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Nature of Volatility Patterns of Futures and Options on Nifty Index

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Derivatives were introduced in Indian financial market to reduce volatility in the spot market. The present study attempts to study the impact of derivatives on stock market volatility. In the present study, data have been taken for Nifty Index for a period from 01-01-1996 to 05-02-2016. For analyzing the impact of introduction of derivatives on Nifty Index Volatility, we have taken proxy variable of Nifty Junior Index and Standard & Poor's 500 (S & P 500) Index returns. The data have also been classified into pre-futures (introduced on 12-06-2000) and post-futures and pre-options (introduced on 04-06-2001) and post-options period. The results show that volatility has reduced after introduction of futures and options.

Keywords: derivatives, volatility, NIFTY, futures, stock market, efficiency

Introduction

Derivatives were introduced in Indian financial market in June 2000 to make the system more efficient, reduce risk, increase flexibility, and reduce transaction cost. Spot market and derivatives market are intertwined and movement of prices and volumes of financial assets in one market affects the other. Derivatives trading helps in price discovery, improves the overall market depth, enhances market efficiency, augment market liquidity, reduces asymmetric information, and thereby reduces volatility of the cash market (Kumar et al., 1995; Antoniou et al., 1998).

Volatility is variability of prices around the mean. It is associated with uncertainty and is a synonym to risk. High-volatility is a symptom of market disruption wherein securities are not being fairly priced and capital market is not functioning properly and is also a reflection of efficiency of market.

The present study analyses the impact of derivatives trading on spot price volatility. In analyzing the relationship between spot price volatility and the impact of futures trading, three issues were addressed. First, does the existence of derivatives trading in itself have any effect on volatility? Second, and perhaps more important, whether does the existence of index derivatives trading affect volatility, what is the relationship between information and volatility following the onset of futures and options trading? Third, what is the extent to which derivatives trading influence the volatility of index ignoring the other market wide information? Since, many events have occurred in the recent past other than the introduction of derivatives trading, it is essential to distinguish the impact of volatility due to the introduction of derivatives trading from that of the others.

The rest of the paper is organized as follows: Section two reviews the literature, Section three explains

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methodology of the study, Section four analyses the results, and Section five concludes the study.

Review of Related Literature

Derivatives trading has lower transaction cost than the cash market. Thus, it helps in enhancing the availability of information flow. Frequent arrival and rapid processing of information might lead to increased volatility in spot market. The following studies discuss about the impact of introduction of derivatives on market volatility.

Pal and Chattopadhyay (2019) analysed interdependence between the Indian stock market and other domestic financial markets, namely, the foreign exchange market, bullion market, money market during the period 1996 to 2012. The results of the DCC-MV-TARCH model estimation reveal significant asymmetric volatility spillover between the domestic stock market and the bullion market.

Rastogi and Athaley (2019) studied the integration of volatility in the spot, futures, and options market. The results revealed that the volatility in the options market is not associated with volatility in the spot and futures market. But the volatility in spot and futures markets is associated with each other.

Rubani (2017) studied various aspects of growth in the financial markets since 1991. They explained how these developments lead to increased volatility in prices of goods and services and portfolio values and securities prices.

Xie and Huang (2014) studied the effect of futures on the spot market volatility by employing GARCH models. They have taken daily data of China Securities Index (CSI) 300 and CSI 300 Index futures are used in this study. The authors pointed out that volatility of the spot market has not been reduced and sensitivity to historical information increased after introduction of futures. They did not find any leverage effect before or after introducing futures.

Kalantzis and Milonas (2013) analyzed the impact of futures trading on spot price volatility with reference to spot electricity market in France and Germany. They employed VECM-GARCH models over the period of nine years from 2002 to 2011 and concluded that volatility has reduced after introduction of futures trading.

Sahu (2012) analysed the effect of equity derivatives trading on the spot market volatility in India with the employment of GARCH (1, 1) model by using daily returns of 73 companies from April 1, 1998 to March 31, 2008. The results depict that volatility has reduced after introduction of equity derivatives.

Sakthivel and Kamaiah (2011) analysed the effect on volatility by introduction of futures trading in the Indian stock market. They applied GARCH (1, 1) model on daily closing prices of Nifty. They concluded that volatility has reduced after introduction of trading of futures.

Singh and Kansal (2010) studied the impact of derivatives trading on the volatility of Indian stock market in context of NSE CNX Nifty Index. To examine this impact, they used 12 years of data (from 1995-1996 to 2008-2009). They found that derivative trading has reduced volatility and increased volume of trading.

Debasish (2009) examined the effects of the introduction of futures trading on the price volatility of the NSE Nifty spot market. He used six measures of volatility, linear regression model, and the GARCH models to investigate volatility in Nifty prices both before and after introduction of futures trading. He used weekly data of 10 years from April 1997 to April 2007 and found no significant change in volatility after the introduction of futures trading in NSE Nifty.

Katsikas (2007) examined the interaction between volatility and autocorrelation in index futures return of three major European markets. To investigate the relationship, he used autoregressive model (EAR-GARCH).

After applying this model, he found negative relationship between volatility and returns, as autocorrelation is low during volatile periods and high during calm periods in stock index futures returns of three major European markets.

Thenmozhi (2002) studied the impact of introduction of Nifty futures on the volatility of Nifty Index by using GARCH. This study shows that introduction of futures trading reduced the volatility.

Yu (2001) investigated the impact of index futures contract on the spot market volatility. Using GARCH (1, 1) MA (1) model with daily index data, they found increased volatility of stock returns in the USA, France, Japan, Australia but found no change in UK and Hong Kong markets.

Gulen and Mayhew (2000) assessed impact of introduction of equity-index futures on stock market volatility in 25 countries. They observed different effects in different countries. They found that volatility has increased after introduction of futures in Japan and United States and some other countries showed that their volatility decreased and in few of the countries they did not find any effect of futures trading on volatility of the stock market. They have employed univariate, multivariate GARCH, GJR-GARCH, EGARCH, and NGARCH models with the use of daily returns of world market portfolio.

Fung, Lo, and John (1994) studied intra-day (minute-to-minute) stock index futures for the period 1987-1988. The dependency of intraday futures price was estimated using various models, such as auto regressive fractionally integrated moving average, re-scaled range test, variance ratio test, and autocorrelation functions. It was found that futures prices do not have long-term memory and price changes in futures market are not a random walk.

Kamara and Siegel (1992) examined the influence of innovations in the rate of productive activity, unanticipated changes in the default risk premium, unanticipated changes in discount rate, unanticipated price level changes, and changes in expected inflation on the volatility for the pre- and post- futures period. The results indicate that the increase in volatility in the post-futures period cannot be completely attributed to the introduction of futures trading.

Methodology of the Study

The objective of the study is to identify the impact of introducing derivatives on spot market volatility. For the purpose of this study, we have taken Nifty Index returns from 01-01-1996 to 05-02-2016. For analyzing the impact of introduction of derivatives on Nifty Index Volatility, we have taken proxy variable of Nifty Junior Index and S & P 500 Index returns. The data have also been classified into pre-futures (introduced on 12-06-2000) and post-futures and pre-options (introduced on 04-06-2001) and post-options period. Data have been collected from National Stock Exchange (NSE) of India website. Data for S & P 500 Index have been collected from Yahoo Finance Database. After reviewing the literature, among all the three contracts data available on NSE website, we decided to collect near month contract data of futures. Near month contract data give more actual results in comparison of taking far month or middle month contract data. For measuring the impact of derivatives on volatility of Indian stock market, data have been taken up through the following steps.

- Conversion of closing prices of indices into log returns: Since most of the researchers have used closing prices of Indexes and futures market, so we have taken closing prices as data. We have used Microsoft (MS)-Excel, to convert closing prices into returns.

$$Log\ returns = 100*LN\ (P_1 - P_0)$$

$$P_1 = current\ year\ prices$$

P_0 = *previous year prices*

- Checking stationarity and normality of data using augmented Dickey-Fuller (ADF) test: An augmented Dickey-Fuller test is a test for a unit root in a time series sample.
- Lag-range Multiplier test to check whether GARCH is appropriate or not on this data: Lag-range multiplier defines the necessary conditions for the constrained non-linear optimization problems. Lag-range multiplier is a basic function for constrained optimization of differentiation function, especially for non-linear constrained optimization.
- To measure the volatility, GARCH (1, 1) model: A general dynamic linear regression model was constructed to explain spot volatility. A dummy variable was introduced to account for the onset of futures trading, proxy variables to account for general market volatility, and an interaction term. The proxy variables nominated (for which there was no futures trading), was NSE Nifty Junior. The investigation utilized the GARCH family of statistical models to investigate volatility in NSE Nifty spot prices both before and after the onset of futures trading. An econometric term developed in 1982 by Robert F. Engle, an economist and 2003 winner of the Nobel Memorial Prize for Economics to describe an approach to estimate volatility in financial markets. The standard GARCH (p, q) model introduced by Bollerslev suggests that the conditional variance of returns is a linear function of lagged conditional variance terms and past squared error terms.

Analysis and Interpretation

Table 1 shows that descriptive statistics of the sample period divided into pre-futures period (01-01-1996 to 09-06-2000) and post-futures period (12-06-2000 to 3-02-2016) as well as pre-options period (01-01-1996-03-06-2001) and post-options period (04-06-2001 to 3-02-2016).

The Nifty mean return in pre-futures period (0.0459 percent) is higher than post-futures period (0.0433 percent) but standard deviation as a measure of volatility decreases from 1.8534 percent to 1.6265 percent in the latter period.

Over all comparison of standard deviation of Nifty returns, Nifty Junior returns and S & P 500 Index returns shows that standard deviation of Nifty Junior is the highest as compared to Nifty and S & P 500 Index returns. It also shows that volatility of Index decreases after introduction of derivatives (Sahu, 2012; Singla, 2012; Sakhtivel & Kamaiah, 2011; Singh & Kansal, 2010; Pati & Rajib, 2010; Gupta & Singh, 2009) and since there are no derivatives for Nifty Junior Index, so its volatility is also high as compared to Nifty.

The Nifty mean return in the pre-options period (0.0174 percent) is lower than post-options period (0.0548 percent). The standard deviation as the measure of volatility decreases from 1.8291 percent to 1.6190 percent in the post-options period. Lower standard deviation in the post-derivatives period implies that unconditional volatility has decreased.

The highly significant values of the Jarque-Bera test statistics indicate rejection of the null hypothesis of a normal distribution of daily log return at 1 percent significance level for all samples.

Table 1

Descriptive Statistics of Pre- and Post- Derivatives Market

	Pre-futures period (01-01-1996 to12-06-2000)			Post-futures period (12-06-2000 to 31-01-2016)				Pre-options period (01-01-1996 to 03-06-2001)			Post-options period (04-06-2001 to 03-02-2016)		
	Nifty	Nifty Junior	S & P 500 Index	Nifty	Nifty Junior	S & P 500 Index	Nifty Futures	Nifty	Nifty Junior	S & P 500 Index	Nifty	Nifty Junior	S & P 500 Index
Mean returns	0.0459	0.0909	0.0802	0.0433	0.0452	0.0058	0.0432	0.0174	0.0304	0.0537	0.0548	0.0664	0.0109
Maximum	10.3637	8.0566	4.9887	16.3343	13.8254	10.9572	16.1947	10.3637	8.0566	4.9887	16.3343	13.8254	10.9572
Minimum	-8.8405	-9.0327	-7.1127	-15.9810	-19.4901	-9.4695	-17.5194	-8.8405	-9.0327	-7.1127	-15.9810	-19.4901	-9.4695
Std. dev.	1.8534	2.0863	1.1728	1.6265	1.8237	1.3254	1.7123	1.8291	2.1306	1.2081	1.6190	1.7793	1.3238
Skewness	0.2096	-0.1762	-0.3018	-0.7067	-0.9490	-0.1411	-0.8867	0.1219	-0.2706	-0.2151	-0.7333	-0.9884	-0.1602
Kurtosis	5.9810	4.9972	6.5675	15.0894	12.2517	11.8558	16.3048	5.7650	4.6704	5.9202	16.1820	13.8134	12.5178
Jarque-Bera	401.7546	182.3521	580.3793	20376.8300	12268.1000	10797.6100	24779.9000	420.2137	168.1536	475.2030	22399.9000	15386.7700	11548.1000
robability	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Sum	48.8294	96.7365	85.3204	143.0565	149.1093	19.1751	142.6426	22.8129	39.8277	70.3509	167.5794	202.8948	33.2740
Sum Sq. dev.	3651.4410	4626.6970	1462.0440	8729.8480	10974.9300	5797.3670	9675.5480	4375.9120	5937.6270	1908.9550	8007.5070	9671.5240	5353.8210
Observations	1064	1064	1064	3801	3801	3801	3801	1309	1309	1309	3556	3556	3556

The Nifty returns are positively skewed (0.2096) in the pre-futures period which shows that there are higher chances of generating lower returns. But Nifty returns are negatively skewed in the post-futures period (-0.7067), pre-options period (0.1219) and post-options period (-0.7333) which shows that there is higher probability of earning returns greater than the mean. The value of kurtosis is greater than three for pre-futures period (5.9810), post-futures period (15.0894), pre-options period (5.7650) and post-options period (16.1820), so returns are leptokurtic. The analysis also reveal that since kurtosis is higher in post-futures period and post-options period than in pre-futures and pre-options period which implies that the probability of extreme events has increased in post-derivatives period.

Even though there are no derivative contracts traded on Nifty Junior Index, it is necessary to examine its risk return pattern before and after introduction of futures and options. The mean returns of Nifty Junior Index have declined from 0.0909 percent in pre-futures period to 0.0452 percent in post-futures period whereas the return has increased from 0.0304 percent in pre-options period to 0.0664 percent in post-options period. The standard deviation has also declined from 2.0863 percent in pre-futures period to 1.8237 percent in post-futures period also in case of pre-options period (2.1306 percent) to post-options period (1.7793 percent) which shows that volatility has reduced in post-derivatives period.

In case of S & P 500 Index, prior to introduction of futures, the mean return was 0.0802 percent and standard deviation was 1.1728 percent and after introduction of futures contracts, mean returns was 0.0058 percent and standard deviation increased to 1.3254 percent. The S & P 500 Index mean returns have reduced to 0.0109 percent post-options introduction from (0.0537 percent) pre-options period. The standard deviation has also increased to 1.3238 percent post-options from 1.2081 percent in pre-options period.

Test of Stationarity and ARCH Test

The returns data for all the series have to be tested for stationarity. For this, unit root hypothesis testing has been done.

Table 2 shows results of augmented Dickey-Fuller test where unit root hypothesis is that the return series is non-stationary. ADF unit root test is sensitive towards the lag length included in the regression equation.

So, lag length is chosen on the Schwarz Information Criterion (SIC) and ADF is applied with intercept and trend. The return series of Nifty, Nifty Junior, S & P 500 Index, Nifty futures have been analyzed for unit root for full period, pre-futures period, post-futures period, pre-options period, and post-options period separately. All the returns series are stationary at its level and they are significant at 1 percent level. These results are also confirmed with Sahu (2012), Girish (2012), and Gahlot, Datta, and Kapil (2010).

To analyze whether the nature of volatility remains the same after the introduction the futures and options, we divide the sample period into pre-futures and post-futures period and then separately run GARCH (1, 1) estimation for each period.

GARCH estimates before and after introduction of futures are given in Table 3. A higher GARCH coefficient in the post-futures period shows that prices respond to old news more effectively after introduction of futures. The ARCH and GARCH coefficient are statistically significant at one percent level. After introduction of futures, market volatility is determined by recent information. Nifty Junior returns and S & P 500 Index returns are also statistically significant at one percent level.

Table 4 shows GARCH estimates before and after introduction of options. The ARCH (1) coefficient and GARCH (1) coefficient has increased in the post-options period. The highly significant values of ARCH and

GARCH respect that the effect of information is persistent over time, i.e., a shock to today's volatility due to some information today has an effect on tomorrow`s volatility as well as volatility in subsequent periods. Nifty Junior Index and S & P 500 Index returns are significant at 1 percent level of significance.

To check the effect of introduction of futures and options alone GARCH estimates are shown in Table 5. ARCH and GARCH coefficient are highly significant at one percent level. The ARCH component is the coefficient of square of the error term, captures the effect of recent news is 0.1250 after introduction of options, 0.1285 after introduction of futures and has been 0.1276 after introduction of futures & options. The GARCH component represents the coefficient of lagged variance term, and captures the old news. The GARCH coefficient has increased after futures and options introduction to 0.8154 as compared to 0.8196 (post-options) and 0.8153 (post-futures). The coefficient of futures and options dummy are negative which shows that volatility has reduced after introduction of futures and options.

Table 2

Augmented Dickey-Fuller Test Statistic

	Return series	*t*-Statistic	Prob.*	Lag length
Full period	Nifty	-47.4904	0	1
	Nifty Junior	-57.69079	0	0
	S & P 500 Index	-50.99196	0	1
	Nifty Futures	-56.86959	0	0
Pre-futures period	Nifty	-31.92719	0	0
	Nifty Junior	-29.16878	0	0
	S & P 500 Index	-32.68657	0	0
Post-futures period	Nifty	-41.44654	0	1
	Nifty Junior	-49.60808	0	0
	S & P 500 Index	-45.04275	0	1
	Nifty Futures	-56.86959	0	0
Pre-options period	Nifty	-34.72482	0	0
	Nifty Junior	-32.25574	0	0
	S & P 500 Index	-36.49941	0	0
Post-options period	Nifty	-39.95225	0	1
	Nifty Junior	-47.62895	0	0
	S & P 500 Index	-43.19302	0	1

Notes. Source: MacKinnon (1996); * one-sided *p*-values; exogenous: constant, linear trend; SC: Schwarz information criterion.

Table 3

GARCH Estimates for Nifty Index Before and After Introduction of Futures

	Pre-futures		Post-futures	
	Coefficient	*z*-Statistic	Coefficient	*z*-Statistic
Constant	0.5276*	3.8643	0.0968*	11.5597
ARCH (1)	0.0653*	4.0509	0.1041*	14.9943
GARCH(1)	0.7884*	16.7086	0.8599*	96.8234
Nifty Junior returns	-0.0987*	-2.8236	-0.0717*	-11.3087
S & P 500 Index returns	-0.2443*	-4.2499	-0.1097*	-10.0559

Note. * Significant at one per cent level.

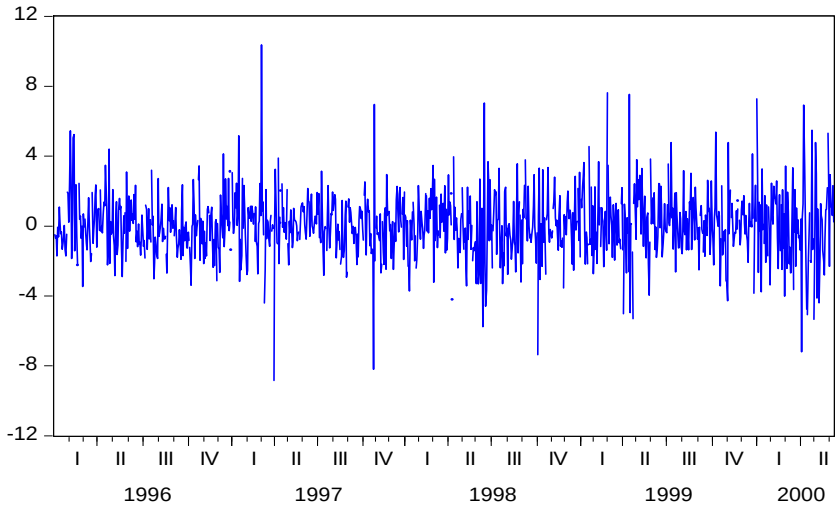
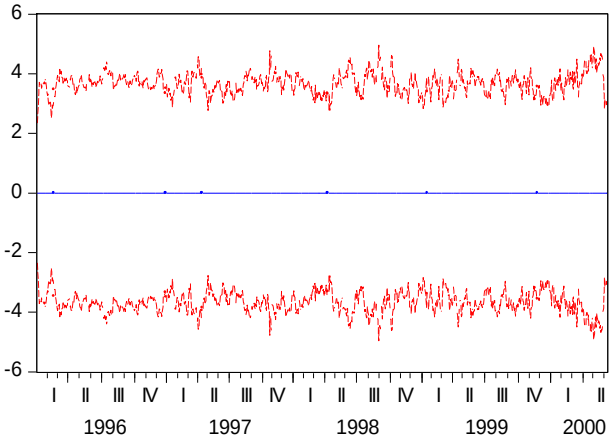


Figure 1. Nifty Returns before introduction of derivatives.



Forecast: NIFTYRETURF	
Actual: NIFTYRETURNS	
Forecast sample: 1/02/1996 6/09/2000	
Adjusted sample: 1/04/1996 6/09/2000	
Included observations: 1063	
Root Mean Squared Error	1.853892
Mean Absolute Error	1.358962
Mean Abs. Percent Error	99.90593
Theil Inequality Coefficient	1.000000
Bias Proportion	0.000626
Variance Proportion	NA
Covariance Proportion	NA

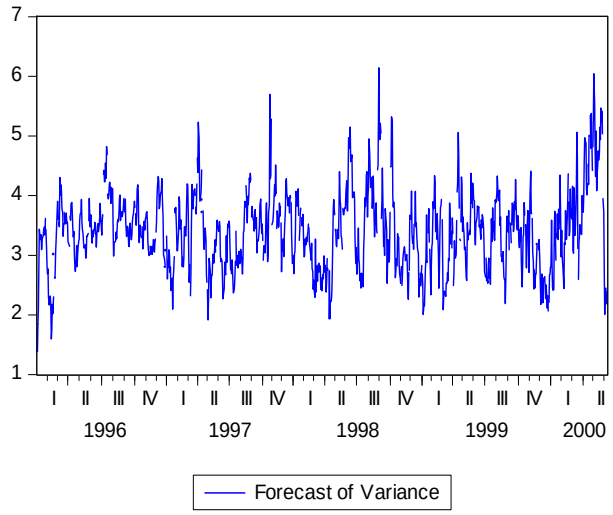


Figure 2. Forecast of variance AR (1)-GARCH (1, 1) model before introduction of futures.

Table 4

GARCH Estimates for Nifty Index Before and After Introduction of Options

	Pre-options		Post-options	
	Coefficient	*z*-Statistic	Coefficient	*z*-Statistic
Constant	0.3719*	4.3120	0.0893*	11.2846
ARCH (1)	0.0700*	5.0745	0.1022*	14.8522
GARCH(1)	0.8228*	25.7433	0.8653*	99.9178
Nifty Junior returns	-0.0293*	-1.8929	-0.0699*	-11.0967
S & P 500 Index Returns	-0.2195*	-4.7462	-0.1049*	-9.6042

Note. * Significant at one per cent level.

Table 5

Impact of Introduction of Nifty Futures and Options on Market Index (GARCH 1, 1)

	Nifty options dummy		Nifty futures dummy		Combined effect of futures and options	
Variable	Coefficient	*z*-Statistic	Coefficient	*z*-Statistic	Coefficient	*z*-Statistic
Mean equation						
C	0.1234*	5.4226	0.1240*	5.4687	0.1238*	5.4446
AR(1)	0.0760*	4.3485	0.0766*	4.3776	0.0765*	4.3720
Variance equation						
Constant	0.2476*	11.3698	0.2743*	11.1851	0.2752*	11.2224
ARCH 1	0.1250*	20.7904	0.1285*	20.4766	0.1276*	20.4542
GARCH 1	0.8196*	97.8860	0.8153*	93.2603	0.8154*	93.2670
DUMMY_Options	-0.1112*	-6.7577			-0.1004*	-2.7242
DUMMY_Futures			-0.1330*	-7.0402	-0.0345*	-1.0440

Note. * Significant at one per cent level.

Conclusion

A higher GARCH coefficient in the post-futures period shows that prices respond to old news more effectively after introduction of futures. The ARCH and GARCH coefficient are statistically significant at one percent level. After introduction of futures, market volatility is determined by recent information. The ARCH (1) coefficient and GARCH (1) coefficient has increased in the post-options period. The highly significant values of ARCH and GARCH reflect that the effect of information is persistent over time, i.e., a shock to today's volatility due to some information today has an effect on tomorrow's volatility as well as volatility in subsequent periods. The ARCH component has increased after introduction of futures and options which shows the effect of recent news. The GARCH coefficient has also increased which captures the old news. The coefficient of futures and options dummy are negative which shows that volatility has reduced after introduction of futures and options.

References

Antoniou, Antonios & Holmes, P & Priestley, Richard. (1998). The effects of stock index futures trading on stock index volatility: an analysis of the asymmetric response of volatility to news. *Journal of Futures Markets*. 18. 151-166.

Debasish, S. S. (2009). An econometric analysis of the lead-lag relationship between India's NSE Nifty and its derivative contracts. *The Journal of Risk Finance, 10*(4), 350-364.

Fung, H. G., Lo, W. C., & John, E. P. (1994). Examining the dependency in intra-day stock index futures. *The Journal of Futures Markets, 14*(4), 405-419.

Gahlot, R., Datta, S. K., & Kapil, S. (2010). Impact of derivative trading on stock market volatility in India: A study of S & P CNX Nifty. *Eurasian Journal of Business and Economics, 3*(6), 139-149.

Girish, G. P. (2012). GARCH model to study the effect of introduction of derivative trading on stock market volatility of national stock exchange (NSE) India. *JM International Journal of finance Research, 2*(3), 61-70.

Gulen, H., & Mayhew, S. (2000). Stock index futures trading and volatility in international equity markets. *The Journal of Futures Markets, 20*(7), 661-685.

Gupta, K., & Singh, B. (2009). Investigating the impact of equity futures and options trading on Indian cash market volatility. *Indian Management Studies Journal, 13*, 1-11.

Kalantzis, G. F., & Milonas, N. T. (2013). Analyzing the impact of futures trading on spot price volatility: Evidence from the spot electricity market in France and Germany. *Energy Economics, 36*, 454-463.

Kamara, A., Miller, T., & Siegel, A. (1992). The effects of futures trading on the stability of the S & P 500 returns. *Journal of Futures Markets, 12*, 645-658.

Katsikas, E. (2007). Volatility and autocorrelation in European futures market. *Emerald Journal of Managerial Finance, 33*(3), 236-240.

Kumar, R. T. ,Balaji, K. N. and Prabu, K. (2011). An empirical study on traders perception on options trading with special reference to the products in the national stock exchange.

MacKinnon, J. (1996). Numerical distribution functions for unit root and cointegration tests. *Journal of Applied Econometrics, 11*(6), 601-618.

Pal, S., & Chattopadhyay, A. (2019). Indian stock market volatility: A study of inter-linkages and spillover effects. *Journal of Emerging Market Finance, 18*(2). Retrieved from https://journals.sagepub.com/doi/abs/10.1177/0972652719846321

Pati, P. C., & Rajib, P. (2010). Volatility and trading volume in an emerging futures market. *Journal of Risk and Finance, 11*(3), 296-309.

Rastogi, S., & Athaley, C. (2019). Volatility integration in spot, futures and options markets: A regulatory perspective. *Journal of Risk and Financial Management, 12*(2), 98.

Rubani, M. (2017). A study of derivative market in India. *International Journal of Business Administration and Management, 7*(1). Retrieved from https://www.ripublication.com/ijbamspl17/ijbamv7n1spl_17.pdf

Sahu, D. (2012). Effect of equity derivatives trading on spot market volatility in India—An empirical exploration. *European Journal of Business and Management, 4*(11). Retrieved from https://www.iiste.org/Journals/index.php/EJBM/article/view/2460

Sakthivel, P., & Kamaiah, B. (2011). The effect of derivative trading on volatility of underlying stocks: Evidence from the NSE. *Indian Journal of Economics and Business, 10*(4), 511-531.

Singh, G., & Kansal, S. (2010). Impact of derivatives trading on stock market volatility during pre and post F & O period: A case study of NSE. Retrieved from https://mzu.edu.in/wp-content/uploads/2019/09/Vol_1_Issue_1.pdf

Singla, R. (2012). Effects of derivatives on the volatility in the Indian stock market. *Abhinav Journal, National Monthly Journal of Research in Commerce and Management, 1*(4), 78-82.

Sakthivel, P. (2011). The effect of derivative trading on volatility of underlying stocks: evidence from the NSE. *Indian journal of economics & business, 10*(4).

Thenmozhi, M. (2002). Futures trading, information and spot prices volatility of NSE-50 index futures contract. *NSE Newsletter, NSE Research Initiative, Paper No. 18.* Retrieved from http://www.nseindia.com/content/ research/paper59.pdf/

Xie, S., & Huang, J. (2014). The impact of index futures on spot market volatility in China emerging markets finance & trade. *Emerging Markets Finance and Trade, 50*(s1), 167-177.

Yu, S. W. (2001). Index futures trading and spot price volatility. *Applied Economics Letters, 8*, 183-186.