Effect of Stock Index Futures Trading on Volatility and Performance of Underlying Market: The case of India

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ABSTRACT

The study pertains to analyse the effect of stock index futures trading on volatility and performance of underlying market. The four stock index futures of National Stock Exchange (NSE) are selected for the study. The study used GARCH (1,1) model to test the effect of futures trading. Overall the study found that the introduction of stock index futures doesn't have a significant effect on the performance of all the selected underlying stock indices but there is a significant difference in volatility of all the selected underlying market before and after introduction of stock index futures.

Keywords: Stock Index Futures, Volatility, GARCH (1,1) model and National Stock Exchange.

INTRODUCTION:

The National Stock Exchange (NSE) of India has continued as leading stock exchange among the major global stock exchanges. World Federation of Exchange (WFE) survey reveals that NSE India, ranked top two among the world stock exchanges for number of single stock futures contracts traded globally during the year 2016. Basically the derivatives were introduced in India to reduce the volatility in underlying assets. Many researchers and regulators made an attempt to understand whether the introduction of futures will reduce the volatility of spot markets assets. When theoretical futures price (Cost of Carry Model) exceeds the actual futures price then arbitragers take short position in futures market and long position in spot market. Primarily these mechanism create prices differences in futures and spot markets. M.Thenmozhi (2002) clearly stated that this process raises question of introduction stock and index futures effect on volatility of underlying assets. Volatility places a very vital role in global capital market. The market participant's investment decisions are mainly depends on the market volatility. The researchers and academicians are not in consensus decision whether futures trading will decrease or increase the market volatility.

LITERATURE REVIEW:

Manasa and Suresh (2018) studied Indian stock market and found decrease in the volatility of underlying banking stocks after introduction of Bank nifty index futures. Yilgor and Charbelle (2016) found that derivatives trading reduce the spot market volatility and observed no relationship between spot market volume and derivatives trading. Singh and Tripathi, (2016) used GARCH model and found that the volatility of underlying stock market has reduced after introduction of stock index futures contract. Manmohan and Mishra (2011) conducted a study to observethe exchanging volume headway of neighbouring month index prospects is the most exceptional learn for volatility the prospects plug in India. Ruchika et al (2010)observed that introduction of futures does not influence the volatility of Bank Nifty and also individual banking stocks other than Axis, IDBI and ICICI banks. Sathya and Debasish(2009)found that no changes in the volatility after the introduction of Futures Trading.Tripathy et al (2009) showed fall in Spot and hike in market efficiency after introduction of derivatives on the Spot Market due to increased impact of activities happening in the economy.Alberg et al. (2008) studied an empirical study using GARCH model and shown overall estimation of

measuring conditional variance has improved. Vipul(2006) has studied the fluctuations in volatility in the Indian Stock Market after the introducing the derivatives and it marks with the reduction in volatility of the spot market in the post introduction of derivatives. Nagaraj and Kiran (2004) shown there is no truly enormous (or basic) capacity in mean returns and intra-day volatility of the market list. Hetamsaria and Deb (2004) found reduction in spot market volatility after introduction of futures index and suggested that the domestic market factors had a significant impact, in determining the volatility of the Nifty index. Nath (2003) concluded that the volatility of Nifty index had fallen in the post future period. The GARCH model results show that there is no structural change in the conditional volatility of the component stocks after such introduction of derivatives. Shenbagaraman (2003) has investigated the influence of the introduction of derivatives trading on cash market and it displays the result of no change in volatility of underlying asset before and after introduction of derivative trading. Bandivadekar and Ghosh (2003) found decrease in the spot market volatility due to futures trading. Rahman (2001) found that the spot join volatility bears a positive relationship with sudden exchanging volume and open importance for futures markets. The results show that there is no structural change in the conditional volatility of the component stocks after such introduction of derivatives.Thenmozhi (2002), in her study has used Ordinary Least Square Multiple Regression Technique and the variance ratio test to study the influence of the introduction of Nifty index futures on the Nifty index volatility in the Indian markets. The author found reduction in spot market volatility. Guien and Mayhew (2000) found more volatility when open interest in stock index futures is high. Min and Najand (1999) found that trading volume influences volatility changes in spot and futures market. Bhari and Malliaries (1998) foundthat currency price volatility causes by the unexpected change in the currency trading volume.

METHODS:

OBJECTIVE OF THE STUDY:
The objective of the study is to analyse the impact of introduction of index futures on the volatility and performance of the underlying stock indices of NSE, India.

HYPOTHESIS:
H0a= The return series of selected underlying stock indices have unit root before and after introduction of respective stock index futures.
H0b= There is no significant difference in the performance (mean return) of the selected underlying index pre and post introduction of index futures.
H0c= There is no significant difference in the volatility of the selected underlying index pre and post introduction of index futures.

SELECTION OF INDICES:
The daily closing prices have been collected from 4 stock indices (NIFTY 50, NIFTY Midcap 50, NIFTY Bank, and NIFTY IT). The stock indices are selected based on their availability of trading in the stock exchange. The study selected all the indices which were introduced on or before 2007. Table (1) shows the date of introduction of respective stock indices.

Table 1: Shows date of introduction of four stock index futures.

Index Futures	Date of Introduction
Nifty 50	June 12, 2000
Nifty IT	August 29, 2003
Nifty Bank	June 13, 2005
Nifty Midcap 50	October 5, 2007

Source: https://www.nseindia.com

Table 1 shows stock index futures and their introduction dates in National Stock Exchange (NSE). The study considered four stock index futures and its impact on underlying stock market.

METHODS OF DATA COLLECTION:
The study collected the daily closing prices of four underlying stock index (Nifty 50, Nifty Midcap 50, Nifty Bank and Nifty IT) of NSE. The data has been collected two years prior and post to respective index futures

introduction date. The daily closing prices of four underlying stock index (Nifty 50, Nifty Midcap 50, Nifty Bank and Nifty IT) are collected from National Stock Exchange (NSE) website.

RESEARCH TOOLS:

The percentage return of selected index calculated using the following formula.

$Ri = ln\left[\dfrac{P1}{P0}\right] * 100$, Where, P1=today's closing price of the respective index, P0=yesterday's closing price of the respective index, ln=natural logarithm.

Augmented Dickey Fuller (ADF) test- The study used ADF test to test whether the return series of the selected series is stationary or non-stationary.

The GARCH (Generalized Auto-Regressive Conditional Hetero-skedasticity):- GARCH (1, 1) model is used to test if the introduction of stock index futures had any effect on the performance and the volatility of the respected stock indices before and after introduction of stock index futures.

Generalized Autoregressive Conditional Heteroscedasticity (GARCH) model, originally developed and proposed by Bollerslev the GARCH (1, 1) model, which can be written as:

$\sigma^2_t = \alpha_0 + \alpha_1 u^2_{t-1} + \alpha_2 \sigma^2_{t-1}$

Where $\alpha_0 > 0$, $\alpha_1 > 0$, $\alpha_2 > 0$, $\alpha_1 + \alpha_2 < 1$,

which explains that the conditional variance of *u* at time *t*depends not only on the squared residual term in the previous time period (t-1) as in ARCH(1) model but also on its conditional variance in the previous time period.

RESULTS AND DISCUSSION:

Table 2: Descriptive statistics of selected four underlying stock indices.

	Nifty 50		Nifty Midcap 50		Nifty Bank		Nifty IT	
	Before	**After**	**Before**	**After**	**Before**	**After**	**Before**	**After**
Mean	0.0823	-0.0543	-0.0279	0.1048	0.1700	0.1053	-0.0187	-0.3183
Median	0.1157	0.0143	0.1284	0.2989	0.1253	0.1349	0.0014	0.2108
Maximum	7.5393	5.9960	13.0969	7.3930	11.4014	6.8761	10.7367	11.8673
Minimum	-7.7098	-6.3095	-16.2046	-8.1169	-15.1381	-7.38705	-22.1257	-235.827
Std. Dev.	1.9737	1.5287	2.8399	1.7400	2.1531	1.8358	3.0120	10.7339
Skewness	-0.0530	-0.4718	-0.4345	-0.9467	-1.04413	-0.29441	-0.85708	-21.2264
Kurtosis	4.6688	4.9391	6.8504	6.8460	12.421	4.5800	10.3359	466.2726
Sum	41.2630	-27.229	-13.6466	51.1440	84.5262	52.3663	-9.3302	-158.841
Observations	501	501	488	488	497	497	499	499

Source: Researcher's own calculation

Table (2) clearly shows thedescriptive statistics of selected four underlying stock index futures (Nifty 50, Nifty Midcap 50, Nifty Bank and Nifty IT) before and after introduction of respective index futures. Table (2) shows the mean return of Nifty 50, Nifty bank and Nifty IT has been decreased after introduction of respective index futures. But the mean return of Nifty midcap 50 index has been increased after introduction of respective index futures. Similarly, the mean volatility (standard deviation) of Nifty 50, Nifty bank and Nifty Midcap 50 has been decreased after introduction of respective index futures. But the volatility has been increased after introduction of futures in case of Nifty IT index. Finally, the table (2) clearly shows the standard deviation of Nifty 50, Nifty Midcap 50, Bank Nifty has come down 29%, 38.72%, 14.37% respectively after introduction of stock index futures.

Table 3: Summary of the Unit Root Test Results

At Level						
Underlying Stock Index	**Index Futures Introduction Date**	**Before and After the introduction date**	**N**	**t statistic**	**P value**	**Conclusion**
NIFTY 50	12-Jun-00	Before	501	-21.6332***	0	I(0)
		After	501	-8.5617***	0	I(0)
NIFTY Midcap 50	5-Oct-07	Before	488	-18.7193***	0	I(0)
		After	488	-6.386***	0	I(0)

At Level						
Underlying Stock Index	**Index Futures Introduction Date**	**Before and After the introduction date**	**N**	**t statistic**	**P value**	**Conclusion**
NIFTY Bank	13-Jun-05	Before	497	-6.1557***	0	I(0)
		After	497	-15.6521***	0	I(0)
NIFTY IT	29-Aug-03	Before	499	-6.7251***	0	I(0)
		After	499	-22.4586***	0	I(0)

Note: *** indicates significant at 1% level(Source: Researcher's own calculation)

Table (3) shows the ADF test results for all the underlying index return series before and after introduction of respective index futures. The p values in all the cases are clearly indicating that it's significant at 1% level. Thus, the underlying index return series before and after introduction of respective index futures are stationary at level.

Table 4: shows the Results ofGARCH (1, 1) Model test on NIFTY 50 (Mean Returns)

Variable (Var)	Coefficient (β)	Std. Error (SE)	t-Statistic	Prob (p)
@YEAR>2000	-0.0391	0.0936	-0.4179	0.6761
R^2	0.000065	Mean Depend Var(MDV)		0.0186
Adj R^2	0.000065	S.D. Depend Var (SDDV)		1.7796
S.E R	1.7796	Akaike Info Crite (AIC)		3.9916
Sum Squ Err(SRE)	3173.322	Schwarz Crit (SC)		3.9965
Log Likelihood (LL)	-2000.815	Hann-QuinCriter(HQC).		3.9935
DW stat (DW)	1.8654			

Note: *** indicates significant at 1% level (Source: Researcher's own calculation)

The table (4) shows the test results of Nifty 50 index. The P value indicates it's insignificant. Thus, unable to reject the null hypothesis (Hypothesis 2) which states that there is no significant difference in the performance (mean return) of the selected underlying index before and after the introduction of index futures (Year 2000).

Table 5: shows the results of GARCH (1, 1) model test on NIFTY 50 index (StandardDeviation)

GARCH = B(1) + B(2) RESID(-1)^2 + B(3) GARCH(-1) + B(4) @YEAR>2000				
Var	**β**	**SE**	**t**	**p**
C	0.54199	0.132023	4.1052 ***	0.0000
RESID(-1)^2	0.13341	0.025513	5.2289 ***	0.0000
GARCH(-1)	0.72288	0.051349	14.0776***	0.0000
@YEAR>2000	-0.2662	0.080138	-3.3216 ***	0.0009
R^2	-0.0001	MDV		0.01863
Adj R^2	0.00089	SDDV		1.77966
S.E R	1.77887	AIC		3.8723
SRE	3173.88	SC		3.89189
LL	-1938	HQC		3.87974
DW	1.86519			

Note: *** indicates significant at 1% level (Source: Researcher's own calculation)

Table (5) shows the results of GARCH (1, 1) model test on standard deviation of underlying Nifty 50 index before and after introduction of Nifty index Futures (Year 2000). The p value of coefficient @YEAR>2000 clearly indicating that it's significant at 1% level. Thus, reject the null hypothesis (Hypothesis 3). Thus, it can be stated that, the volatility (standard deviation) of underlying Nifty 50 index is not remain same or equal before and after introduction of Nifty 50 index futures (Year 2000).

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Table 6: Results of GARCH (1, 1) model test on NIFTY Midcap 50 (Mean Returns)

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Var	β	SE	t	p
@YEAR>2007	-0.097629	0.113245	-0.862106	0.3888
R^2	0.000295	MDV		0.050653
Adj R^2	0.000295	SDDV		2.345904
S.E R	2.345559	AIC		4.543947
SRE	5369.606	SC		4.548947
LL	-2218.718	HQC		4.54585
DW	1.701104			

Note: *** indicates significant at 1% level (Source: Researcher's own calculation)

Table (6) shows the results of GARCH (1, 1) model test on standard deviation of underlying Nifty 50 index before and after introduction of Nifty index Futures (Year 2000). The p value of coefficient @YEAR>2000 clearly indicating that it's significant at 1% level. Thus, reject the null hypothesis (Hypothesis 3). Thus, it can be stated that, the volatility (standard deviation) of underlying Nifty 50 index is not remain same or equal before and after introduction of Nifty 50 index futures (Year 2000).

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Table 7: Shows the results of GARCH (1, 1) model test on NIFTY Midcap index (Standard Deviation)

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GARCH = B(1) + B(2)*RESID(-1)^2 + B(3)*GARCH(-1) + B(4) *@YEAR>2007				
Var	β	SE	z	p
C	0.2526	0.0578	4.3693***	0.0000
RESID(-1)^2	0.1970	0.0205	9.6274***	0.0000
GARCH(-1)	0.7214	0.0294	24.5421***	0.0000
@YEAR>2007	0.5690	0.1258	4.5223***	0.0000
R^2	-0.0005	MDV		0.0507
Adj R^2	0.0006	SDDV		2.3459
S.E R	2.3453	AIC		4.2251
SRE	5373.6950	SC		4.2451
LL	-2059.9800	HQC		4.2327
DW	1.6998			

Note: *** indicates significant at 1% level (Source: Researcher's own calculation)

Table (7) shows the results of GARCH (1, 1) model test on standard deviation of underlying Nifty 50 index pre and post introduction of Nifty index Futures(Year 2000) . The p value of coefficient @YEAR>2000 clearly indicating that it's significant at 1% level. Thus, reject the null hypothesis (Hypothesis 3). Thus, it can be stated that, the volatility (standard deviation) of underlying Nifty 50 index is not remain same or equal pre and post introduction of Nifty 50 index futures (Year 2000).

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Table 8: Results of GARCH (1,1) model test on NIFTY Bank (Mean Return)

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Var	β	SE	t	p
@YEAR>2005	0.084901	0.105513	0.804652	0.4212
R^2	-0.003839	MDV		0.13368
Adj R^2	-0.003839	SDDV		1.99536
S.E R	1.999184	AIC		4.22436
SRE	3972.754	SC		4.22929
LL	-2100.619	HQC		4.22623
DW	1.676876			

Note: *** indicates significant at 1% level (Source: Researcher's own calculation)

The table (8) shows the test results of Nifty 50 index. The P value indicates it's insignificant. Thus, unable to reject the null hypothesis (Hypothesis 2) which states that there is no significant difference in the performance (mean return) of the selected underlying index pre and post introduction of index futures (Year 2000).

Table 9: Results of GARCH (1,1) model test on NIFTY Bank (Standard Deviation)

GARCH = B(1) + B(2)*RESID(-1)^2 + B(3)*GARCH(-1) + B(4)				
Var	β	SE	z	p
C	0.4402	0.1053	4.1817***	0.0000
RESID(-1)^2	0.1493	0.0242	6.1722***	0.0000
GARCH(-1)	0.7274	0.0433	16.8061***	0.0000
@YEAR>2005	0.0886	0.0612	1.4478***	0.1477
R^2	-0.0045	MDV		0.133682
Adj R^2	-0.0035	SDDV		1.995357
S.E R	1.9988	AIC		4.079929
SRE	3975.3420	SC		4.099638
LL	-2025.7650	HQC		4.087422
DW	1.6757			

Note: *** indicates significant at 1% level (Source: Researcher's own calculation)

Table (9) shows the results of GARCH (1, 1) model test on standard deviation of underlying Nifty 50 index pre and post introduction of Nifty index Futures (Year 2000). The p value of coefficient @YEAR>2000 clearly indicating that it's significant at 1% level. Thus, reject the null hypothesis (Hypothesis 3). Thus, it can be stated that, the volatility (standard deviation) of underlying Nifty 50 index is not remain same or equal pre and post introduction of Nifty 50 index futures (Year 2000).

Table 10: Results of GARCH (1,1) model test on NIFTY IT (Mean Return)

Var	β	SE	t	p
@YEAR>2003	-0.4858	0.38327	-1.267467	0.2053
R^2	0.00114	MDV		-0.167121
Adj R^2	0.00114	SDDV		7.849765
S.E R	7.84528	AIC		6.958694
SRE	61856.1	SC		6.963579
LL	-3499.2	HQC		6.96055
DW	2.01379			

Note: *** indicates significant at 1% level (Source: Researcher's own calculation)

The table (10) shows the test results of Nifty 50 index. The P value indicates it's insignificant. Thus, unable to reject the null hypothesis (Hypothesis 2) which states that there is no significant difference in the performance (mean return) of the selected underlying index pre and post introduction of index futures (Year 2000).

Table 11: Shows Results of GARCH (1,1) model test on CNX IT (Standard Deviation)

GARCH = B(1) + B(2)*RESID(-1)^2 + B(3)*GARCH(-1) + B(4)				
Var	β	SE	z	p
C	0.2777	0.0731	3.7965***	0.0001
RESID(-1)^2	0.0025	0.0002	-11.9723***	0.0000
GARCH(-1)	0.9653	0.0093	103.7697***	0.0000
@YEAR>2003	4.9265	1.1836	4.1625***	0.0000
R^2	-0.0005	MDV		0.1671
Adj R^2	0.0005	SDDV		7.8498
S.E R	7.8476	AIC		6.0526
SRE	61955.0000	SC		6.0722
LL	-3040.4760	HQC		6.0601
DW	2.0105			

Note: *** indicates significant at 1% level (Source: Researcher's own calculation)

Table (11) shows the results of GARCH (1, 1) model test on standard deviation of underlying Nifty 50 index pre and post introduction of Nifty index Futures (Year 2000). The p value of coefficient @YEAR>2000 clearly indicating that it's significant at 1% level. Thus, reject the null hypothesis (Hypothesis 3). Thus, it can be stated that, the volatility (standard deviation) of underlying Nifty 50 index is not remain same or equal before and after introduction of Nifty 50 index futures (Year 2000).

CONCLUSION:

The study has attempted to examine the effect of the introduction of index futures and its subsequent effect on the stock market volatility and performance. From the results of the GARCH (1, 1) model it is found that the introduction of stock index futures doesn't have a significant effect on the performance of all the selected underlying stock indices but there is a significant difference in volatilityof all the selected underlying market pre and post introduction of stock index futures. The results have shown that introduction of futures has resulted in a reduction in the spot market volatility. Further, the study suggests that market participants can have a close look on the behaviour of futures trading to predict stock market volatility. It is essential that the investors are aware of the introduction of futures on underlying stock exchanges and accordingly make wise decisions while estimating the volatility of the stock.

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