Effect of High Frequency Trading On Retail Investors – A Study in India

Rajan Lakshmi, Vedala Naga Sailaja

ABSTRACT: ***The present study has been emphasized on the high frequency trading factors impact on the retail investors trading activity. The study has considered the historical time series data from the period of 1st July, 2018 to 31st Sep, 2018 of Spot market index-Nifty and index future – Banknifty. The GARCH model has been applied to know the one minute spot index-Nifty volatility impact on the other time periods and the result reveals that the five minutes banknifty volatility got influenced slightly but there no impact has been observed on the banknifty time periods of fifteen minutes, thirty minutes, one hour and one day. The high frequency trading factors impact on the retail trading activity has been examined with the primary data. The structure equation model has been framed and the result indicated that the small margin trading with less time horizon trading positions are getting influenced but at end of the day influence has been observed on the market prices. This paper is useful to the retail investors, regulators, fund managers and research academicians.***
Keyword: Banknifty, factors, High frequency trading, Nifty, Retail traders and Volatility.

I. INTRODUCTION

The role of high frequency trading activity is increasing in recent past and posing crucial questions, whether high frequency trading is beneficial for the financial markets to both regulators and academic research scholars. Recent academic research have focused on the impact of HFT on multiple areas such as transaction cost, market quality, liquidity, efficiency and market integrity, though the results are sometimes non-conclusive. The present study is focused on the effect of high frequency trading factors on retail investors trading activity. The historical time data of spot market index- Nifty has been considered to examine the volatility on the index future – Banknifty. The study is also focused on the retail investors' opinion on the effect of high frequency trading activity. The retail investors are not unable to take technology advantage like institutional investors. The effect of HFT will be in short span of time and in overnight positions it doesn't show the significance influence on the market. The intra-day retail trader is getting influenced by the high frequency trading activity which is not known to them. The present study has made an attempt to know the high frequency trading factors effect on the retail investors.

II. REVIEW OF LITERATURE

Hruska (2016): The paper emphasizes on the HFT trading strategies which increases or decreases the liquidity due to the fleet of orders concept. The study has considered the eight months historical time series data and applied the regression estimation models and result found that the direction of the market at different points is changing with the presence of HFT and also reducing the liquidity.

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Scholtus, van Dijk & Frijns (2012): The authors stated that order flow though high frequency trading plays the greater importance with strategies based on the macro-economic news announcements. The study investigated the effect of algo trading on the market quality at the time of the news releases. The study also observes that the latency of 300 ms or more significantly reduces the returns of news based trading strategies.

Chaboud et al. (2011): The study has focused on the high frequency trading impact on the volatility and liquidity in foreign exchange market. The sample data from 2006 to 2007 has considered of algorithmic data which displayed the orders. The study found the evidence of causal relationship between the HFT and increased exchange rate volatility. The study concluded that the algorithmic traders associated with lower volatility and also pushes the liquidity over the hour following macroeconomic data releases.

Chaboud et al. (2009): The study stated that the trading pattern of the market will not reflect the high frequency trading activity. The order flow will not represent the involvement of high frequency trading activity. The author examined the data and studied with the several proxies of automated trading activity. The study concludes that the retail investor unable to take the advantage of the market movement in short time period with compared to high frequency traders.

III. OBJECTIVES OF THE STUDY

1. To study the impact of high frequency trading on the stock price volatility.
2. To study the Impact of high frequency trading factors on retail investors activity.

IV. HYPOTHESES OF THE STUDY

H0: There is no impact of high frequency trading on the stock price volatility.
H0: There is no impact of High frequency trading factors on retail investors.

SCOPE OF THE STUDY: The study has been emphasized on the high frequency impact on the price volatility and retail investors' activity. The historical has been considered for the period of 1st July, 2018 to 31st Sep, 2018 of Nifty spot index and Banknifty future index data. The study has been segmented in two one minute, five minutes, fifteen minutes, Thirty minutes, one hour and one day historical prices.

RESEARCH METHODOLOGY: The present study is qualitative and quantitative nature, where the retail investors' opinions were collected with scheduled questionnaire by considering the simple random sampling methodology. The

secondary data has been used from the NSEIndia for the Spot index – Nifty and Index future – Banknifty. The study has compared the one minute volatility with the five minute, fifteen minute, thirty minute, one hour and one days time period. The study has considered the GARCH model for the volatility and structure equation model has been applied to know the impact of multiple independent variables on the one dependent variable.

V. DATA ANALYSIS

1st Objective: To study the impact of high frequency trading on the stock price volatility.

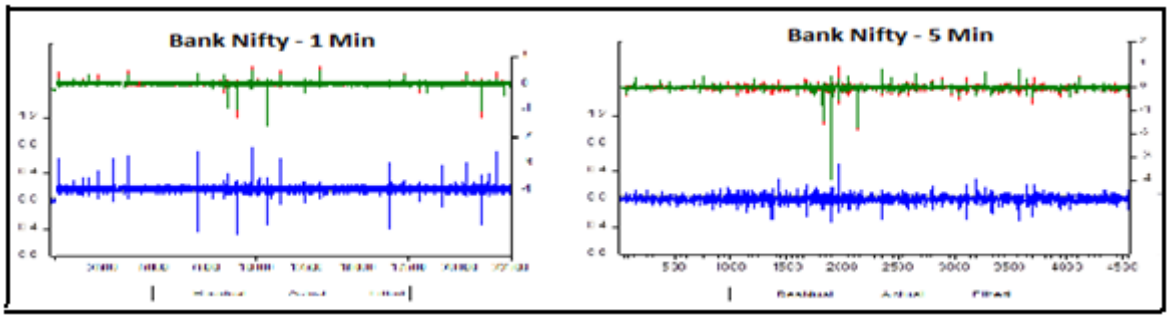
1 min to 5 min: The bank nifty returns volatility has been measured for the one minute and five minute data on the period of 3 months i.e., 1st July, 2018 to 31st Sep, 2018. To know the volatility heteroskedasticity test ARCH has been applied on Bank Nifty.

H0: There is no impact of volatility on the bank nifty for the one minute and five minute period.

Heteroskedasticity Test: ARCH				
Bank Nifty-1 min	F-statistic	6.142173	Prob. F(1,22496)	0.0003
	Obs*R-squared	0.621176	Prob. Chi-Square(1)	0.0003
Bank Nifty-5 min	F-statistic	4.224237	Prob. F(1,4556)	0.0026
	Obs*R-squared	0.445248	Prob. Chi-Square(1)	0.0026

Table Heteroskedasticity reflects that the p value of the chi-square is observed to be significant i.e., 0.000 < 0.5. The F statistic is observed to significant as the calculated value is greater than the critical value (>3.8508) which signifies that Null hypothesis has been rejected and Alternative hypothesis has been accepted i.e., volatility is exists in the one minute prices of bank nifty returns as well as in five minute prices of bank nifty returns.

Residual Graph

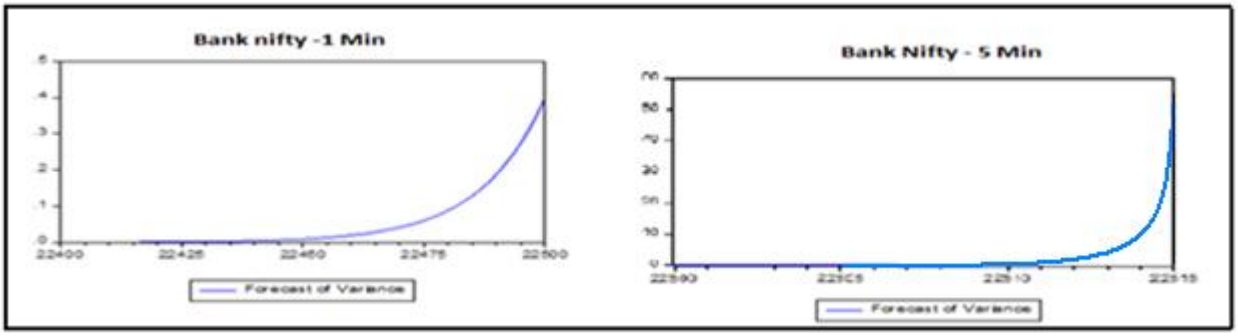


The above graph depicts one minute and five minutes prices of bank nifty fluctuations for the period of 3 months. In both period of data residual graph movement crossed the fitted lines which states that the volatility is exists, as the volatility of one cluster is followed by the other volatility of cluster. Further, residual graph reveals that one minute prices are narrower and having more fluctuation than 5 minutes prices of bank nifty.

Bank Nifty-1 min	Dependent Variable: Bank nifty
	Method: ML ARCH - Normal distribution (BFGS / Marquardt steps)
	Presample variance: backcast (parameter = 0.7)
	GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*GARCH(-1)

	Variable	Coefficient	Std. Error	z-Statistic	Prob.	R- Sqaure	Akaike info criterion	Schwarz criterion
	NIFTY	0.766137	0.000270	2842.168	0.0000	0.807997	5.415261	5.413835
		Variance Equation						
	C	2.87E-06	1.57E-07	18.24409	0.0000			
	RESID(-1)^2	0.243167	0.001465	166.0148	0.0000			
	GARCH(-1)	0.835135	0.001190	702.0334	0.0000			
	Variable	Coefficient	Std. Error	z-Statistic	Prob.	R- Sqaure	Akaike info criterion	Schwarz criterion
Bank Nifty – 5 Min	NIFTY	1.086098	0.002630	413.0134	0.0000	0.816675	3.270000	3.264363
		Variance Equation						
	C	0.000169	9.21E-06	18.36724	0.0000			
	RESID(-1)^2	0.281620	0.009069	31.05274	0.0000			
	GARCH(-1)	0.716507	0.006849	104.6116	0.0000			

Table illustrates that GARCH effects between the nifty over bank nifty. Result indicates that, for one minute prices of banknifty seems to be having 0.835 units on nifty. Whereas, five minutes data of bank nifty observed to be having 0.716 units on nifty. That means that Bank nifty of one minute's price is having high influence on Nifty, than the five minutes prices. Further, R-square under one and five minutes prices are shown strong fit of model. Hence it is concluded that one minute and five minutes is seems to be having high volatility effects.



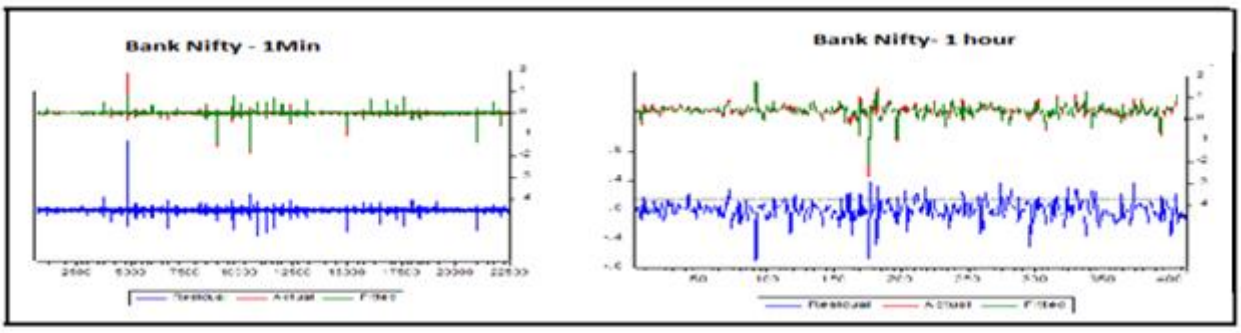
Above graph shows the one minute and five minute bank nifty return forecast variance. Figure reflects that trend line is moving upward direction under one minute, whereas five mintue prices shows a slightly higher volatility.

1 min to 15 min: The bank nifty returns volatility has been measured for the one minute and fifteen minute data on the period of 3 months i.e., 1st July, 2018 to 31st Sep, 2018. To know the volatility heteroskedasticity test ARCH has been applied on Bank Nifty.

H0: There is no impact of volatility on the bank nifty for the one minute and fifteen minute period.

Heteroskedasticity Test: ARCH				
Bank Nifty-1 min	F-statistic	6.142173	Prob. F(1,22496)	0.0003
	Obs*R-squared	0.421176	Prob. Chi-Square(1)	0.0003
Bank Nifty-15 Min	F-statistic	4.620903	Prob. F(1,416)	0.0018
	Obs*R-squared	0.621453	Prob. Chi-Square(1)	0.0018

Table Heteroskedasticity reflects that p value of the chi-square seems to be statistically significant i.e., 0.000 < 0.5 and F statistic is also observed to significant as the calculated value is greater than the critical value (>3.8508) which signifies that Null hypothesis has been rejected and Alternative hypothesis has been accepted i.e., volatility is exists in the one minute prices of bank nifty returns as well as in fifteen minute prices of bank nifty returns.

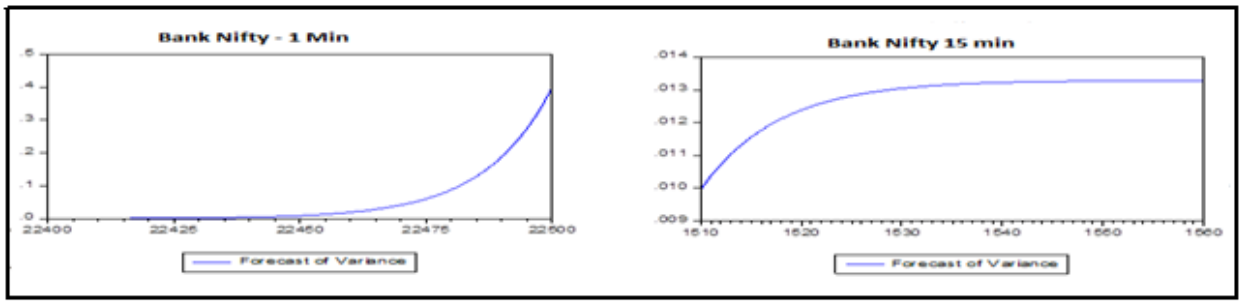


Above figure illustrate one minute and fifteen minutes price of bank nifty fluctuation for the period of 3 months. In both period return prices of residual graph movement crossed the fitted line which indicates the volatility exists between them (i.e., Bank nifty to nifty for 1 min and Bank nifty to nifty for 15 min).Further, it depicts the one cluster followed by other volatility of cluster seems to be high in 1 min as compare cluster volatility in 15 min.

Bank Nifty-1 min	Dependent Variable: Bank nifty							
	Method: ML ARCH - Normal distribution (BFGS / Marquardt steps)							
	Presample variance: backcast (parameter = 0.7)							
	GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*GARCH(-1)							
	Variable	Coefficient	Std. Error	z-Statistic	Prob.	R- Sqaure	Akaike info criterion	Schwarz criterion
	NIFTY	0.766137	0.000270	2842.168	0.0000	0.807997	5.415261	5.413835
		Variance Equation						
	C	2.87E-06	1.57E-07	18.24409	0.0000			
	RESID(-1)^2	0.243167	0.001465	166.0148	0.0000			
	GARCH(-1)	0.835135	0.001190	702.0334	0.0000			
Bank Nifty – 15 Min	Variable	Coefficient	Std. Error	z-Statistic	Prob.	R- Sqaure	Akaike info criterion	Schwarz criterion
	NIFTY	1.082441	0.006335	170.8600	0.0000	0.816675	3.270000	3.264363
		Variance Equation						
	C	0.001622	0.000138	11.74408	0.0000			

	RESID(-1)^2	0.377001	0.025477	14.79782	0.0000			
	GARCH(-1)	0.500964	0.027396	18.28635	0.0000			

Table illustrates that GARCH effects between the nifty over bank nifty. Result indicates that, for one minute prices of bank nifty seems to be having 0.766 units on nifty. Whereas, five minutes data of bank nifty observed to be having 0.835 units on nifty. That means that Bank nifty of one minute's price is having high influence on Nifty, than the Fifteen minutes prices. Further, R-square in one and five minutes prices are shown strong fit of model.



Above graph shows the one minute and five minute bank nifty return forecast variance. Figure reflects that trend line is moving downward direction under one minute, whereas fifteen minutes fluctuations moving opposite direction i.e., upward movement.

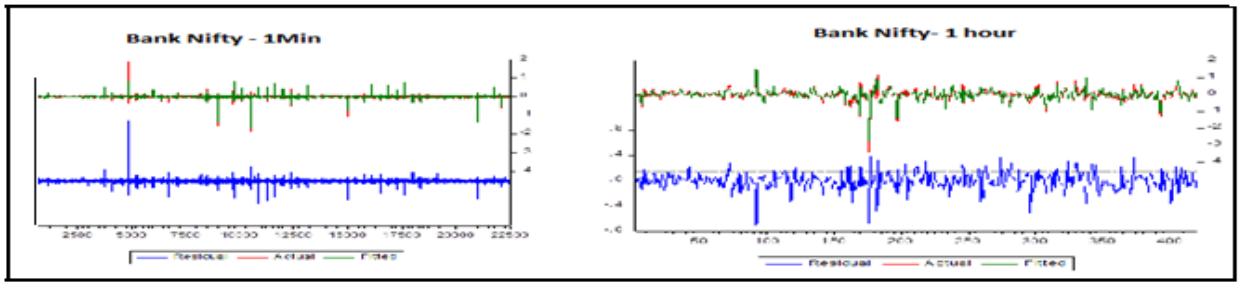
1 min to 1 hour: The bank nifty returns volatility has been measured for the one minute and one hour data on the period of 3 months i.e., 1st July, 2018 to 31st Sep, 2018. To know the volatility heteroskedasticity test ARCH has been applied on Bank Nifty.

H0: There is no impact of volatility on the bank nifty for the one minute and one hour period.

Heteroskedasticity Test: ARCH				
Bank Nifty-1 min	F-statistic	6.142173	Prob. F(1,22496)	0.0003
	Obs*R-squared	0.421176	Prob. Chi-Square(1)	0.0003
Bank Nifty-1 hour	F-statistic	5.166888	Prob. F(1,416)	0.0036
	Obs*R-squared	0.690588	Prob. Chi-Square(1)	0.0037

Table Heteroskedasticity indicates that the p value of the chi-square is observed to be significant i.e., 0.000 < 0.5. The F statistic is observed to significant as the calculated value is greater than the critical value which signifies that Null hypothesis has been rejected and Alternative hypothesis has been accepted i.e., volatility is exists in the one minute prices of bank nifty returns as well as in one hour prices of bank nifty returns.

Residual Graph

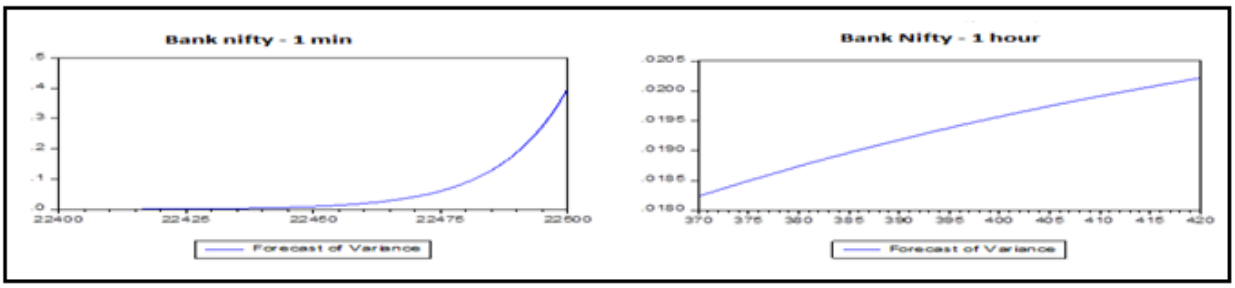


Above figure illustrate one minute and one hour price of bank nifty fluctuation for the period of 3 months. In both period, return prices of residual graph movement crossed the fitted line which indicates the volatility exists between them (i.e., Bank nifty to nifty for 1 min and Bank nifty to nifty for one hour).Further, it depicts the one cluster followed by other volatility of cluster seems to be high in 1 min as compare cluster volatility in one hour.

Bank Nifty - 1 min	Dependent Variable: Bank nifty							
	Method: ML ARCH - Normal distribution (BFGS / Marquardt steps)							
	Presample variance: backcast (parameter = 0.7)							
	GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*GARCH(-1)							
	Variable	Coefficient	Std. Error	z-Statistic	Prob.	R- Sqaure	Akaike info criterion	Schwarz criterion
	NIFTY	0.766137	0.000270	2842.168	0.0000	0.807997	5.415261	5.413835
		Variance Equation						
	C	2.87E-06	1.57E-07	18.24409	0.0000			
	RESID(-1)^2	0.243167	0.001465	166.0148	0.0000			
	GARCH(-1)	0.835135	0.001190	702.0334	0.0000			
Bank Nifty – 1 Hour	Variable	Coefficient	Std. Error	z-Statistic	Prob.	R- Sqaure	Akaike info criterion	Schwarz criterion
	NIFTY	0.757582	0.012586	60.19140	0.0000	0.826394	-1.142722	-1.1041

								74
		Variance Equation						
	C	0.000284	5.62E-05	5.061048	0.0000			
	RESID(-1)^2	0.032053	0.006277	5.106138	0.0000			
	GARCH(-1)	0.419375	0.008548	79.2541	0.0000			

Table illustrates that GARCH effects between the nifty over bank nifty. Result indicates that, for one minute prices of bank nifty seems to be having 0.835 units on nifty. Whereas, one hour prices of bank nifty observed to be having 0.41 units on nifty. That means that Bank nifty of one minute's price is having high influence on Nifty, than the one hour prices. Further, R-square in one and one hour prices are shown strong fit of model. Hence it is concluded that the volatility exists in one minutes prices of bank nifty is having narrower fluctuation, whereas one hour return prices seems to be having breakpoints.



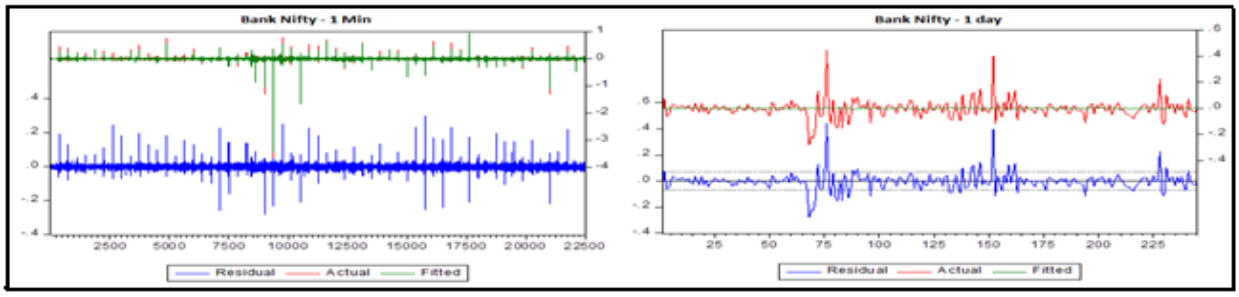
Above graph shows the one minute and five minute bank nifty return forecast variance. Figure reflects that trend line is moving downward direction under one minute, whereas one hour prices movement is observed to be flat, which states that volatility has narrowed as time period is increased.

One minute to one day: The bank nifty returns volatility has been measured for the one minute and one day data on the period of 3 months i.e., 1st July, 2018 to 31st Sep, 2018. To know the volatility heteroskedasticity test ARCH has been applied on banknifty.

H0: There is no impact of volatility on the bank nifty for the one minute and one day period.

Heteroskedasticity Test: ARCH				
Bank Nifty-1 min	F-statistic	6.142173	Prob. F(1,22496)	0.0003
	Obs*R-squared	0.421176	Prob. Chi-Square(1)	0.0003
Bank Nifty-1 day	F-statistic	5.371414	Prob. F(1,416)	0.0022
	Obs*R-squared	0.371983	Prob. Chi-Square(1)	0.0022

Table Heteroskedasticity reflects that p value of the chi-square seems to be statistically significant i.e., 0.000 < 0.5 and F statistic is also observed to significant as the calculated value is greater than the critical value (>3.8508) which signifies that Null hypothesis has been rejected and Alternative hypothesis has been accepted i.e., volatility is exists in the one minute prices of bank nifty returns as well as in one day prices of bank nifty returns.

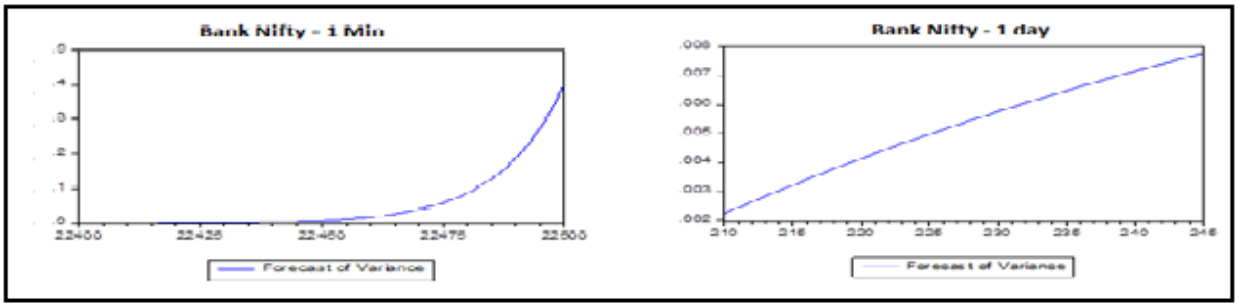


The above graph depicts one minute and five minutes prices of bank nifty fluctuations for the period of 3 months. In both period of data residual graph movement crossed the fitted lines which states that the volatility is exists, as the volatility of one cluster is followed by the other volatility of cluster. Further, residual graph reveals that one day prices seems to be having low fluctuation than volatility exists in one minute prices of bank nifty.

Bank Nifty- 1 min	Dependent Variable: Bank nifty							
	Method: ML ARCH - Normal distribution (BFGS / Marquardt steps)							
	Presample variance: backcast (parameter = 0.7)							
	GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*GARCH(-1)							
	Variable	Coefficient	Std. Error	z-Statistic	Prob.	R- Sqaure	Akaike info criterion	Sch warz criteri on
	NIFTY	0.766137	0.000270	2842.168	0.0000	0.807997	5.415261	5.413 835
		Variance Equation						
	C	2.87E-06	1.57E-07	18.24409	0.0000			
	RESID(-1)^2	0.243167	0.001465	166.0148	0.0000			
	GARCH(-1)	0.835135	0.001190	702.0334	0.0000			
Bank Nifty – 1 day	Variable	Coefficient	Std. Error	z-Statistic	Prob.	R- Sqaure	Akaike info criterion	Schw arz criteri on

	NIFTY	0.003720	0.005445	0.683238	0.4945	0.433614	2.766726	2.709563
		Variance Equation						
	C	0.000237	3.53E-05	6.691174	0.0000			
	RESID(-1)^2	0.188575	0.053088	3.552120	0.0004			
	GARCH(-1)	0.226079	0.030551	26.05761	0.0000			

Table illustrates that GARCH effects between the nifty over bank nifty. Result indicates that, for one minute prices of bank nifty seems to be having 0.835 units on nifty. Whereas, five minutes data of bank nifty observed to be having 0.226 units on nifty. That means that Bank nifty of one minute's price is having high influence on Nifty, than one day prices of bank nifty. Further, R-square observed in the both the case that one minutes show strongly fit the model whereas, one day returns prices shown moderate fit the model.



Above graph shows the one minute and five minute bank nifty return forecast variance. Figure reflects that trend line is moving downward direction under one minute, whereas one day prices movement shows a flat movement, which states that volatility has narrowed as time period is increased.

2nd Objective: To study the impact of HFT factors on Retail investors.

Structured Equation Method: Structured equation method employed to determine the Impact of HFT factors on retail investors. First the model was specified and applied reliability test of the model based on sample data that comprised of all observed variables in the model. The primary task in this model testing procedure was to determine the Goodness-of-fit between the hypothesized model and the sample data. As such the structure of the hypothesized model was imposed on the sample data to test how well the observed data fits this restricted structure and constructs the links among the variables simultaneously.

Goodness of fitness: The various common model-fit measures used to assess the model's overall goodness of fit as explained below

Table

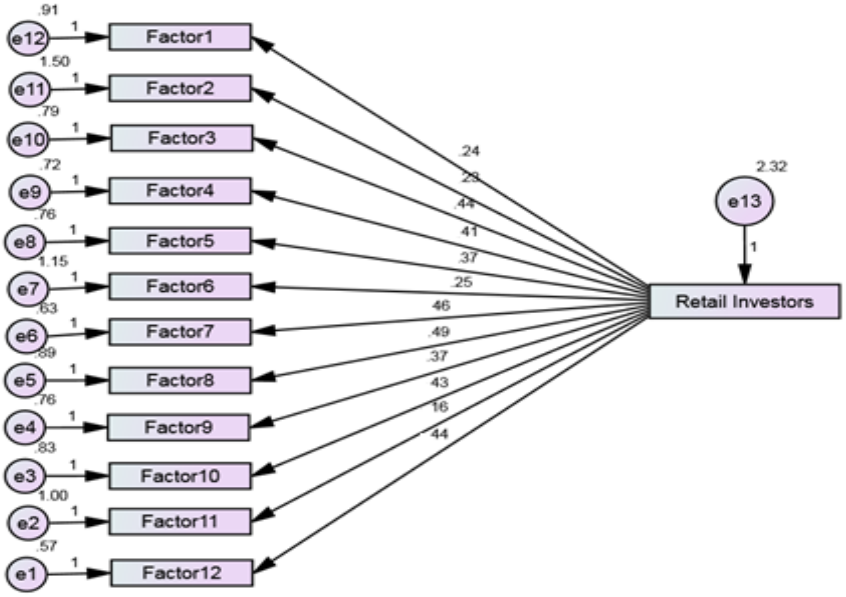
Fit Statistics of the Measurement Model

Fit statistic	Recommended	Obtained

Chi-square		139.439
Df		25
Chi-square significance	p < = 0.05	0.000
GFI	<0.90	0.831
AGFI	>0.90	0.767
NFI	>0.90	0.920
RFI	>0.90	0.965
CFI	>0.90	0.829
TLI	>0.90	0.913
RMSEA	<0.05	0.031

The Fitness model table depicts that Goodness of Fit Index (GFI) is obtained 0.831 which is below the recommended value 0.90. The Adjusted Goodness of Fit Index (AGFI) also seemed to less than the recommended value (0.767<0.90) as well. The Normed Fit indexes (NFI) (0.920<0.90), Relative Fit Index (RFI) (0.0965<0.90) are above the recommended value but this statistic says that model fit is satisfactorily acceptable. Whereas, Comparative Fit Index (CFI) is observed to be below the recommended value and Tucker Lewis Index (TLI) seem to be above the 0.90 with their respective values as 0.829,0.913. Further, Root mean square Residual (RMSEA) seems to be less than the 0.05 (0.031<0.05). Hence the model shows an overall strong acceptable fit. It can be concluded that model is fit for structure equation model.

Path diagram:



***Source**: Compiled through AMOS 24 Version on primary data.*

The research model exhibited good fit with the observed data as mentioned above. All the different stages hypothesized path seems to be significant at 5 % level (p-value <0.05) and reveals the standardized regression weights of the output as below table.

Regression Weights of HFT Factors Impact on Retail Investors

			Estimate	S.E.	C.R.	P	Significant/non-significant
Factor1	<---	Retail Investors	0.244	0.069	3.513	***	Significant
Factor2	<---	Retail Investors	0.231	0.08	2.9	***	Significant
Factor3	<---	Retail Investors	0.437	0.063	6.908	***	Significant
Factor4	<---	Retail Investors	0.410	0.073	5.64	***	Significant
Factor5	<---	Retail Investors	0.374	0.075	4.977	***	Significant
Factor6	<---	Retail Investors	0.247	0.075	3.311	***	Significant
Factor7	<---	Retail Investors	0.456	0.08	5.698	***	Significant
Factor8	<---	Retail Investors	0.490	0.072	6.774	***	Significant
Factor9	<---	Retail Investors	0.369	0.074	4.967	***	Significant
Factor10	<---	Retail Investors	0.428	0.073	5.887	***	Significant
Factor11	<---	Retail Investors	0.157	0.081	1.939	***	Significant
Factor12	<---	Retail Investors	0.438	0.07	6.271	***	Significant

***Source**: Compiled through AMOS 24 Version on primary data.*

The above table illustrates the influence of High frequency trading on Retail Investors. Results indicates that p-value for all the HFT factors are observed to be statistically significant at 5% level in which Factor8 "Very short holding periods, small margin per trade" and Factor-7 "No significant position at the end of a day (flat position)" is highly estimated and influenced on the retail investors with their estimated value as 0.490 and 0.456 followed by the Factor-12 "Flash crash" (0.438). Further results reveal that Factor-3 "Working an order through time and across markets" (0.437), Factor-10 "Focus on highly liquid instruments" (0.428), Fcator-4 "Very high number of orders, rapid order cancellation" (0.410) Factor-5 "Proprietary trading" (0.374) and Factor-9 "Minimize market for large orders" (0.369), seem to be among the core factors of HFT influencing on the retail investors. Whereas Factors namely Factor-6 "Mainly spread and arbitrage income" (0.247), Factor-1 "Direct market access" (0.244) and Factor-2 "Low latency requirement" (0.231) are having the moderate influence impact on the retail investors. Hence concluded that Factor-11 "Observing market data in real-time" (0.157) observed to have a lowest influence impact of HFT on Retail Investors.

VI. FINDINGS OF THE STUDY:

1. The study found from GARCH test that Volatility effects exists between bank nifty prices of one minute, five minutes, fifteen minutes, one hour minutes and one day with spot market index - nifty. But, the fluctuation of one hour and one day return prices of bank nifty shown wider volatility effects.

2. It also observed from forecasting test that one minutes and five minutes return price of bank nifty is having more fluctuation which indicates that the next 15 min of the one minutes and five minutes transaction seems to be having high trading effects.
3. The study revealed that one hour and one day fluctuation are less as compare to minute transaction and forecasting test reflects that one hour and one day return prices of bank nifty show stable performance of trading (i.e., not frequently trading action).
4. The study found from SEM model that Factor 8 i.e., Very short holding periods, Small margin per trade is shown high influence on retail investors, with its regression weight as 0.490 followed by "No significant position at end of a day and Flash markets.
5. It also found that the HFT factors considered in the study seems to be having significant influence on retail investors which indicates that these factors will create a perspective towards high frequency trading by the investors.
6. The study illustrate that factor-11 i.e., Observing market data in real-time is observed to be having low influence on retail investors with its estimate value as 0.157 followed by factor - 2 (Low latency requirement) is influence by 0.231 and Factor - 1 (Direct market access) is influenced with 0.244.

VII. CONCLUSION OF THE STUDY:

The present study concludes the impact of high frequency trading impact on the retail investors has been studied with the help of qualitative and quantitative analysis. The study has considered the historical time series data of the spot market index – Nifty and index future – Banknifty to measure the influence of high frequency trading on volatility of the market. The study has focused on the different time periods of the high frequency trading impact to compare with the one minute data with other time periods. The Garch model has been applied and the result reveals that the spot market index nifty volatility of one minute influence has been found on five minutes Banknifty future index. The one minute nifty influence has been observed on the fifteen minutes, thirty minutes, one hour and one day times periods of Banknifty. The high frequency trading impact has been measured on the retail investors trading activity with the help of the primary data. The structure equation model has been framed and the analysis result indicated that the very short holding periods with small margin per trade is having the significance influence and the it also depicted that the there is not much influence one end of the day position by the flash market. The study concludes that the high frequency trading influence is there in short time period but retail investor cont take the advantage due to non-availability of the of technology and funds. Hence there is a need to do further research in this area by considering the other external factors impact along with the retail investors' behaviour and attitude on the trading activity in the market.

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