

EFFECT OF DERIVATIVE ON THE VOLATILITY OF INDIAN CAPITAL MARKET

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ABSTRACT

The aim of this study is to assess the impact of introducing index and stock futures and options contracts on the volatility of the underlying stock index in India. So many studies has been made to check the effects of futures and options listing on the underlying cash market volatility in the developed and developing markets. The empirical evidence is mixed and most suggest that the introduction of derivatives do not destabilize the underlying market. Previous studies also show that the introduction of derivative contracts improves liquidity and reduction of informational asymmetries in the market.

To check the error variance in the return series, a GARCH (1,1) model is used by incorporating future and options in the conditional variance equation. We find that there is no stabilization or destabilization effect on market volatility. The post-derivatives period shows that the sensitivity of the index returns to market returns and any day-of-the-week effects have disappeared. Also we found that there is change in the volatility patterns during the post derivative period.

Key words: *Indian capital market, Volatility*

JEL Code: G17

I. INTRODUCTION

The modelling of asset returns volatility continues to be one of the key areas of financial research as it provides substantial information on the risk patterns involved in investment and transaction processes. A number of works have been undertaken in this area. Given the fact that stock market shows high levels of price volatility, which lead to unpredictable outcomes, it is important to examine the dynamics of volatility. The derivatives market was launched mainly with the twin objectives to transfer risk and to increase liquidity, thereby ensuring better market efficiency. The examination of how far these objectives have materialized is important both theoretically and practically.

The derivatives were launched mainly with the twin objective of risk transfer and to increase liquidity thereby ensuring better market efficiency. In India, derivatives trading started in June 2000 with introduction of Index future followed by index options in June 2001, and options and futures on individual securities in July 2001 and November 2001, respectively. Since inception, National Stock Exchange of India (NSE) established itself as the

sole market leader in this segment in the country and during 2008-09, it accounted for 95 % of the market share (NSE, 20012). The total turnover on the F&O Segment was Rs. 31533003.96 crore during 20012-13. The average daily turnover during 20012-13 was Rs. 126638.57 crore.

In this paper, we attempt to study the volatility implications of the introduction of derivatives on the cash market. Through this study, we seek evidence regarding whether the listing of futures and options lead to any significant change in the volatility of the cash market in India. We have selected S&P CNX Nifty Index along with two stocks to which the first derivatives contract was introduced by the NSE in India. In this study we have added option contract along with future contract.

II. REVIEW OF LITERATURE

An academic study on the volatility due to future and option in Indian Capital Market is very important and pertinent in the context of its structural existence. Before taking up such exercise, an attempt is made in this section to present a review of the available studies in the area of volatility in capital market and related area of recent origin in India and abroad. The research studies conducted in the field of volatility in India and abroad relate mostly to institutional, functional and developmental activities of Indian Capital Market.

Cox (1976) examines the effect of organized futures trading on information in spot markets and they found that the introduction of futures markets led to greater informational efficiency, as they were relatively inexpensive, with low margin requirements and low transaction costs.

In their research, Kawaller, Koch & Koch (1987) examines the intraday price movements in the index futures market led to movements in the spot market (on minute to minute data); and they found that future price movement consistently lead index movement by twenty to forty five while movement in index rarely affect future beyond one minute. In the end they concluded that there is no destabilising effect as the movements reflected the ability of the futures markets to process information faster.

Shenbagaraman (2003) examined the impact of the introduction of derivative trading on cash market volatility using data on stock index futures and options contracts traded on the Nifty Index. Author found that the futures and options trading have does not change in the volatility of the underlying stock index, but the nature of volatility seem to have changed in the post-futures market. Author also concluded that whether greater futures trading activity in terms of volume and open interest is associated with greater spot market volatility. It found no evidence of any link between trading activity variables in the futures market and spot market volatility.

Thenmozhi and Sony (2004) examine the impact of derivatives trading and cash market volatility in the Indian context. The volatility is examined considering the day-of-the week effect, domestic market factors and world market movements. The study concluded that the introduction of index futures and options has reduced spot market volatility. Persistence of volatility is reduced in post-derivatives period and day-of-the-week effect is found to be insignificant after the introduction of derivatives. The results provide evidence of increased market efficiency in the Indian stock market after the introduction of derivatives that the reduction of volatility in the underlying stock market had increased market efficiency.

Drimbetas, Nikolaos and Porfiris (2007) examines the effects of the introduction of the futures and options into the FTSE/ASE 20 index on the volatility of the underlying index. Their result shows that the introduction of derivatives has induced a reduction of the conditional volatility of the FTSE/ASE20 index and consequently it has increased its efficiency.

Mallikarjunappa and Afsal (2007) studied the volatility implications of the introduction of derivatives on the stock market in India using S&P CNX IT index. They found that clustering and persistence of volatility in different degrees before and after derivatives and the listing in futures has increased the market volatility. The sensitivity of the index return to domestic and global return remains same even after the introduction of futures trading. Also authors stated that the nature of the volatility has altered during the post-derivatives period with prices highly dependent on recent innovations which is a sign of improved market efficiency.

III. OBJECTIVES

The objectives are as follows:

1. To study the impact of introducing index and stock futures and options contracts on the volatility of the stock and index.
2. To study that either introduction of derivatives destabilize the underlying market or not.

IV. DATA SET

To satisfy the objectives the data period starts from 1st April 2001 to 31st March 2011. The data used in this category is based on Secondary data, collected from national stock exchange and its official website, consider that data sources used as highly reliable due to its function for the financial markets and is core business competences within data supply and gathering.

V. DATE OF INTRODUCTION OF DERIVATIVE CONTRACT

The National Stock Exchange of India Limited (NSE) commenced trading in derivatives with the launch of index futures on June 12, 2000. The futures contracts are based on the popular benchmark S&P CNX Nifty Index. The Exchange introduced trading in Index Options (also based on Nifty) on June 4, 2001. NSE also became the first exchange to launch trading in options on individual securities from July 2, 2001. Futures on individual securities were introduced on November 9, 2001. Futures and Options on individual securities are available on 149 securities stipulated by SEBI. Date of launching of derivative contract has been taken as cut off date.

VI. HYPOTHESIS

Hypotheses were set as follows.

H₀: Introduction of derivative contract in capital market does not affect the underlying spot market volatility.

H_{1A}: Introduction of derivative contract on index S&P CNX Nifty will affect the underlying spot market volatility of S&P CNX Nifty.

H_{1B}: Introduction of derivative contract on particular stock will affect the underlying spot market volatility of particular scrip.

H_{2A}: Introduction of derivative contract on index S&P CNX Nifty will destabilize the underlying S&P CNX Nifty.

H_{2B}: Introduction of derivative contract on particular stock will destabilize the underlying.

VII. RESEARCH MEHODOLOGY

The econometric literature provides a range of models (GARCH, VAR etc) to become cognizant about the facts of financial time series. Although present study is based on volatility measures and destabilizing problems with the instruments like derivative, for this purpose ARMA-GARCH (1, 1) model was used, as the volatility model that meet the requirements of capturing the statistical properties of the return data. In this section, different elements were explored which included GARCH (1, 1) model. First of all, the autoregressive moving average (ARMA) processes were investigated in the conditional mean specification part of the model. After the confirmation of ARMA, the presence of ARCH was checked. The GARCH framework was referred to as the first moment of financial time series. After that, generalized autoregressive conditional heteroscedasticity (GARCH) processes were described in the conditional variance specification part, which was referred to as the second moment of financial time series.

Moreover, in line with the Symmetric GARCH framework of conditional variance, a dummy variable was added in order to capture the effect of future and option on volatility, that is, the circumstance that negative shocks tend to have a larger impact on the volatility than positive shocks.

Hence equation 1 and 2 estimated as:

$$Y_t = \alpha_0 + \alpha_1 X_t + \varepsilon_t, \quad \text{where, } \varepsilon/Y_{t-1} \sim N(0, \sigma^2_t) \dots \dots \dots 1$$

$$\sigma^2_t = \beta_0 + \sum_{j=1}^p \beta_j \varepsilon^2_{t-1} + \sum_{j=1}^q \beta_j \sigma^2_{t-j} + Y_0 D \dots \dots \dots 2$$

VIII. INTERPRETATION

Destabilization Effect: A dummy variable was introduced into the conditional variance equation, and found that the coefficient on the futures/option dummy Y_0 , for the CNX Nifty which equals to -0.0000651 with a t-stat of 0.153 for future dummy (Table 4) and -0.0000643 with a t-stat of -0.238 for option dummy (Table 4), which were not statically significantly, different from zero, indicating that there was no impact on volatility, while confirming the GARCH effect and suggesting that the introduction of derivative contracts did not appear to have any destabilization impact on spot market volatility. Similar Results were found in all stocks.

Week Day Effect: This appears to be statically significant (at 1% level of significance) day-of-the-week effects as given by the coefficients on the dummies for every day except Wednesday (table 4 and 5). in all stocks and in CNX Nifty. During pre future/option period, week day effect was present everyday (at 1% level of significance) except Wednesday while during post introduction period there was no week day effect (Table 6 and 7).

Persistency Analysis: The sum of the coefficients of ARCH and GARCH approaching unity, indicating a large degree of persistence in all stocks and nifty, hence it can be concluded that bigger shocks had been decayed with time in CNX S&P Nifty and other stock.

FnO Effect: after the analysis of table 6 and 7, it was found that GARCH coefficient accept the null hypothesis ($\beta_2 = 0$) during post future/option period, hence it can be concluded that there was no effect of future and option on the spot market volatility in our sample..

Chow Test: If computed F value exceeded the value of 2.64, and then the hypothesis of parameter stability can be rejected. This suggests that the regression coefficients were statistically different before and after futures listing and it can be concluded that there was change in the volatility pattern, after the introduction of future and option. Similar results were found in all stock.

IX. RESULTS AND DISCUSSION

Time series were subject to check the stationarity. For this purpose we applied the augmented dickey fuller test. The Dickey fuller test applied on the return series of the spot price of all companies and CNX S&P Nifty Index. The hypothesis developed by Kapetanios et al. (2003) of non-stationary series was used against stationary non-linear alternatives. The established hypothesis are as follows:

H₀: $\delta=0$, (that time series do not show any stationary effect at given level of significance)

and, **H₁: $\delta < 0$:** (that time series shows the stationary effect at given level of significance)

After complete analysis of table 1, it was clear that all time series does not show any stationarity at levelled analysis of augmented dickey fuller test, and accept the null hypothesis that all time series were non stationary at levelled analysis and accepts the alternate hypothesis that time series are stationary at levelled analysis. At first difference (lag) all time series were found to be stationary.

Table 2 provides the descriptive statistics of the daily returns for the companies and index. The daily time series observations on the basis of closing price had been mentioned in the parenthesis of the period. the period was divided under study into pre-futures and post-futures periods using cut-off dates given in the table 1, to study symmetric nature of the time series three test, skewness, kurtosis and Jarque Bera, had been applied to check whether time series was normally distributed or not. For a normal distribution the skewness was zero. A distribution skewed to the right had positive skewness and a distribution skewed to the left had negative skewness. For the normal distribution, Kurtosis gave a measure of the thickness in the tails of a probability density function. For a normal distribution the kurtosis should be three. It followed that, for a normal distribution, the excess kurtosis treated as zero. If kurtosis exceeded three, then the problem of leptokurtosis would arise. The Jarque-Bera test for normality followed the chi square distribution.

Table 3 shows the descriptive statistic of returns of individual stock and S&P CNX Nifty for pre derivatives & post derivatives period. The mean value of all stock as well as nifty has been increased during post future and option period. The reasons for the better returns after the post derivative period was high trading, development and regulations in the capital market. Standard deviation had been taken as a measure of volatility, decreased from in all companies from the pre-futures period to the post-futures period. A similar result was shown with respect to the pre-options and post-options periods. This result shows that there was a decrease in spread with the introduction of futures and options trading. Returns shows the evidence of fat tails in whole period and post future and option period, since the kurtosis exceeds three, which was the normal value, while the problem of leptokurtosis wasn't arise during pre future and options. Jarque bera test also following the non normality distribution.

X.CONCLUSION

We have studied the behaviour of volatility of stock market after introduction of future by using GARCH (1, 1) model. We have considered S&P CNX Nifty and 2 individual stocks of which all are derivative stock. The results suggest that the introduction of derivatives does not have any stabilizing (or destabilizing) effect in terms of decreasing (or increasing) volatility

In case of index future, the volatility in the S&P CNX Nifty has declined after the introduction of S&P CNX Nifty future but the magnitude of dummy variable is very low which shows decline in volatility is very low. In case of 2 individual stocks, it shows a decrease in volatility. Nifty shows changing patterns of volatility. The day-of-the-week effects has been dissipated after futures introduction

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ANNEXTURES

TABLE 1: Test of stationarity with augmented dickey fuller test

***based on the data taken from NSE's official website**

For p value: at 1 % level is 0.01; 5% level is 0.05, at 10% level is 0.1

	ADF Levelled				ADF Ist Difference			
	LAG Length	ADF	P-Value	t- stat	Lag Length	ADF Stat.	P-Value	t- stat
ICICI bank	6	0.7216	0.834	0.808	5	-18.640*	0.000	43.19
Ranbaxy	6	0.7341	0.8314	0.459	5	18.441*	0.000	31.62
Nifty	6	0.5871	0.4156	0.13	5	-17.257*	0.00	16.24

TABLE 2: DESCRIPTIVE STATS

Descriptive Stat.						
Company	Period (Count)	Mean	SD	Skew	Kurt	JB

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ICICI bank	Whole Period(3284)	0.096321	3.342252	0.056079	3.497896	35.6422244
	Pre future (939)	0.084006	4.238499	0.128955	1.337173	110.7828757
	Pre Option (849)	0.11729	4.25022	0.198206	1.160353	125.27856
	F/Post (2345)	0.103821	2.916052	-0.03670	5.043528	408.55402
	O/Post (2435)	0.088401	2.962901	-0.102	5.07662	441.7425
Ranbaxy	Whole Period (3443)	-0.01361	4.785214	-2.18288	137.0820	2518748.1438
	Pre future (1098)	-0.00083	7.204007	-0.78387		
	Pre Option (1008)	-0.03852	7.477237	-0.75162	66.81143	171114.6498
	F/Post (2345)	-0.01925	3.058135	-7.52398	163.3045	2532968.78672
	O/Post(2435)	-0.0026	3.044038	-7.34468	160.3649	2534356.5102
Nifty	Whole Period (3254)	0.050817	1.729893	-0.22826	6.378880	1576.18936
	Pre future (553)	0.049420	1.989310	0.005025	1.674824	40.465548
	Pre Option (799)	0.014019	1.934679	-0.12179	1.861705	45.1120298
	F/Post (2701)	0.051805	1.672258	-0.30672	8.044951	1177.887155
	O/Post (2455)	0.066989	1.668428	-0.29414	8.788343	3462.673

*Based on the data taken from NSE's official website

Note: JB Test at 5% level of significance is 7.88

TABLE 3; ARCH Effect

		LM	LB Q(1)	LB Q(2)	LB Q(3)	LB Q(4)	LB Q(5)	LB Q(6)			
Index/scrip (Count)	Intercept	Y ₁	Y ₂	Y ₃	Y ₄	Y ₅	Y ₆	R ²	F	CR ²	
ICICI bank (3284)	Coefficient	-0.843*	-0.256* (108.11)	0.020 (109.55)	0.003 (109.53)	0.004 (109.59)	0.024 (111.561)	-0.043 (117.87)	0.4193	36.11	1417.2
	Std Error	0.029	0.025	0.017	0.017	0.017	0.017	0.017			
	t-stat	9.583	3.09	0.978	0.394	0.349	0.994	0.145			
	P- Value	0.000	0.000	0.753	0.456	0.651	0.357	0.459			
Ranbaxy (3443)	Coefficient	-0.725*	-0.204** (70.075)	-0.022 (71.706)	0.003 (71.744)	-0.035 (76.354)	0.031 (80.010)	-0.006 (80.123)	0.7863	34.05	2605
	Std Error	0.019	0.024	0.017	0.016	0.016	0.016	0.017			
Nifty (3254)											

TABLE 4: ESTIMATES OF GARCH (1, 1) MODEL WITH FUTURE DUMMY

	t-stat	16.23	2.9509	0.349	0.167	0.924	0.843	0.330			
	P- Value	0.000	0.000	0.456	0.115	0.664	0.336	0.441			
Nifty (3254)	Coefficient	-0.416*	-0.269*	0.003	0.015	0.005	-0.004	-0.014	0.6746	62.05	2195.2
			(129.710)	(129.742)	(130.409)	(130.473)	(130.532)	131.275)			
	Std Error	0.022	0.025	0.018	0.018	0.018	0.018	0.017			
	t-stat	7.69	5.239	0.945	0.222	0.119	0.741	0.541			
	P- Value	0.000	0.000	0.466	0.644	0.493	0.536	0.657			

Mean Equation									Variance Equation				
α_0	α_1	α_2	α_3	α_4	α_5	α_6	α_7	β_0	β_1	β_2	γ_0	R^2	
Intercept	Return	Lagged return of Dow Jones	Mon	Tue	Wed	Thurs	Fri	Arch0	Arch1	Garch1	Future Opti on Dummy		
ICICI Bank	-0.00152 (-3.02)	0.92 (62.719)	0.009850 (8.63)	-1.32 (-7.89)	0.1138 (8.84)	0.00421 (1.096)	0.2643 (8.07)	0.00160 (2.51)	0.0000657 (3.80)	0.07416 (6.88)	0.8137 (71.66)	-0.0000425 (-0.127)	0.452
Ranbaxy	-0.00132 (-3.30)	0.71365 (67.667)	0.002135 (6.28)	1.28829 (7.69)	0.1847 (12.46)	0.002272 (1.24)	0.19834 (6.54)	0.00198 (3.89)	0.0000165 (4.00)	0.05324 (9.79)	0.7454 (71.64)	-0.0000414 (-0.267)	0.3582
Nifty	-0.00119 (-2.88)	0.65888 (55.633)	0.001596 (8.14)	1.39467 (7.76)	0.1436 (8.32)	0.001982 (1.37)	0.19510 (6.14)	0.00261 (4.84)	0.0000566 (3.89)	0.05444 (8.99)	0.8259 (72.92)	-0.0000651 (0.153)	0.6952

TABLE 5: ESTIMATES OF GARCH (1,1) MODEL WITH OPTION DUMMY

TABLE 6: ESTIMATES OF GARCH (1,1) MODEL BEFORE AND AFTER FUTURE INTRODUCTION

	Mean Equation								Variance Equation				R ²
	α_0	α_1	α_2	α_3	α_4	α_5	α_6	α_7	β_0	β_1	β_2	γ_0	
	Intercept	Return	Lagged return of Dow Jones	Mon	Tue	Wed	Thurs	Fri	Arch0	Arch1	Garch1	Future/Option Dummy	
ICICI BANK	-0.00171 (-3.05)	0.8429 (62.993)	0.009831 (8.59)	-1.4409 (-7.92)	0.1143 (8.88)	0.00441 (1.101)	0.2656 (8.10)	0.00171 (2.57)	0.0000668 (3.85)	0.07427 (6.93)	0.8151 (71.68)	-0.0000417 (-1.16)	0.668
Ranbaxy	-0.00147 (-3.36)	0.71377 (67.822)	0.002152 (6.33)	1.28841 (7.73)	0.1866 (12.51)	0.002261 (1.20)	0.19835 (6.59)	0.00207 (3.92)	0.0000174 (4.03)	0.05336 (9.82)	0.7471 (71.69)	-0.000040 (-0.327)	0.3369
Nifty	-0.00132 (-2.92)	0.65895 (55.837)	0.001581 (8.10)	1.39452 (7.72)	0.1448 (8.36)	0.001970 (1.33)	0.19521 (6.17)	0.00272 (4.88)	0.0000584 (3.92)	0.05429 (8.94)	0.8241 (72.01)	-0.0000643 (-0.238)	0.7201

	α_0	α_1	α_2	α_3	α_4	α_5	α_6	α_7	β_0	β_1	β_2	R ²	Chow test
	Intercept	Return	Lagged return of Dow Jones	Mon	Tue	Wed	Thurs	Fri	Arch0	Arch1	Garch1		
ICICI Pre	-0.00169 (-4.86)	0.818 (72.221)	0.007795 (9.96)	0.813 (4.34)	0.1030 (9.21)	0.00583 (2.358)	0.1855 (6.89)	0.00189 (3.01)	0.0000568 (3.34)	0.06312 (5.32)	0.9131 (80.89)	0.681	18.271
ICICI Post	-0.00014 (-2.21)	0.73105 (65.244)	0.003836 (4.35)	0.538 (0.3301)	0.0351 (0.244)	0.00130 (0.107)	0.19287 (0.711)	0.00129 (0.188)	0.0000186 (1.01)	0.09418 (7.85)	0.002573 (0.4306)	0.229	
Ranbaxy Pre	-0.00161 (-4.31)	0.55921 (39.446)	0.005369 (1.84)	0.64956 (4.49)	0.1287 (9.82)	0.001891 (1.08)	0.15863 (5.57)	0.00136 (3.46)	0.0000281 (5.39)	0.03126 (4.682)	0.5273 (48.95)	0.3354	31.790
Ranbaxy Post	-0.00147 (-2.87)	0.41849 (37.338)	0.009861 (7.85)	0.96327 (0.672)	0.0938 (0.713)	0.000589 (0.081)	0.65192 (0.248)	0.000960 (0.164)	0.000056 (0.651)	0.03945 (6.73)	0.005829 (0.412)	0.3459	
Nifty Pre	-0.00136 (-3.11)	0.62151 (62.341)	0.008130 (6.59)	0.9418 (6.45)	0.1665 (10.93)	0.002259 (1.62)	0.1543 (4.97)	0.002272 (4.23)	0.0000494 (3.67)	0.02356 (4.40)	0.5862 (61.85)	0.7201	21.053
Nifty Post	-0.00091 (-1.77)	0.60297 (48.061)	0.002426 (8.34)	1.0658 (0.697)	0.0948 (0.627)	0.001392 (0.117)	0.0654 (0.305)	0.000875 (0.386)	0.0000482 (3.49)	0.06580 (6.74)	0.004387 (0.3394)	0.6811	

TABLE 7: ESTIMATES OF GARCH (1,1) MODEL BEFORE AND AFTER OPTION INTRODUCTION

	Mean Equation								Variance Equation				Chow test
	α_0	α_1	α_2	α_3	α_4	α_5	α_6	α_7	β_0	β_1	β_2	R ²	
	Intercept	Return	Lagged return of Dow Jones	Mon	Tue	Wed	Thurs	Fri	Arch0	Arch1	Garch1		
ICICI Pre	-0.0032 (-4.89)	0.829 (73.246)	0.007781 (9.91)	0.819 (4.36)	0.1040 (9.26)	0.00595 (2.361)	0.1841 (6.84)	0.00196 (3.04)	0.0000579 (3.38)	0.06322 (5.37)	0.9142 (81.29)	0.355	18.271
ICICI Post	-0.00028 (-2.25)	0.73117 (64.286)	0.003847 (4.39)	0.552 (0.330)	0.0368 (0.240)	0.00143 (0.110)	0.1926 (0.708)	0.00136 (0.190)	0.0000196 (1.04)	0.09429 (7.89)	0.002581 (0.4309)	0.288	
Ranbaxy Pre	-0.00176 (-4.37)	0.55937 (40.751)	0.005381 (1.88)	0.64971 (4.53)	0.1299 (9.87)	0.001877 (1.02)	0.1587 (5.61)	0.00148 (3.48)	0.0000267 (5.34)	0.03140 (4.687)	0.005288 (0.4899)	0.3805	31.790
Ranbaxy Post	-0.00161 (-2.90)	0.41862 (36.243)	0.009876 (7.89)	0.96344 (0.677)	0.0949 (0.719)	0.000570 (0.078)	0.65205 (0.254)	0.000984 (0.169)	0.000067 (0.655)	0.03958 (6.77)	0.005838 (0.5415)	0.3369	
Nifty Pre	-0.00149 (-3.14)	0.62161 (61.346)	0.008141 (6.62)	0.9426 (6.49)	0.1678 (10.97)	0.002274 (1.67)	0.1521 (4.93)	0.002262 (4.218)	0.0000479 (3.62)	0.02376 (4.44)	0.5849 (60.65)	0.6843	21.053
Nifty Post	-0.00084 (-1.75)	0.60282 (50.058)	0.002450 (8.39)	1.0666 (0.699)	0.0965 (0.630)	0.001384 (0.112)	0.0666 (0.309)	0.000888 (0.390)	0.0000496 (3.52)	0.06595 (6.78)	0.004371 (0.3272)	0.7028	