International Economics and Finance Journal

ISSN :0973-5259

Volume 14 • Number 2 • July to December 2019

Relationship Between India VIX and other VIX

H. Ramasubramanian[1] and Sharon Sophia[2]

[1]*MBA (Finance and Analytics), Final Year, VIT Business School, VIT University, Chennai. Email: h.koushik@yahoo.com*

[2]*Assistant Professor, VIT Business School, VIT University, Chennai Email: (drsharonsophia@gmail.com)*

ABSTRACT

Objectives: The research focuses on relationship between India VIX compared with VIX of Chicago, Brazil, China, and USA over a period of two years. This paper also determines the volatility of the stock market and the momentum change with other markets.

Methods/Statistical analysis: For the purpose of the present study, secondary data is being used. The forecasting is done with the help of using Time Series Model, ARCH, Granger Causality and future forecast is done.

Findings: From the study it can be found that for every change in the Brazilian stock market, the Indian Stock Market also shows a change. This means that Volatility in the Indian Market is because of the Volatility in the Brazilian market. The Jarque Bera Test is used to find the Skewness, Kurtosis, and Deviation in the data. Stationarity in the data is found out using Correlogram test. The relationship between Dependent and Independent variable is represented using ARCH Model.

Application/Improvements: This is the first study to compare and contrast different stock markets to identify the effect of volatility in the stock market.

Keywords: Volatility, Stock Market, Change in VIX, Stationarity, Risk, Investor.

1. INTRODUCTION

Uncertainty of expected returns is the major concern of the investors, the predictableyields and inconsistency of yields are negatively correlated as discussed trendy many financial economics study. The stochastic market behaviour and the variation of returns has led to volatility of stock market. Volatility Index is considered as investors fear gauge and acts as an indicator for investors fear. As CBOE (Chicago Board of Options Exchange) adopted the implied volatility so India VIX also follows in NSE NIFTY 50. The frequent change in the price as well as price movement acted as fear gauge for Volatility Index for investor's investments. When VIX Index is low the level of risk is less for investors and the vice versa.

Fama, 1965; and French 1980; Trading hours face more volatility than the closing hours. French and Roll 1986; contribute the market itself is a greater contributor of Volatility that any asymmetric information. Other research also states that asymmetric information, financial information and investor behaviour may also be the cause of Volatility in the market. Research evidence indicate that any information based on economic factors or investor reflect the market volatility. Imbalance in trade and private information reflect the investor's perception and market volatility, Investors irrational and sentimental behaviour affects the stock market behaviour.

The study focuses on Indian VIX which is called to be a fear index for the investors, will this Index have an impact on the other Volatility index in the other global markets. The global VIX markets taken for the study are closely related the Indian VIX markets and their impact on Indian VIX and its reflections are empirically identified using time series model.

2. THEORETICAL FRAMEWORK

The study contributes towards the market reflection of the price and its momentum change across the global markets. The main contribution of the study is to identify do markets significantly change as the price change takes place in other markets. If so than Indian VIX markets are at par with the Global markets and thestudy contributes to the new arena of research not done in this field. The market timing of India VIX and the other market change in price reflection is considered as a major factor to identify the need of the study. If the markets move in the same direction or in the different direction. If the markets move in the same direction the price movements reflect the other markets behaviour if the markets movement is different direct it will not reflect in any change. It is an indication that that any change in any countries behaviour will not have any affect in the other market behaviour.

3. LITERATURE REVIEW

Past studies identifies a major thrust for the study using VIX. VIX is research in various context either they use it in establishing the relationship between various markets or the effect of one market over the other. Frequently other studies also focuses on the market indicator, economic variables and other factors that may create a fear gauge among the market and inflate the price movement in the VIX market. Interestingly all these studies contribute to the moving behaviour of the VIX market across the Globe. These studies are also a trendsetter in market movements and the share price return in the market which is significantly a major area toward research.

Snehal Bandivadekar and Saurabh Ghosh, (2003), contend the effect of spot market volatility of index future on S&P CNX NIFTY and BSE SENSEX with ARCH / GARCHprediction. DebeshBhowmik, (2013), the study evaluated the global equity market multidimensional framework on stock market volatility using MG GARCH and GARCH Model. M.Thenmozhi and Abhijeet Chandra, (2013), examines that negative NIFTY yieldsstandassociated to change in the India VIX. Index movements move independently and theirmovement is asymmetric in relationship.DebasisBagchi, (2006), using market ratios the study targets to examine direct and cross-relationship of India VIX. The study is related to the Indian VIX market and

the Korean VIIX market and if effect during the long term tandem relationship. Ming Jing Yang, (2012), explores that the emerging markets have more predictive power of the volatility index (VIX) than other market trend it is studied for an interval of December 2006 to March 2010. The study concludes that VIX and option market have more forecasting power that other markets. Ashok Banerjee and Ritesh Kumar, (2011), attempts to compare the performance of conditional volatility model (GARCH) and VIX in predicting underlying volatility using the high frequency data from Nifty 50 index. The markets concentrated in this study are cash index market and stock market. NIFTY 50 index, conditional volatility index, and VIX are the variables used in this study and the instruments used are time series model or forecasting model. MadhusudanKarmakar, (2005),the study focuses on the conditional volatility models of India VIX and assess the models based onout-of sample forecast accuracy. The studyexamines the leverage ofsignificance in Indian companies. This research has been conducted in the Indian stock market, the variables being S&P CNX NIFTY and BSE SENSEX. The instrument used in the study is regression based efficiency test.Daniel.O.Cajueiro, Benjamin.M.Tabak, (2005), tests whether cross-border markets have long-term dependence on volatility for equity returns. The study has been made in 12 stock markets using GARCH Model test.Kumar, Sundaram, (2009), the study uses EG Co-integration model to examines the associationamid macroeconomic constraints of stock returns in National Stock Exchange. Suchismita Bose, (2007), using GARCH model the changes in return and the VIX market the future market and the stock market are examined.

The present focuses on the recurring behaviour of VIX market with Global markets which are assumed to be the strong markets and price changes reflects the other markets 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.

4. DATA AND MEASUREMENT OF VARIABLES

The research is designed to test the effect of India VIX closing price compared with Chicago VXOCLS, Brazil VXEWZCLS, China VXFXICLS and US NASDAQ VIX.Time series model is used to test the relationship between these market and which market move significantly close with Indian market changes and which market do not react to any changes made by the stock market on a whole. The time period for the study spanning from1stMarch 2014 to 31stMarch 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, the relationship between India VIX and other country Volatility Indices is presented and discussed. Also a comparison is made with India VIX and other Volatility Indices and the effect of change of the base variable is analysed.

The hypothesis for the study is

1. The estimate the relationship between India VIX with other leading VIX markets.
2. With momentum change in the India VIX market and its effect on the other cross border market.

Table 1
Summary Statistics

	India	*Brazil*	*China*	*USA*	*Chicago*
Mean	16.32388	39.95490	29.72546	18.19537	16.38471
Median	15.29000	40.50000	29.39000	17.33500	15.42500
Maximum	40.74000	59.38000	58.40000	42.95000	37.66000
Minimum	0.00000	0.00000	0.00000	0.00000	0.00000
Std. Dev.	5.308374	10.98085	8.654524	5.694848	5.426186
Skewness	-0.043884	-1.482063	-0.791162	-0.225738	-0.053379
Kurtosis	6.265671	7.045098	6.889737	6.493984	5.601889
Jarque-Bera	182.3186	429.6265	301.2441	212.0341	115.8459
Probability	0.00000	0.00000	0.00000	0.00000	0.00000
Sum	6692.790	16381.51	12187.44	7460.100	6717.130
Sum Sq. Dev.	11525.14	49316.83	30634.42	13264.40	12042.39
Observations	410	410	410	410	410

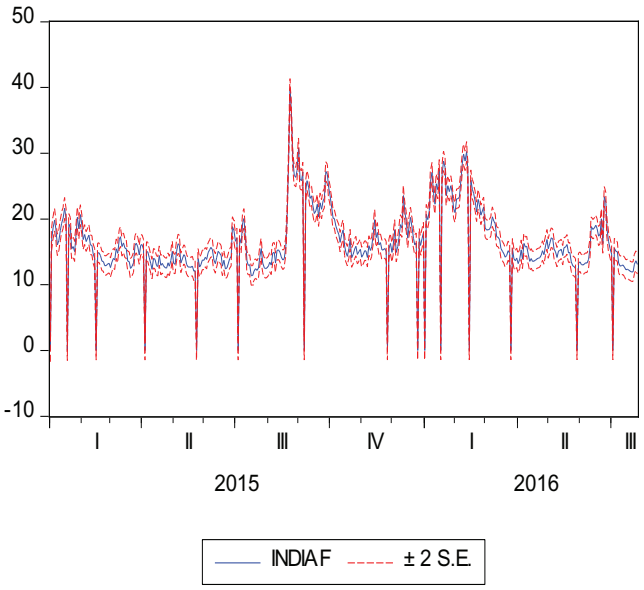
There are 410 observations of CBOE Equity Index from 01-01-2015 to 27-07-2016 for each country. The mean CBOE Equity Index is more for Brazil VXEWZ from 01-01-2015 to 27-07-2016 and the least is for India VIX.The median CBOE Equity Index is more for Brazil VXEWZ from 01-01-2015 to 27-07-2016 and the least is for India VIX.The standard deviation CBOE Equity Index is more for Brazil VXEWZ from 01-01-2016 to 27-07-2016 and the least for India VIX.The skewness for all the country is on the negative side. For Brazil VXEWZ alone it is skewed more towards the left and for other countries, it is near to the zero. The Kurtosis for all the countries is greater than zero. This implies that the data heavy tailed and there is a random variance.The p-value of JarqueBera Test is less than 0.05, indicates data is normally distributed.Sum of squared deviations should be low for a better fit. India VIX has a low sum of squared deviations which means it varies from the mean value

Table 2
Table showing ARCH Model results

Variable	*Coefficient*	*Std. Error*	*Z-Statistic*	*Prob.*
Brazil	-0.032598	0.003554	-9.172823	0.0000
China	-0.014778	0.006010	-2.458813	0.0139
USA	0.577701	0.022807	25.33045	0.0000
Chicago	0.466481	0.021618	21.57795	0.0000
		Variance Equation		
C	0.054017	0.014264	3.787092	0.0002
RESID(-1)^2	0.564601	0.143647	3.930490	0.0001
GARCH(-1)	0.337434	0.103003	3.275968	0.0011

Variable	*Coefficient*	*Std. Error*	*Z-Statistic*	*Prob.*
R-squared	0.978603	Mean Dependent Var		16.32388
Adjusted R-squared	0.978445	S.D. Dependent Var		5.308374
S.E. of regression	0.779354	Akaike info criterion		1.753315
Sum squared resid	246.6014	Schwarz Criterion		1.821884
Log likelihood	-352.4296	Hannan-Quinn criter.		1.780433
Durbin Watson stat	0.334325			1.780433

The dependent variable for this test is India VIX.



Forecast: INDIAF	
Actual: INDIA	
Forecast sample: 1/01/2015 7/27/2016	
Included observations: 410	
Root Mean Squared Error	0.775543
Mean Absolute Error	0.568601
Mean Abs. Percent Error	NA
Theil Inequality Coefficient	0.022517
Bias Proportion	0.013168
Variance Proportion	0.017639
Covariance Proportion	0.969194
Theil U2 Coefficient	NA
Symmetric MAPE	NA

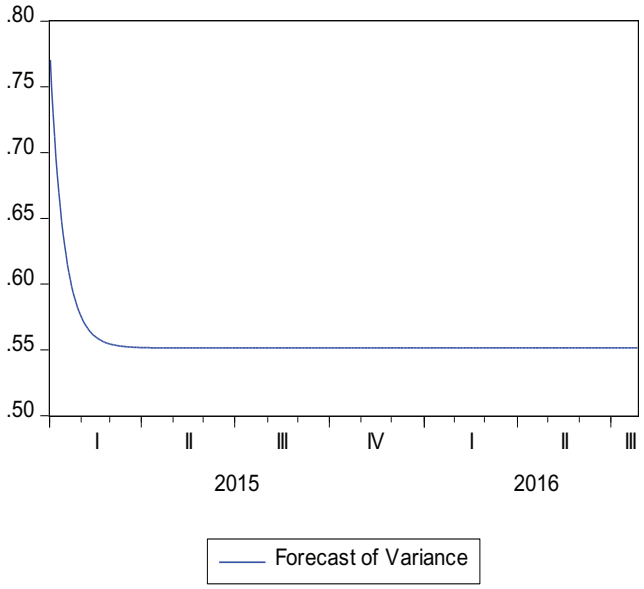


Figure 1: Chart Showing the Forecasted Values of Variables under Study

R-squared value of 0.978603 indicates that the every independent variables like Brazil, China, USA and Chicago illuminates 97.8603% of the deviation from the dependent variable India.Adjusted R-squared value of 0.978445 indicates that the variables which has strong correlation like Brazil, China USA and Chicago describes 97.8445% of the total variation in Indian market.S.E. of regression is0.779354 means that the average distance of the residual points i.e. the difference between actual and predicted values of relationship and fitted line is 0.779354.Lesser the fit better is the fit.Sum of squared residuals is 246.6014 which indicates the amount of error remaining between regression function and data set. 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 likehood is -352.4296.Durbin-Watson stat is used to identify the existence of autocorrelation between residuals. Thestandards should lie between 0 and 4 where values approaching 0 indicate positive and 4 is negative autocorrelation. Here the value is approaching towards 0.334325 which means there is a positive autocorrelation between the past and present relationship between independent and dependent variables.

Interpretation: Root mean squared value is 0.775543. This shows that the model is a best fit model. Mean absolute error is 0.568601. This denotes the value of errors in the forecast. There is no mean absolute percentage error in the data set.The inequality coefficient is 0.22517. It is perfectly fit if U = 0, and imperfect if U = 1. Bias is 0.013168 is an indication of systematic error. If it is close to 0, it is a perfect fit model. Systematic over or under prediction happens with large bias. Variance is 0.017639 is an indicator of degree of variability to forecast. The movement of variance proportion is not equated to the forecasted proportion. Covariance is 0.969194 is a tandem movement between actual value and the forecasted value.

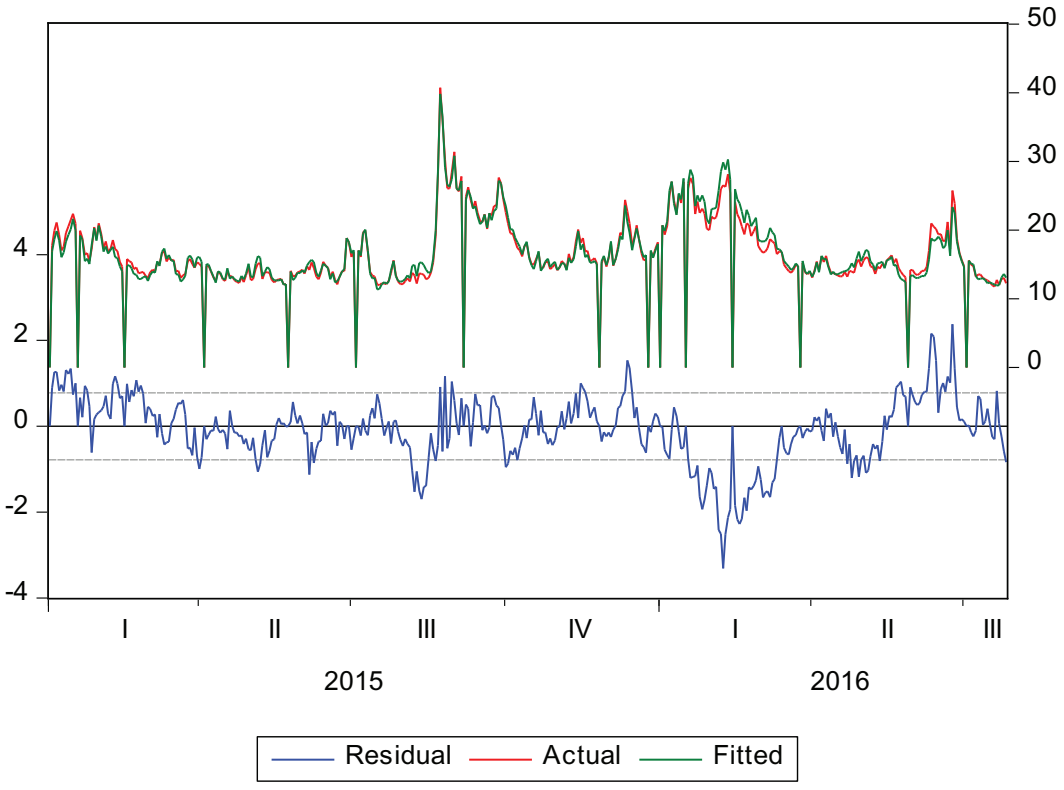


Figure 2: Chart showing the Actual, Fitted and Residuals value

Interpretation: Actual value of the dependent variable shows a good pattern with a positive movement. This indicates that the linear model provides a good fit to the data set. Fitted value of the dependent variables shows a positive movement above the regression line. This indicates that the linear model provides a good fit to the data set. Residual value of the dependent variable shows a random pattern with positive and negative movement. This random pattern indicates that a linear model provides a decent fit to the data. 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 actual values are greater than fitted. The residual values below the regression line indicate actual values are less than fitted. The sum of positive and negative residual values is zero.

Table
Table showing the Granger Causality Test

Null Hypothesis	*Obs*	*F-Statistic*	*Prob.*
BRAZIL does not Granger Cause INDIA	408	9.41073	0.0001
INDIA does not Granger Cause BRAZIL		2.36996	0.0948
CHINA does not Granger Cause INDIA	408	9.89243	6.E-05
INDIA does not Granger Cause CHINA		3.20727	0.0415
USA does not Granger Cause INDIA	408	0.54915	0.5779
INDIA does not Granger Cause USA		0.04462	0.9564
CHICAGO does not Granger Cause INDIA	408	0.43556	0.6472
INDIA does not Granger Cause CHICAGO		0.45132	0.6371
CHINA does no Granger Cause BRAZIL	408	3.92196	0.0206
BRAZIL does no Granger Cause CHINA		5.75210	0.0034
USA does not Granger Cause BRAZIL	408	1.96161	0.1420
BRAZIL does not Granger Cause USA		8.84570	0.0002
CHICAGO does not Granger Cause BRAZIL	408	1.76979	0.1717
BRAZIL does not Granger Cause CHICAGO		8.08941	0.0004
USA does not Granger Cause CHINA	408	3.72886	0.0249
CHINA does not Granger Cause US\A		10.0284	6.E-05
CHICAGO does not Granger Cause CHINA	408	1.94165	0.1448
CHINA does not Granger Cause CHICAGO		7.36576	0.0007

When changes in Indian market will not affect Brazilian market as *p* value is 0.0948. Indian and USA market as well the vice versa has no relationship even during market changes. Both the markets do not react to changes. The same is the condition of Chicago and Indian VIX the markets dare not sensitive to any information. USA and Chicago market do not have any long term impact on any change that takes place in Brazil market. Chicago market do not implement China market. All this comparisons are done based on the *p* value.

5. FINDINGS

The study shows how the Indian stock market behaves with every change in the foreign market.It is found that for every change in the Brazilian Market (VXEWZCLS) the volatility was found in India (VIX) also. The JarqueBera test is used to find the Skewness, Kurtosis and the Standard Deviation etc.Stationarity in the data has been found out using Correlogram Test.ARCH Model represents the linear associationamong the dependent and independent variables.India VIX moves so do other markets also move simultaneously. The rate of change in each country's volatility index with the other is found using Granger Causality Test with the help of one Null and one alternate Hypothesis.

6. CONCLUSION

The study on Volatility Index of Stock Markets is done to analyse the effect of change of the base country's index with respect to other countries. Any change in India VIX reflects the change in other markets as well. This indicates the market movement among the shares. The result indicates that individual market movements with India VIX the other countries that do not relate are USA and Chicago. The movement of volatility has an inverse effect.

References

Ayodeji,R. 2009. "Stock return volatility and the global financial crisis in an emerging market: The Nigerian case".

Bagchi,D. 2006. "Some preliminary examination of predictive ability of India VIX". https://www.nseindia.com/content/research/res_241_completed.pdf

Bandivadekar,S. Ghosh,S. 2003. "Derivatives and Volatility on Indian Stock Markets". Vol. 24 No. 3

Banerjee,A. Kumar,R. 2011. "Realized volatility and India VIX", financelab.iimcal.ac.in/resdoc/WPS-688.pdf

Bhowmik,D. 2013. "Stock Market Volatility: An Evaluation". Vol. 3, Iss. 10, pp.71-86.

Bose,S. 2002. "Foreign Institutional Investment in Indian Equity Market". Vol. 2 Iss.9-10.

Bose,S. 2007. "Understanding the volatility characteristics and transmission effects in the Indian Stock Index and Index Futures Market".

Deb,GS. Mukherjee,J. 2008. "Does stock market development cause economic growth? A time series analysis for Indian Economy". Vol. 21 pp.142-149

Hussain,F. 2011. "Day of the week effect and stock returns (Evidence from Karachi Stock Exchange – Pakistan), Vol. 3 Iss.1 pp25-31

Karmakar,M. 2005. "Modelling conditional Volatility of the Indian Stock Market". Vol. 30, No. 3, pp.21-35

Kaur,H. 2004. "Time varying volatility in the Indian Stock Market", Vol. 29, Iss. 4, pp25-42

Lux,T. 2012. "Evolvement of uniformity and volatility in the stressed global financial village".PLoS ONE 7(2): e31144. doi:10.1371/journal.pone.0031144

Mahajan,S. 2009. "The empirical investigation of relationship between Return, Volume and Volatility Dynamics in Indian Stock Market". Vol. 2 Iss. 4 pp113-137

Mayhew,S. 1999. "Stock Index futures trading and volatility in international equity markets". Vol. 20, Iss, 7 pp661-685.

Mishra,PK. 2009. "Empirical evidence on Indian Stock Market efficiency in context of the Global Financial Crisis". Vol. 1 Iss. 2. Pp149-157

Mishra,PK. 2010. "Gold price volatility and stock market returns in India". Vol. 10 Iss. 9. Pp47-55

Mukherjee,D. 2007. "Comparative analysis of Indian Stock Market with International Markets". Vol. 1 Iss. 1 pp39-71

Nath,G. 2012. "Behaviour of stock market volatility after derivatives". Vol. 5 Iss. 1 pp289-305

Singh,D. 2010. "Causal relationship between macroeconomic variables and stock market: A Case study for India". Vol. 29, No. 4, pp25-42

Sundaram. 2009. "Investigating causal relationship between stock return with respect to exchange rate and FII: An evidence from India".

Tabak,B. 2005. "Testing for time-varying long range dependence in volatility for emerging markets".

Thenmozhi,M. Chandra,A. 2013. "India Volatility Index and Risk Management in the Indian Stock Market". https://www.nseindia.com/research/content/res_WorkingPaper9.pdf

Varma,J. 1999. "Value at risk models in the Indian Stock Market".

Yang,MJ. 2012. "The forecasting power of the Volatility Index in emerging markets: Evidences from the Taiwan Stock Market". Vol. 4 Iss. 2 pp217-231

Yartey,C. 2008. "The determinants of stock market developments in emerging markets: Is South Africa different?" Vol. 8 Iss. 32 pp2-31.