indicating that Nifty volatility has increased with the introduction of the above mentioned derivative products such as index futures, index options, stock options and stock futures. This may be due to the speculative operations and the Fll's active participation in the market. The market players might have been attracted to the futures and options segment, because of low transaction costs and the leverage advantage available in the market. Index volatile cash market, the fear among investors motivates them to engage in more hedging activities in the future: market, which in turn leads to volatility.

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