Dynamism of Indian futures and Cash Markets - An analysis with Impulse response function

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Summary
A dynamic relationship between futures and cash markets in the form of positive and negative response of each variable and causal relationship is found through the impulse response function by taking the data of S&PCNX Nifty and its underlying index for the period 2000-2011. The result reveals that there is positive significant response from the futures and spot market shocks. Further it is found that spot return, turnover, open interest, futures market volatility and number of contracts are playing a vital role to predict the movement of futures market as the existence of causal relationship among them. The causal relationship between futures market and its determinants helps the traders and investors to predict the market. The negative or positive sign of effect in the futures market from the determinants provide more clarity on the movement and help the traders to make decision on buying or selling option. The weak or semi strong form of market behavior of Indian market is also proved by the study.

Key words :- Dynamic relationship, Causality, Impulse response, Forms of market.

1. Introduction
Very strong relationship between futures index trading and the liquidity of its underlying market shows that the trading of stock index futures enhances the liquidity of the underlying stocks (Galloway.M.Tina and Miller 1997). The trading between futures and its spot market also enhances the liquidity of its trading. The role of arbitrage process in the index futures helps to increase the trading volume and its liquidity. Danthin (2003) and Edward (2006) argue that index related trading strategies like index arbitrage will increase liquidity. Trading between spot and futures market enhances the trading volume and liquidity of the index trading. Variables from the futures market can also be used as the elements which may predict the movement of futures return. The relationship between different variables in the futures market reveals the ability of each variable to reflect the information flow to the market and its role in determining the futures market movement. Information flow, measured by trading volume has a positive relationship with volatility while market depth measured by open interest has an inverse relationship with volatility (Bessembinder and Seguin 1992, P. Sakthivel and B.Kamaiah 2009). The reaction and response of market shock on each variable help the traders to predict the movement of another variable. The Impulse response function measures the time profile of effect of a shock, on the expected futures values of a variable- a conditional variance of equity volatility (Dawson and Stikouras 2009). The unexpected shocks are easily absorbed and quickly disappeared as a result of risk neutrality as participant have hedged their exposure to market fluctuations.

The inter relationship between variables in futures market and the ability of the variable to respond to the shocks on the variables can also be traced with the help of impulse response function. Impulse responses and variance decomposition analysis explain economic significance in addition to statistical significance (Brajesh Kumar and P.Singh 2009). The interrelationship between futures return, spot return, open interest, turn over, number of contract and futures market volatility are discussed in by this study with the help of Impulse Response Function and this provides information on the causal relationship between these variables separately and together of the futures market in India. Literature proves the point those variables both from spot and futures markets play the role of passing information and their relationship helps to provide one with another. Therefore in order to identify the
role of each variable on the futures return and find the level of influence of each one to the futures return, the VAR system is applied. This method takes each variable as endogenous and exogenous and finds the influence of each variable to another separately and together. This study is an attempt to find the level of influence of each variable in the futures market and helps the traders to predict the movements of futures return then make strategic decisions on the trading pattern. The literatures find that open interest, trading volume and volatility are playing their own role in the futures market (Julio 2008), Pratap Chandra Pati (2010), Gwilym et al (1999), Cambell et al (1993) Spyrou (2005) and Puja Padhi (2009). This study is organized as the first section contains introduction, review of literature is in the second part. Third part is explaining the data and the methodology uses for the study, analysis and the interpretation is in fourth section and the final part concludes the study.

2. Review of literature

Stephen P.Ferris, Hun Y.Park & Kwangwoo Park (2002), Jian Yang, David A. Bessler & Hung-Gay Fung (2004), Hongyi Chen, Laurence Fung & Jim Wong (2005), Christos Floros (2007), Stephane. M. Yen & Ming. Hsiang Chen (2010) investigate the relationship between Open Interest, Volume and Volatility in developing futures markets and the results indicate the significant relationship among the futures daily volatilities, the lagged total volume and the lagged total open interest. The inter relationship and informational content between open interest, trading volume, mispricing and the volatility of Indian markets are studied by Sandeep Srivastave (2003), Kedar Nath Mukherjee & R.K. Mishra (2004), Ash Narayan Sah & G. Omkarnath (2005), Suchismita Bose (2007), Vipul (2008) and the results indicate that any increase or decrease in mispricing are not lead to the significant change in volatility, volume and open interest for any of the futures or the underlying shares., M. Thenmozhi (2002) , Puja Padhi (2007), Vasilieios Kallinterakis & Shikha Khurana (2008), S. Bhauunik, M.Karanaos & A. Kartsaklas (2008), P.Sakthivel & B.Kamaiah (2009), Mayank Joshipura (2010) make a study on the different topics which are connected to the introduction of derivative trading and the level of volatility in futures market and the results show that the effect of introduction of derivatives trading on average daily excess return of underlying stocks and portfolios. The thorough review of literature reveals that even though there are lot of studies in the area relationship between futures return and other variables in the futures market, it is very hardly to see that the study which uses many variables from the same market and variable from the underlying market also. This study make an attempt to fill the research gap by taking maximum variables form the futures and spot market of NSE India and applying VAR Impulse response function for the analysis.

3. Objectives of the Study
To find the significant relationship among the variables in Indian Futures and Cash Markets.

4. Data and Methodology
Daily closing indices of Nifty-50 spot and Nifty futures from 12th June 2000 to 30th June 2011 (11 years, 132 near month strikes) futures return (FUTR) open interest (OI), turnover (TURN), volatility (VOL), number of contract (CONT) and spot return (SPOTR) are taken as the variables for the study.
4.1. Econometrics Models Used in the Study

In order to check the properties of the time series data, the basic test descriptive statistics and unit root test are used here and to satisfy the objective of the study VAR impulse response function is also applied for the empirical analysis.

4.1.1. Impulse response function

Autoregression has a moving average representation, a vector autoregression can be written as a vector moving average. In fact

\[ xt = \mu + \sum_{i=0}^{\infty} A_i e_{t-i} \]  

(1)

This equation is the VMA representation of \( x_t = A_0 + A_1 x_{t-1} + e_t \) in that the variables (\( y_t \) and \( z_t \)) are expressed in terms of the current and past values of the two types of shocks. The VMA representation is an essential feature of Sims’s (1980) methodology in that it allows us to trace out the time path of the various shocks on the variables contained in the VAR system. Writing the two- variable VAR in matrix form,

\[ \begin{bmatrix} y_t \\ z_t \end{bmatrix} = \begin{bmatrix} a_{10} & a_{11} a_{12} \\ a_{20} & a_{21} a_{22} \end{bmatrix} \begin{bmatrix} y_{t-1} \\ z_{t-1} \end{bmatrix} + \begin{bmatrix} e_{1t} \\ e_{2t} \end{bmatrix} \]  

(2)

This equation expresses \( y_t \) and \( z_t \) in terms of the \( \{e_{1t}\} \) and \( \{e_{2t}\} \) sequences. However, it is insightful to rewrite (2) in terms of the \( \{e_{1t}\} \) and \( \{e_{2t}\} \) sequences. The vector of errors can be written as

\[ \begin{bmatrix} y_t \\ z_t \end{bmatrix} = \begin{bmatrix} y \\ z \end{bmatrix} + \sum_{i=0}^{\infty} \begin{bmatrix} \phi_{11}(i) \phi_{12}(i) \\ \phi_{21}(i) \phi_{22}(i) \end{bmatrix} \begin{bmatrix} e_{1t-i} \\ e_{2t-i} \end{bmatrix} \]

Or, more compactly,

\[ x_t = \mu + \sum_{i=0}^{\infty} \phi_i e_{t-i} \]  

(3)

The moving average representation is an especially useful tool to examine the interaction between the \( \{y_t\} \) and \( \{z_t\} \) sequences. The coefficient of \( \phi \) can be used to generate the effect of \( e_{yt} \) and \( e_{zt} \) shocks on the entire time paths of the \( \{y_t\} \) and \( \{z_t\} \) sequences. The accumulated effects of unit impulses in \( e_{yt} \) and \( e_{zt} \) can be obtained by the appropriate summation of the coefficients of the impulse response functions. The four sets of coefficients \( \phi_{11}(i), \phi_{12}(i), \phi_{21}(i), \) and \( \phi_{22}(i) \) are called the impulse response function. Plotting the impulse response function is the practical way to visually represent the behavior of the \( \{y_t\} \) and \( \{z_t\} \) series in response to the various shocks. Impulse Responses trace out the responsiveness of the dependent variables in the VAR to shocks to each of the variables.

5. Analysis & Results

5.1. Summary Statistics

Table No.1 shows the summary statistics of variables included in the study period. The mean, median and standard deviation of futures returns are positive, indicating that the investors are getting returns
and it is negatively skewed (-0.474) and peakedness of the distribution is showed through kurtosis (12.009). Jarque Bera test value (9441.874) shows that the distribution is asymmetric and which is supported by the probability value presented. Same trend is observed in spot return during study period. Other variables included in the study have also non normality distribution position. The asymmetric return in futures and spot market is supported by the findings of the previous studies like, Fama (1965), Stevenson & Bear (1970), Kendall & Hill (1995) Chen (1996) Reddy (1997) Kamath et al. (1998) and Kapil Gupta et al. (2009). Finding of Karpoff (1987) also support the theoretical back ground of this distribution in such a way that in the speculative derivative market, the volume of positive news is always higher than the volume of negative news because in the increasing market trend the speculators take every dip in the stock index as an opportunity to buy which may cause the speculative assets return to behave asymmetrically. The volatile nature of the derivative market also may cause the distribution of spot and futures return in asymmetric. Diagler and Wiley (1999), finds that high degree of volatility in speculative market, both optimistic and pessimistic views of traders to information causes expected variation in prices. Negatively skewed indices imply that futures market is in backwardation and offers significant arbitrage opportunities to traders (Vipul 2005).

5.2. Stationarity of Variables
Prior to further using econometrics models there is a need to examine the stationarity of each individual time series as most data are non-stationary. This means that the series tend to exhibit a deterministic and stochastic trend. It is important to make sure that the variables are stationary because the assumptions for asymptotic analysis in Granger stationarity of variables, test will be valid. From table No.2, it is clear that variables used for that analysis are stationary in its level form and both unit root test such as ADF and PP test result confirms the result.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Level ADF</th>
<th>Level PP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spotr</td>
<td>-12.45741**</td>
<td>-48.67637**</td>
</tr>
<tr>
<td>Futr</td>
<td>-12.52330**</td>
<td>-51.13509**</td>
</tr>
<tr>
<td>OI</td>
<td>-4.422677**</td>
<td>-6.836442**</td>
</tr>
<tr>
<td>Cont</td>
<td>-3.000871**</td>
<td>-6.426959**</td>
</tr>
<tr>
<td>Turn</td>
<td>-2.934808**</td>
<td>-5.695540**</td>
</tr>
<tr>
<td>Vola</td>
<td>-7.885084**</td>
<td>-11.23244**</td>
</tr>
</tbody>
</table>

*** indicates the significance at 1% level, ** denotes 5% level of significance.
AIC criterion is used to select lag length.

5.3. Shocks and their Time Profile
The effect and response of shock from and to each variable is important to identify the influence of one to another. A shock in one variable may influence that variable itself and it may pass on its shocks to other variables in due course time. Analysis of such shock relationship and its period of existence provide ideas for the decisions to investors. The causality between variables reveal the leading effect but how long such effect exists and in what duration it effects are presented through impulse response or time profile of shocks. Impulse response measures the time profile of the effects of shock on the expected future value of a variable- a conditional variance of equity volatility (Dawson and Stai Kouras 2009). Results of time profile shocks of variables included in the study are presented below.
Figure No. 1

Results of Impulse Response for Futures Market for the Study Period
Response to generalized one S.D innovations

Figure No. I shows that changes in spot market return makes positive and significant change in futures return for two days, but it makes negative and significant changes in number of contracts and turnover. Insignificant impact is seen on volatility, whereas, market depth represented by open interest is not responding to the changes in spot market. Almost the same result is seen from the changes in futures return, except making open interest to react insignificantly. Changes or shocks in market depth do not make any change in spot and futures market return in the initial days but in due course, it makes a very minimal positive response which lasts for 10 days. From the beginning of changes, open interest makes the trade volume to change positively and negative response is seen in volatility due to change in open interest. Any shock in number of contract makes spot and futures return to have negative and significant changes for two days, when turnover and open interest have positive and significant
changes for 10 days time. Turnover and its changes show the similar results as that of number of contract. While means that trade volume of futures market makes spot and futures return have negative changes and with no response in volatility.

Futures market volatility and its shocks make spot and futures return negatively and significantly, and trade volume positively and significantly and almost no result on open interest is seen from the results. In short, it is found that spot and futures returns have bi directional positive and significant relation for a two days period. Trade volume and volatility of futures market influences spot and futures return negatively in the early stages of changes and these variables have bidirectional position changes among themselves. Positive significant relationship between volatility and unexpected volume is found (Watanabe (2001) & Pratap Chandrapati 2010).

6. Conclusion
The positive and negative response of each variable and causal relationship is found by the study through the impulse response function. This empirical result shows that there is positive significant response from the futures and spot market shocks. It is proved that spot return, turnover, open interest, futures market volatility and number of contracts are playing a vital role to predict the movement of futures market because of their causal relationship among them. The causal relationship between futures market and its determinants helps the traders and investors to predict the market. The negative or positive sign of effect in the futures market from the determinants provide more clarity on the movement and help the traders to make decision on buying or selling option clearly. The response of futures return to the change of determinants is revealed by the impulse response function results.

References


