Causality between India VIX and its Futures Prices

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Abstract

India VIX is a volatility index based on the index option prices of NIFTY. It indicates the investor's perception of the market's volatility in the near term. Now the VIX futures can be used by the participants either to diversify their portfolio or to trade on volatility in the futures market. The relationship between the VIX and the VIX Futures is an active consideration for market participants because the investors are always inquisitive to know whether the VIX Futures Market leads the VIX Spot Market or vice versa. This study is the empirical test of the linear relation of VIX and the VIX Futures market for the period ranging from 26 February 2014 to 31 March 2016and will be useful for the investors to take trading or investment decisions. It will also be helpful for the regulatory authorities in designing the new financial instrument or to modify the existing one. According to linear Granger Causality test during the full sample period, VIX and VIX Futures have bidirectional causal relationship. This bi-directional causality between India VIX and India VIX Futures shows that both spot and the future market react simultaneously to the new information.

Keywords: India VIX, Granger Causality, Volatility.

Introduction

It is the volatility of the stock market which remains an active consideration of all the participants of the stock market and the academicians. That is why in the year 1993 Chicago Board of Exchange (CBOE) introduce VIX - CBOE Volatility Index. It was the weighted measure of the implied volatility of eight S&P 100 at-the-money put and call options, and after analysing the success of the implied volatility index many countries in the world are encouraged to introduce the same in their respective stock markets. In the same series of introduction of volatility indices India also introduce the INDIA VIX in the year 2008. VIX are the Volatility indices that enables the market participants to trade expected changes in market volatility in a single transaction. Investors expecting rising volatility levels will go long, whereas investors expecting decline in volatility will go short. That is why the every investor remains inquisitive toward the volatility of the stock market. And Volatility Index (India VIX) shows the expected market volatility over the next 30 calendar days. A higher India VIX value indicates higher expected volatility and vice-versa.

As per the report of S&P 500 Corporation VIX is very important tool for forecasting the direction of future market movements. In Feb. 2014 NSE Launches NVIX Futures on India VIX index. Although there are number of studies on the relationship of the Indian spot and futures market but there are very few empirical studies on this new market of volatility index. Hence the focus of the present study will on the linear causal relationship of VIX and the VIX Futures market.

The focus of this study is on the lead lag relationship between VIX and the VIX Futures market. Lead-lag relationships reflect that in which market the effect of new information noticed first and in which market it noticed later and this gap of time period reflect the how much the market is lagging behind the other. If the effect of the information reflected at the same time in both the market then there is no lead-lag relationship and hence the market is efficient. The same problems is studied in different financial markets by various academicians.

Review of Literature

(Roope & Zurbruegg , 2002) Studied the Taiwan and Singapore index spot and futures market and found the bidirectional causal relationship between the spot and future market meaning thereby that markets are efficient. From the above studies it is clear that results on the lead-lag relationship are still inconclusive. Hence in the present study we will check the status of the Indian VIX and its future.

(Debasish, 2009) Used Autoregressive Moving Average (ARMA) Model for studying the Lead-lag relationship between NSE Nifty index and its derivatives contracts like futures, call and put options and found that the futures market clearly leads the cash market although this lead appears to be eroding slightly over time.

(Jackline & Deo, 2011) Investigated the Lead - lag relationship between the futures and spot prices in the commodity market in India through Granger Causality Test and found that in short run future price series leads the cash market and vice versa means bidirectional causality in both the selected markets. The result proved that there was no profitable arbitrage that exists and that the selected markets were perfectly efficient.

(Shu & Zhang, 2011)Examined causality between VIX and VIX futures prices with both Linear and Non-linear and found that the nearest and the second nearest maturity VIX futures prices lead the spot VIX index, which indicates that the nearest and the second nearest maturity VIX futures have some price-discovery function. On the other hand they found that there is no causality effect in distant VIX futures prices. They also tested the same for Non –Linear Granger Causality for this they applied modified Baek and Brock nonlinear Granger Causality technique and found that there is bi-directional causality between VIX and VIX futures prices, suggesting that both spot and futures prices react simultaneously to new information. They finally concluded that even though the VIX futures market has some price-discovery function, but such prediction power is unstable and is not very useful in gauging future price movement.

(Zakaria & Shamsuddin, 2012)Empirically tested the relationship between cash price index and future price index in the Malaysian stock market by using co-integration and Granger causality regression. It is found that there is a long rung stable relationship between spot index and futures contract indices of Malaysian stock market. Meanwhile, the Granger causality tests suggest that the direction of causality is unidirectional running from cash market index to futures market indexes. The finding shows that in case of Malaysia, the cash prices lead the futures prices.

(Judge & Reancharoen, 2014) Used the Granger Causality test and Error Correction Model (ECM) to test the lead–lag relationship and forecasting. This model has an advantage of including both a short-term dynamic and long-term equilibrium effect in the model; hence, the test is robust in terms of durations and found that the SET50 index leads SET50 index futures in Thailand. The results of this study are consistent with many other studies that find the spot markets lead futures market.

(Irfan & Hooda, 2017) Empirically investigated the price discovery process through Granger Causality in Agricultural Commodities Market of India. In this they selected 10 agricultural commodities and found that in case of Wheat, Chili, Turmeric and Mustard-Seed there is unidirectional causality (either futures causes spot or the vice versa.). But in case of remaining 6 commodities there is no causality between the spot and futures prices of the commodities.

Research Methodology and Data Collection

The closing values of India VIX and the closing Prices of India VIX Futures were collected from the National Stock Exchange (NSE) website. The study contains the Value of India VIX and India VIX Futures Closing prices for time period from Feb, 2014to March 2016with total of 513daily observations each. All statistics values are calculated with Eviews 9.5 Student Lite software.

Granger's concept (1969, 1988) is used to check the Causality among the variables. Granger proposed a time series data based approach to determine causality. As per Granger X is a cause of Y if X is able to increase the accuracy of the prediction of Y with respect to a forecast, considering only the past values of Y in forecasting Y.

As our study deals with the time series data, the problem with time series data is the non-stationarity. In absence of stationarity the results of Granger concept will be spurious. So here the researchers follow the step by step process to apply granger causality test. So in the first step to check the stationarity of the data ADF test is applied at level and at 1st difference. In the second

step to check the long run equilibrium relationship Johansen Co-integration test is applied and in the final step to check causality Granger Causality concept is used.

Empirical Results

Unit Root Test

Ho1: Variable NVIX Future do have Unit root (Series is Non stationary).

Ha1: Variable NVIX Future do not have Unit root (Series is stationary).

Ho2: Variable VIX do have Unit root (Series is Non stationary).

Ha2: Variable VIX do not have Unit root (Series is stationary).

In time series analysis time series is the prime condition. The time series variables should have unit root at level and it must be stationary at level one. In this study Augmented Dickey Fuller (ADF) test has been applied. It has three models on which it is examined whether the variables are unit root. These three models of ADF test are intercept, trend and intercept and no trend no intercept. Here null hypotheses are Variable NVIX Future do have Unit root and Variable VIX do have Unit root foe VIX futures and VIX respectively which should be accepted or rejected on the basis of their test statistics and probability values. As per the ADF Test theory if the test statistics (in absolute terms meaning after ignoring the negative signs) is greater than the critical value and probability value is less than level of significance (which is at 5% considered good in Finance literature) then the null hypothesis will be rejected. The result of unit root test for the variables NVIX Future and VIX has been portrayed in the table (1) below:

Table 1: ADF Test at Level

ADF Test at Level						
Variables	**ADF Model**	**Test Statistics**	**P-value**	**Critical Value**		
				1%	**5%**	**10%**
NVIX Future	Intercept	-2.82	0.06	-3.44	-2.87	-2.57
	Trend & intercept	-2.85	0.18	-3.98	-3.42	-3.13
	None	-0.58	0.47	-2.57	-1.94	-1.62
VIX	Intercept	-3.27	0.02	-3.44	-2.87	-2.57
	Trend & intercept	-3.27	0.07	-3.98	-3.42	-3.13
	None	-0.69	0.42	-2.57	-1.94	-1.62

Source: Calculated by researcher using E-views 9.5.

The above table depicts the unit root test results in three models of ADF. In all models of ADF test for NVIX Future and VIX, test statistics are less than the critical (except the VIX in case of intercept) value at 5 percent level of significance and probability values are more than 0.05, (except the p value in case of VIX intercept model where p value is 0.02 which is less than 0.05 it can be ignored because other two models show p value 0.07 and 0.42 which are greater than 0.05) which means we are fail to reject null hypothesis. It means that both the variables have got unit root at level.

As per the condition of time series data it is necessary that data should be Non stationary at levels and to be stationary at level one, this study has examined the unit root for the variables at level one. The results of the ADF test has been presented in the following table (2).

Table 2: ADF Test at Level One

ADF Test at Level One						
Variables	**ADF model**	**Test Statistics**	**Prob.**	**Critical Value**		
				1%	**5%**	**10%**
NVIX Future	Intercept	-22.06	0.00	-3.44	-2.87	-2.57
	Trend & intercept	-22.04	0.00	-3.98	-3.42	-3.13
	None	-22.81	0.00	-2.57	-1.94	-1.62
VIX	Intercept	-18.18	0.00	-3.44	-2.87	-2.57
	Trend & intercept	-18.16	0.00	-3.98	-3.42	-3.13
	None	-18.19	0.00	-2.57	-1.94	-1.62

Source: Calculated by researcher using E-views 9.5.

The above table (2) show the result of ADF test at level one. In all models of ADF test for the both variables, t-statistics are greater than critical values at 5 percent level of significance and probability values are less than 0.05. This leads to rejection of null hypotheses which are (a) Variable NVIX Future do have Unit root (Series is Non stationary) and (b) Variable VIX do have Unit root (Series is Non stationary) respectively for both the variables. Which indicate that the NVIX Future and VIX are stationary at level one.

Johansen Co-integration Test

Ho: There is no co-integration between the VIX and VIX Futures.

Ha: There is co-integration between the VIX and VIX Futures.

Examination of co-integration is required to check the relationship between the variables of the study. In time series analysis it is necessary to check whether there is existence of relationship between the variables. To meet the requirement of time series analysis for co-integration, this study has used the Johansen Co-integration test. In this test two statistics such as trace statistics and max statistics has been utilized. The null hypothesis is there is no co-integration between the variables which can be rejected on the basis of trace and max statistics. If the value of trace and max statistics are greater than 5 percent critical value, then the null hypothesis can be rejected. The results of the test has been portrayed in the table (3) below.

Table 3: Johansen Co-integration Test

Johansen Co-integration test								
	Trace Statistics				**Max Statistics**			
Maximum Rank	**Eigen value**	**trace statistics**	**5% critical value**	**Prob.**	**Eigen value**	**max statistics**	**5% critical value**	**Prob.**
None	0.08	47.47	15.49	0.00	0.08	40.12	14.26	0.00
Utmost one	0.01	7.35	3.84	0.01	0.01	7.35	3.84	0.01

Source: Calculated by researcher using E-views 9.5.

The above table (3) indicates that trace and max statics for maximum rank none are more than 5 per cent critical values and the probability values are also less than 0.05 percent level of significance. It leads to reject the null hypothesis which means that there is presence of co-integration between the variables.

Granger Causality Test

The co-integration test reveals the existence of relationship between the variables but it does not indicate the causal relationship. For the examination of causal relationship the present study has adopted Granger causality test with Granger's concept (1969, 1988). In this test probability value plays crucial role for the acceptance or rejection of null hypothesis which is, there is no granger cause between the variables. If probability value is less 0.05 at 5% level of significance the null hypothesis should be rejected. The table (4) depicts the results of the Granger causality test.

Table 4: Granger Causality Test

Granger Causality Test			
Null Hypothesis	**Obs.**	**F-Statistics**	**Prob.**
VIX does not granger cause NVIX Future	511.00	8.33	0.00
NVIX Future does not granger cause VIX	511.00	9.99	0.00

Source: Calculated by the researcher by using E-views 9.5.

The above table (4) shows that the p-value is 0.000, less than 0.05 level of significance which leads to reject the null hypothesis. It means that VIX does granger cause NVIX Future. Probability is also 0.000, less than 0.05 level of significance for the null hypothesis NVIX Future does not granger cause VIX which leads to reject the null hypothesis. It means NVIX Future does granger cause VIX.

Conclusion

As the various stock market are introducing the Volatility Index (VIX) Derivatives one after the another and hence the use of VIX derivatives for portfolio diversification purposes is increases. Soit becomes important to directly address the issue of whether VIX and VIX futures price are predictable by one another, or they can be predicted by their own historical patterns. The empirical results of this study shows that the both variables causes each other which reveals the bidirectional causal relationship between the VIX and VIX Future.

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