

Predicting Equity VIX of Technological Companies



Divya V, Sharon Sophia

Abstract: *The impulse of the study is to examine volatility index of single options share of five different companies. The study emphasizes on the relationship between various VIX stocks when compared with VIX of Apple. The main objective of this study is to predict relationship of volatility index of single options stock of five different companies – Apple, Amazon, Goldman Sachs, Google, IBM. These equity stocks are considered to be the premier stocks which has its independent VIX. The study uses time series model. The test of its relevance is done Correlation, Covariance, ARCH and Granger Causality test. Any change in the VIX index of Amazon, Goldman sachs, IBM will not affect VIX of Apple. There will not be market affect for stock Amazon, Google, VIX and Goldman Sachs. It is the first study to identify the relationship of the volatility index of single options stock of five different companies.*

Keywords: *Volatility Index, Stock Market, Covariance, NIFTY, GARCH*

I. INTRODUCTION

Volatility implies level of uncertainty in the security price. Higher volatility indicates that the price may change drastically in either direction. Lower volatility indicates that the security's price does not vary drastically, but rather changes at a relentless pace over a timeframe. Volatility in option valuing demonstrates the degree to which the return of the underlying asset will change amongst now and the options termination. Volatility is a statistical measure of dispersal of returns of the securities provided. Volatility given in the option contract is nothing but the rate of coefficient inside option evaluating methodologies which emerges from day by day trading exercises. Volatility of Stock price has got an awesome consideration from both institutes and experts in the course of the most recent two decade because volatility can be used as a risk measure in financial market. Since a few years there has been a greater emphasis on the unpredictability or volatility in stock price. There are different measures of the volatility in stock market. Measuring of Volatility can also be carried out through volatility indices. The greatest attempt of the Volatility Index (VIX) was initiated by Chicago Leading

body of Alternatives Trade (CBOE) in 1993 to gauge advertise desires of the close term instability suggested by stock index option price. Off late even developed and developing economies have adopted the volatility index to predict share price. Implied volatility of option price is a basis to calculate VIX. It basically offers a market-decided, forward-looking appraisal of one-month securities exchange unpredictability. A volatility record is the measure of market desire of instability over a transient period.

Regularly alluded as the 'financial investors fear gage', VIX plans to track the market instability, giving a sign about how anxious the market is about what's to come. It mirrors speculators' accord perspective of future expected securities exchange instability. If the VIX level is low, it infers that the financial specialists are hopeful and self-satisfied as opposed to fear in the market, which demonstrates that the speculators forecast no potential hazard. Despite what might be expected, a high VIX perusing recommends that financial specialists see huge hazard and anticipate that the market will move strongly in either heading. VIX by and large moves contrarily to securities exchanges, rising when stocks fall and the other way around, which is also known as the 'fear index', VIX is really one of the best antagonist's specialized pointers on the planet. The VIX is forward looking. Volatility can have negative effect on existing portfolio position of financial specialists, may require usage of exorbitant supporting systems, and could unfavorably influence general venture returns. Dealers and portfolio supervisors join instability desires in their venture methodology determinations and effectively modify their positions to better oversee chance connected with unpredictability changes. Implied Volatility Index is used by practioners (VIX) to estimate volatility in stock market Index securities, over a brief timeframe and may utilize it as a hedge against existing positions. There is a general conviction that the VIX is an appropriate predictor for the future 30-day volatility of the market index (Whaley 2008). The VIX list influences the normal return of stock markets (Durand, Lim and Zumwalt 2011). The VIX index gives preferable estimate quality over recorded instability (Carr and Wu 2006; Corrado and Mill operator 2005). In 2008, the National Stock Trade has presented an instability record which is called the India VIX. India VIX measures inferred unpredictability figured by the NSE on Nifty 50 Index (also known as CNX Nifty 50 Index). It speaks about the level of volatility inferred by the prime markets but not the genuine or recorded instability of list itself. Volatility is near term forward looking and is ascertained by the call-put alternative premium.

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The study endeavors to examine relationship between the volatility of Indian securities exchange and India VIX, so that it can comprehend the directional impact between both of them. We foresee the negative relationship between them because the higher volatility in the market would imply the negative notion of the financial specialists. Then again, a lower volatility risk could mean a help in the speculator assumption and higher exchanging interest in the market. We additionally look at whether India VIX has prescient power concerning securities exchange unpredictability. The study is helpful for all money related market partners who need to comprehend remarkable components of instability in Indian securities exchange foresee the unpredictability and apply speculation procedures in view of the unpredictability.

A. INDIA VIX

India VIX (IVIX) is the volatility index figure of NSE in light of order book of the option Alternatives. The best offer solicit cites from close and one month from now option agreements are exchanged on the F&O segment NSE are utilized. India VIX shows the financial specialist's view of the market's instability. It delineates normal market instability in the following 30 days. Higher the India VIX values, higher the normal unpredictability and the other way around. A high India VIX price would propose that the market expects noteworthy changes in the Clever, while a low India VIX price would recommend that the market expects negligible change. It has likewise been watched that verifiably, a negative relationship exists between the two. Instability record like India VIX are regularly seen to show mean returning qualities by swaying around a long-haul change. India VIX reflects the normal development in option record throughout the following 30 days. For instance, if the value of India VIX is 16.8025, it means there is a normal annualized change of 16.8025% in the following 30 days. Despite the fact that VIX is called as the "fear gauge", a high VIX value is not really bearish for stocks. Rather, India VIX is a measure of market which saw instability in either bearing, including the upside. India VIX utilizes calculation approach of CBOE, with the appropriate corrections to adjust to the option choices order book.

II. LITERATURE REVIEW

Ashok Banerjee (2011), in this study endeavors to look at the execution of restrictive instability using (GARCH) and VIX in anticipating hidden unpredictability of Clever 50 record. The fundamental unpredictability of the NIFTY 50 is caught utilizing the highest recurrence information. A few methodologies are considered to evaluate acknowledged instability. The VIX and GARCH models are assessed utilizing diagnosis, similar to the mean total blunder, root mean squared mistake. SnehalBandivadekar and Saurabh Ghosh(2003), in this study considers the effect of presentation of record prospects of spot instability on both the S&P CNX Index and BSE Sensex utilizing Curve/GARCH method. Stavros Degiannakis and Christos Floros (2010), utilized Curve models for the day by day S&P500 log-returns are assessed, though the intraday costs involve the dataset for an ARFIMAX demonstrate. Model's determining execution is factually unrivaled when the CBOE's VIX list is joined as an

informative variable. Robert F. Engle and Eric GhyselsBumjeanSohn (2009), return to the connection between securities exchange unpredictability and macroeconomic action utilizing another class of segment models that recognize short keep running from common developments. We concentrate long chronicled information arrangement of total securities exchange instability in the beginning of nineteenth century, as in Schwert (1989). The models determined by the inflation and modern generation development are standardized as far as pseudo expectation for skylines of one quarter out-perform more conventional time arrangement unpredictability models at longer skylines. Henceforth, crediting financial basics into instability models pays off regarding long skyline gauging. The additionally find that at a day by day level, inflation and mechanical generation development, represent between 10 % and 35 % of one-day ahead instability forecast. In future, macroeconomic essentials assume a significant part even at short skylines. Eventually, every one of the models - absolutely time arrangement ones and those determined by financial factors - include basic breaks over the whole specimen traversing approximately a century and a half of day by day information. Thus, our examination likewise concentrates on pre-WWI i.e. the Incomparable Depression period, and the post-WWII. Our primary findings stay substantial crosswise over subsamples.M. T. Raju and KiranKarande (2003), considers value disclosure and unpredictability with regards to presentation of Clever fates in the National Stock Trade in June 2000. Cointegration and Summed up Autoregressive Contingent Heteroscedasticity methods are utilized to study value revelation and unpredictability individually. The real discoveries are that the prospects advertise (and not the spot showcase) reacts to deviations from harmony and value revelation happens in both the fates and spot advertise, particularly in the later 50% of the study time frame. Outcomes additionally demonstrate unpredictability the spot advertise has descended after the presentation of stock list prospects. Jordi Galí and TommasoMonacelli (2004), in this study exposes out little economy adaptation of the Calvo sticky value model, and shows how the harmony progression can be diminished to basic representation in the local inflation and the yield crevice. It utilizes the subsequent system to break down the macroeconomic ramifications of three option govern based strategy administrations of the little open economy: residential inflation and CPI-based Taylor rules, and a conversion scale peg. We demonstrate that the key difference among these administrations lies in the relative measure of their conversion scale instability. We additionally examine a unique case for which residential inflation constitutes the ideal arrangement, and where a straightforward second request estimates the utility of the agent purchaser and used to assess the welfare misfortunes connected with the imperfect principles. C. William Schwert (1988), in this paper breaks down the connection of stock unpredictability with genuine and ostensible macroeconomic instability, money related influence,

stock exchanging action, default hazard, and firm gainfulness utilizing month to month information from 1857-1986. Also, influence has a moderately little impact on stock instability. The abundance of the changes in total stock unpredictability is hard to clarify utilizing simple models of stock valuation. Surya Bahadur and G. C. Ranjana Kothari (2016), in this paper exactly breaks down the association amid India VIX and unpredictability in the Indian securities exchange. VIX India is an unpredictability list in view of the file alternative costs of NIFTY. The study inspects the day by day VIX and CNX NIFT unpredictability information for the 5-year time frame somewhere around 2009 and 2014. The study comes about uncover that Indian VIX has negative association with NIFTY and market return. In view of piece importance test, change disintegrations and drive reactions of vector auto-relapse (VAR) show, the study finds that stuns in Indian VIX have huge illustrative power for NIFTY unpredictability. There is presence of element interrelationship and lead-slack connections between India VIX and securities exchange unpredictability. Besides, the discoveries uncover that India VIX is a decent estimating marker for NIFTY Index instability over a one-month time span. Also it is observed that VAR show has predominant anticipating capacity for future securities exchange unpredictability. Gaurav Dixit and Dipayan Roy and NishantUppal (2013), in this paper figures a range of enthusiasm for the analysts in different domains of back particularly in the share trading system e.g. stock file, return on a stock, and so on. Securities exchange instability is one such territory. Since the beginning of inferred instability list (VIX) by the Chicago Leading body of Choices Trade (CBOE) in 1993, VIX record has created a great deal of intrigue. This study looks at the foreseeing capacity of a few specialized markers identified with VIX file to estimate the following exchanging day's instability. There is a wide arrangement of techniques accessible for gauging in fund. In this study, simulated neural system (ANN) demonstrating method has been utilized to gauge the upwards or downwards development in next exchanging day's instability utilizing India VIX (an unpredictability list in light of the Clever Record Choice costs) based pointers. The aftereffects of the study uncover that ANN models can be genuine convenient in gauging the downwards development in VIX. The information about a more plausible downwards development in instability may be critical esteem include for the speculators and help them in settling on choices identified with exchanging. The present study identifies the relationship and the movement of shares in the market. The present focuses on the recurring behaviour of VIX stocks with Global stocks which are assumed to be the strong stocks and price changes reflects the other stocks on a whole. The momentum in change in closing price and its effect in various markets makes the study first of its kind and relevant in Indian market scenario.

III. DATA AND ESTIMATION OF FACTORS

The analysis is designed to examine the extensive range of association amid the daily closing price of the Amazon-CBOE Equity VIX is VXAZN, Apple-CBOE Equity VIX is VXAPL, Goldman Sachs-CBOE Equity VIX is

VXGS, Google-CBOE Equity VIX is VXGOG, IBM-CBOE Equity VIX is VXIBM. Time series model is used to test the relationship between these stocks and which stock move significantly close with Apple stocks changes and which stock do not react to any changes made by the stock market on a whole. The time period for the study spanning from 2011 to 2016. The data source is taken from Federal Reserve Economic Data – St. Louis Fed Res. The time series model is tested using E-views Software for Time series.

In this section, an empirical result obtained from the analysis is presented. First efficiency of the different stock estimates and its effect on other equity stock is presented. Next, the relationship between Apple VIX and other stocks Volatility Indices is presented and discussed. Finally, a comparison is made with Apple VIX and other stocks Volatility Indices and the effect of change of the base variable is analysed.

IV. HYPOTHESIS

- A. H1: Apple VIX stocks had impact on the other selected VIX Stocks
- B. H2: VIX Stocks of the selected companies (Amazon, Goldman Sachs, Google and IBM) has impact on VIX Apple.

V. ANALYSIS AND INTERPRETATION

I. Tables

A. Table No. 1 Table showing ARCH Model Results

VARIABLE	COEFFICIENT	STD. ERROR	t-STATISTIC	PROB.
VXAZNCLS	0.356660	0.026525	13.44597	0.0000
VXGOGCLS	0.412188	0.042967	9.593162	0.0000
VXGSCLS	0.003338	0.020770	0.160692	0.8724
VXIBMCLS	0.296119	0.050764	5.833293	0.0000
R-Squared	0.414798	Mean dependent var		29.48118
Adjusted R-Squared	0.413397	S.D. dependent var		6.412618
S.E. of regression	4.911426	Akaike info criterion		6.024183
Sum squared resid	30225.00	Schwarz Criterion		6.040528
Log likelihood	-3782.199	Hannan-Quinn criter.		6.030326
Durbin Watson	0.172524			

R-squared value of 0.414798 indicates that every independent variable like VXAZNCLS, VXGOGCLS, VXGSCLS, VXIBMCLS explains 41.4798% of the total variance in the dependent variable (VXAPLCLS). Adjusted R-squared value of 0.413397 indicates that the variables which has strong correlation like VXAZNCLS, VXGOGCLS, VXIBMCLS explains the total variance of 41.3397% in the dependent variable (VXAPLCLS).S.

E. of regression equals to 4.91145 means that the average distance of the residual points i.e. the difference between the actual and the predicted values of the relationship and the fitted line is 4.91145. Lesser the difference better is the fit. Sum of squared residuals is 30225.00 which indicate the amount of error remaining between regression function and data set.



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Smaller the value better will be our estimation. Log likelihood is used to determine the optimal values of the estimated coefficients and compare the fit of different coefficients and so higher value is better. In our study the log like hood is -3782.199. The Durbin-Watson statistics is the statistical test used to check the autocorrelation between residuals with the help of regression analysis. The value of this statistics should lie between 0 – 4, where the least value represents positive autocorrelation and negative value means positive auto correlation. Here the derived value is 0.172524 that means this has a positive autocorrelation between the variables (independent and dependent). Akaike information criteria is 6.024183 which is a measure of the information lost when this model is used. So, lower the value, best is the model. Schwarz criterion is 6.040528. Lower the value of the models better is the fit. Hannan-Quinn Information Criterion should be small to be a better fit. Here it is 6.030.

B. Table No. 2 Table showing Basic Statistics using Jarque-Bera Test

	VXAPLCLS	VXAZNCLS	VXGOGCLS	VXGSCLS	VXIBMCLS
Mean	29.48118	34.16426	25.70541	28.59736	21.15037
Median	28.80000	32.57000	24.82000	26.28000	20.30000
Maximum	62.60000	66.06000	55.60000	87.47000	44.23000
Minimum	17.96000	18.47000	14.29000	16.16000	13.23000
Std. Dev.	6.412618	8.022647	6.022825	9.863944	4.359886
Skewness	0.846386	0.657245	0.970658	1.964334	1.277088
Kurtosis	4.065889	3.089284	4.393344	8.046105	5.543923
Jarque-Bera	209.5837	90.91548	299.0673	2142.012	680.6322
Probability	0.000000	0.000000	0.000000	0.000000	0.000000
Sum	37057.84	42944.48	32311.70	35946.88	26586.01
Sum Sq. Dev.	51648.82	80839.77	45560.68	122205.5	23874.81
Observations	1257	1257	1257	1257	1257

There is 1257 observations of CBOE Equity VIX from 2011-09-12 to 2016-09-08 for each company. The mean CBOE Equity VIX from 2011-09-12 to 2016-09-08 is most for VXAZNCLS and least for VXIBMCLS. The middle of observations of CBOE Equity VIX from 2011-09-12 to 2016-09-08 is most for VXAZNCLS and least for VXIBMCLS. The maximum value of observations of CBOE Equity VIX from 2011-09-12 to 2016-09-08 is most for VXGSCLS and least for VXIBMCLS. The minimum value of observations of CBOE Equity VIX from 2011-09-12 to 2016-09-08 is most for VXAZNCLS and least for VXIBMCLS. The standard deviation which is the measure of dispersion of data from its mean is most for VXGSCLS and least for VXIBMCLS. Lower value is better. All the companies have positive skewness values which means it is skewed towards right and since the value is nearby zero it is symmetric data. The kurtosis value for all the company's' CBOE Equity VIX is greater than zero which means it is heavy tailed which means that there is random variance. The p-value of JarqueBera probability is less than 0.05 which means that data is not normally distributed. The smaller the sum of squared deviations the better is the fit. VXIBMCLS has smaller value which means it varies less from the mean.

C. Table No. 3 Table showing Correlation between the variables under study

	VXAPLCLS	VXAPLCLF	VXAZNCLS	VXGOGCLS	VXGSCLS	VXIBMCLS
	CLS	F	S	LS	S	S
VXAPLCLS	1.000000	0.694891	0.651254	0.654424	0.548828	0.564169
VXAPLCLF	0.694891	1.000000	0.924670	0.928542	0.740487	0.866339
VXAZNCLS	0.651254	0.924670	1.000000	0.744957	0.635212	0.699522
VXGOGCLS	0.654424	0.928542	0.744957	1.000000	0.704082	0.790874
VXGSCLS	0.548828	0.740487	0.635212	0.704082	1.000000	0.707946
VXIBMCLS	0.564169	0.866339	0.699522	0.790874	0.707946	1.000000

Correlation coefficient values approaching 1 has stronger correlation like VXAPLCLS and VXGOGCL. Correlation coefficient values approaching -1 has weaker correlation. correlation coefficient value 0 indicates no correlation.

D. Table No. 4 Table showing Covariance Matrix

	VXAZNCLS	VXGOGCLS	VXGSCLS	VXIBMCLS
VXAZNCLS	0.000704	-0.000473	-5.95E-05	-0.000473
VXGOGCLS	-0.000473	0.001846	-0.000206	-0.001195
VXGSCLS	-5.95E-05	-0.000206	0.000431	-0.000243
VXIBMCLS	-0.000473	-0.001195	-0.000243	0.002577

If both the dependent and independent variables tend to move in same direction (increase or decrease), we can say it has a positive coefficient relationship. If the variables are not moving in same direction (one tends to increase and the other decrease), then it has negative coefficient relation between them. Here the covariance between the two is always negative.

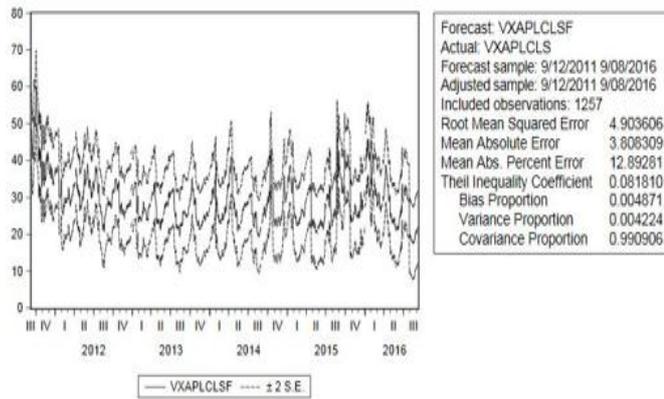
E. Table No. 5 Table showing Granger Causality Test results

NULL HYPOTHESIS	Obs.	F-Statistic	Prob.
VXAZNCLS does not Granger Cause VXAPLCLS	1163	0.93089	0.3945
VXAPLCLS does not Granger Cause VXAZNCLS		15.0553	4.E-07
VXGOGCLS does not Granger Cause VXAPLCLS	1163	9.72533	6.E-05
VXAPLCLS does not Granger Cause VXGOGCLS		6.80433	0.0012
VXGSCLS does not Granger Cause VXAPLCLS	1163	2.51121	0.0816
VXAPLCLS does not Granger Cause VXGSCLS		2.92695	0.0540
VXIBMCLS does not Granger Cause VXAPLCLS	1163	1.75967	0.1726
VXAPLCLS does not Granger Cause VXIBMCLS		7.46107	0.0006
VXGOGCLS does not Granger Cause VXAZNCLS	1163	16.9884	5.E-08
VXAZNCLS does not Granger Cause VXGOGCLS		2.18567	0.1129
VXGSCLS does not Granger Cause VXAZNCLS	1163	7.44254	0.0006
VXAZNCLS does not Granger Cause VXGSCLS		1.27757	0.2791
VXIBMCLS does not Granger Cause VXAZNCLS	1163	20.3829	2.E-09
VXAZNCLS does not Granger Cause VXIBMCLS		0.50236	0.6052
VXGSCLS does not Granger Cause VXGOGCLS	1163	7.57357	0.0005
VXGOGCLS does not Granger Cause VXGSCLS		0.04872	0.9524
VXIBMCLS does not Granger Cause VXGOGCLS	1163	9.39687	9.E-05
VXGOGCLS does not Granger Cause VXIBMCLS		3.63554	0.0267
VXIBMCLS does not Granger Cause VXGSCLS	1163	3.52944	0.0296
VXGSCLS does not Granger Cause VXIBMCLS		4.08055	0.0171

Any change in the VIX index of Amazon, Goldman sacks, IBM will not affect VIX of Apple. There will not be market affect for stock Amazon, Google, VIX and Goldman Sacks. This study indicates as equity stock options are independent of their own there is less variation or less interdependence of stock.

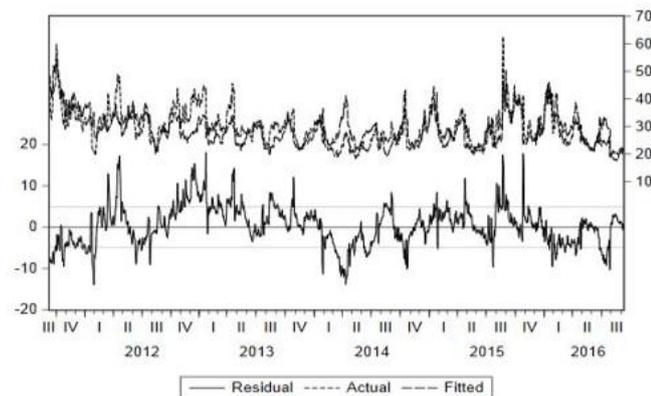
II. Figures

A. Figure 1 Chart showing the Forecasted Value for the variables under study



Root mean squared error is 4.90. Lower the value better is the forecast. Mean absolute error is 3.80 which means it the mean of the errors in the forecast. Lesser the value better is the forecast. Mean absolute percent error is 12.89 which is a measure of size of error in percentage terms. Lesser the value better is the forecast. The Inequality Coefficient is 0.081810. If U is equal to 0 for all forecasts then there is a perfect fit; if U is 1 then it means the predictive performance is as bad as it possibly could be. In our test result, bias is 0.00487 which is an indication of systematic error. Whichever is the value of U, bias should be close to 0. A large bias suggests that there is systematic error or under prediction. In our test result, variance is 0.004224 which indicates the ability of the forecasts to replicate the degree of variability in the variable to be forecasted. If the variance proportion is large then the actual series has fluctuated considerably whereas the forecast has not. Unsystematic errors measured by the Covariance which is 0.990906.

B. Figure 2 Chart showing the Residuals value



Actual value of the dependent variable has fairly random pattern with positives and negatives. Linear model provides a decent fit to the data if there is a random pattern. Fitted or estimated variable also has fairly random pattern with positives and negatives. Residual plot also has a fairly random pattern with positives and negatives. The line at 0 level is the regression line. The residual is the difference between actual and fitted. The residual values above the regression line indicate that the actual values are greater than the fitted. The residual values below the regression line indicate that the actual values are lesser than the fitted. The sum of positive

and negative residuals value is zero.

VI. CONCLUSION

This study contributes the existing literature by examining the relationship of volatility index of single option share of five companies which is supplemented by results from different tests. The movement of Gold man sacks Volatility and Apple Volatility do not have the same relationship. Their movement is different but other stocks move in tandem in same direction. In their individual relationship with Apple stocks, Amazon, Gold man Sachs and Google do not have an individual relationship. All socks move in an independent manner as they dominate the market.

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