Chapter-6
Findings and Conclusion

Relationship between spot and futures markets has been an area of vast empirical investigation in the last few decades. Although considerable attention has been paid to examine the relationship between stock index and stock index futures, only a few studies have examined the relationship between individual stock and stock futures. Besides, most of the previous studies have examined only first moment relationship, that is, lead-lag relationship between a market index and its associated futures contract.

The present study is an attempt to fill this gap to some extent. The study examines first and second moment relationships between spot and futures markets for CNX Nifty and all of its constituent stocks. More specifically, the study addresses the following questions:

- Do spot and futures markets have a long-run equilibrium relationship? In other words, are spot and futures markets cointegrated?
- Does there exist any lead-lag relationship between spot and futures price changes?
- Does volatility in one market affect volatility in another market?
To answer the abovementioned questions, the study has used 5-min transaction price data from June 1, 2012 to May 31, 2013 and employed a number of tools & techniques of time series econometrics.

This chapter is organized as follows. Section 6.1 presents a summary of the findings along with conclusion. Section 6.2 states the major limitations of the study and finally, section 6.3 suggests areas for further research.

6.1 FINDINGS AND CONCLUSION

The major findings of the study are presented below:

The results of Augmented Dickey-Fuller (ADF) test suggest that the price series of spot and futures markets for CNX Nifty and all of its fifty constituent stocks have a unit root. In other words, both the spot and futures price series in their levels are non-stationary. Besides, the ADF test suggests that first differences of log prices (returns) are stationary for all the time series considered. This implies that both spot and futures price series are integrated of the order 1, i.e., I(1).

For studying long run relationship between spot and futures markets Johansen-Juselius (1990) cointegration procedure has been employed. The results of J-J cointegration analysis suggest that spot and futures price series of CNX Nifty and all of its component stocks are cointegrated. It implies that there is long run relationship between spot and futures markets. Further, this long run relationship exists at the level of index as well as at the level of individual stocks.

For cointegrated variables, the appropriate econometric technique is Vector Error Correction Model (VECM). The whole series of examination is carried out with three sample specifications, viz., sample 1 (full sample); sample 2 (sample obtained after
removing overnight returns); and sample 3 (sample obtained after removing returns for the first and last 30-minutes). For estimating the VECM for the full sample, 3 lags are found most appropriate based on Schwarz Information Criterion (SIC). The result of VECM reveals that the coefficient of the error correction term \( ect_{t-1} \) for \( \Delta F_t \) is positive and statistically significant at 10% level. However, the error correction term for \( \Delta S_t \) is statistically insignificant. It implies that futures market responds to correct for the disequilibrium from the long-term relationship and spot market does not.

Further, the positive coefficient of \( ect_{t-1} \) for \( \Delta F_t \) implies that if futures price is relatively lower than spot price at time \( t-1 \), then it is likely to adjust upward to restore the equilibrium in the next period. Moreover, for \( \Delta S_t \), own lags as well as lags of \( \Delta F_t \) are statistically significant. However, for \( \Delta F_t \), neither own lags nor lags of \( \Delta S_t \) are significant except for the first lag. It implies that for predicting spot market, information for the last 15 minutes (3 lags) is important, however, for the futures market, only last 5 minutes information (1 lag) is useful.

The results of VECM for sample 2 for CNX Nifty are qualitatively similar to that of the full sample. It is the futures market which has the tendency to adjust to correct the deviation from the equilibrium relationship. However, if we look at the size and significance of lagged coefficients then it is evident that spot market has a memory of 15 to 25 minutes but futures market has a memory of only 5 minutes.

For sample 3, it is found that error correction takes place in both the markets. Again, if we examine individual coefficients then for \( \Delta S_t \) all the lags (3 in this case) from the spot and futures markets are significant, and for \( \Delta F_t \) only one lag is significant. This indicates that for predicting futures market returns only past 5-min returns information from the spot market is important and any older information is not important.
Besides, the error correction mechanism is also studied after partitioning the one year intraday data into many smaller sub periods. For different sub-periods, it is found that most of the times it is the futures market which adjusts to correct the deviation from the long-run equilibrium relationship. For a few sub periods spot market is also found to react to correct the disequilibrium. Further, it is also found that for a few sub periods, both the markets adjust to restore the equilibrium relationship.

Further, to examine the direction of flow of information between spot and futures markets, Granger Causality test has been applied based on Vector Autoregression (VAR). The null hypothesis that futures market does not granger cause spot market is rejected at 5% level of significance for all the three samples. Similarly, the null hypothesis that spot market does not granger cause futures market is also rejected for all the three sample specifications. It implies that for CNX Nifty, spot and futures markets have feedback relationship and significant information transmission takes place between the two markets.

The error correction mechanism for the individual stocks that comprises the CNX Nifty reveals that for most of the stocks it is the futures market which adjusts to correct the deviation from the long run equilibrium relationship. This behavior of individual stocks corroborates the behavior of CNX Nifty.

The short term temporal relationship between the futures and spot markets for all the fifty stocks of CNX Nifty is carried out in the framework of VAR. The null hypothesis that spot market does not granger cause futures market is rejected for all the 50 stocks. Similarly, the null hypothesis that futures market does not granger cause spot market is also rejected. It implies that both spot and futures markets granger cause each other indicating that feedback relationship exists between the two
markets. This indicates that past history of spot market returns is helpful in predicting returns from the futures market and vice versa. Thus, a feedback relationship exists between futures and spot markets for all the 50 constituent stocks. However, an examination of the size and significance of the lagged coefficients in the VAR model points that causality from futures to spot market is much stronger than in the reverse direction. Lead-lag relationship between spot and futures return series of individual stocks has also been examined after removing first and last 30-min data. BHARTIARTL is the only stock for which there is no granger causality from futures to spot market, otherwise for all other stocks there runs granger causality from spot to futures and futures to spot markets.

The results of ARCH-LM test suggest that for sample 1, CNX Nifty and its futures contract both do not have ARCH effects. Mostly, financial time series suffer from conditional heteroscedasticity. However, in this case, the absence of ARCH effects may be due to inclusion of overnight returns in sample 1. For sample 2 and sample 3 it is found that both CNX Nifty and its futures contract have ARCH effects. The results for sample 2 & 3 are consistent with commonly observed volatility clustering in financial assets' returns.

For sample 2, Bivariate-GARCH (1,1) model with constant conditional correlation suggests that volatility spillovers run from spot to futures market and not vice versa. However, The results of Bivariate-EGARCH (1,1) reveal that volatility spillovers take place in both the directions.

For sample 3, Bivariate-GARCH and Bivariate-EGARCH both models suggest that volatility spillovers run in both the directions. Therefore, innovations in either of the markets are helpful in predicting volatility in another market.
For both sample 1 and 2, the results of bivariate-EGARCH suggest that there is asymmetric response of volatility.

Volatility linkages are also examined using Granger Causality test based on VAR. For CNX Nifty, the results of Granger Causality are mixed. On the basis of the Granger causality test, it is found that for full sample no volatility spillovers take place between spot and futures markets. For sample 2 (removing overnight returns) the null hypothesis that spot market volatility does not spillover to futures market is rejected only at 10% level of significance. However, the null hypothesis that no volatility spillovers take place from futures to spot market is rejected at all conventional levels of significance. Thus, for sample 2, it can be concluded that volatility spillovers run from futures to spot market. For sample 3 (excluding first and last 30-min), it is found that volatility spillovers run in both the directions.

The issue of volatility spillover has also been examined at the level of individual stocks. For examining volatility spillover bivariate vector autoregressive (VAR) model has been used. For sample 1, it is found that for 41 stocks volatility spillovers run from futures to spot market and for 26 stocks volatility spillovers run in the reverse direction. For 25 stocks, volatility is found to run in both the directions.

For sample 2, the results of Granger Causality suggest that for 48 out of 50 stocks volatility spillovers run from spot to futures market and for 46 stocks volatility spillovers run from futures to spot market. Besides, 44 stocks have bidirectional volatility spillovers.

For sample 3, it is found that for 37 stocks volatility spillovers take place from spot to futures market. The null hypothesis of no granger causality from futures market to
spot market is rejected for 41 stocks. In addition, for 30 stocks volatility spillover takes place in both the directions.

The present study is an attempt to characterize the intraday returns and volatility relationships between futures and spot markets in India. It is found that there exists strong long-run relationship between the spot and futures markets at the level of index as well as at the level of individual stocks. Price discovery takes place in both the markets. Further, futures market is found to play a dominant role in the matter of price discovery. These findings are consistent with previous researches in India as well as abroad.

As far as the volatility linkages between futures and spot markets are concerned, the present study has come up with mixed results. Previously in the Indian markets, Karmakar (2009) employed BEKK-GARCH to show that for CNX Nifty volatility of futures market spills over to the spot market and not vice versa. However, he utilized daily data and for uncovering volatility dynamics intraday data are more appropriate. In a similar study, Pati and Rajib (2011) employed 5-min intraday data and found that for CNX Nifty volatility spillovers run in both directions. However, they also reported stronger role of futures market as compared to spot market.

Present study highlights an important characteristic of time series models. For studying volatility dynamics, the study has utilized three different models, viz., Bivariate-GARCH, Bivariate-EGARCH with asymmetry and VAR. In addition, the mechanism of volatility linkages is studied with three sample specifications viz., sample 1 (full sample); sample 2 (sample obtained after removing overnight returns); and sample 3 (sample obtained after removing returns for the first and last 30-minutes). Interestingly, different models yielded different results and even the same
model obtained different results for different sample specifications. This implies that generalizing on the basis of a-theoretic time series models should be done with great caution. Moreover, this also underlines the inherent complexity in modeling higher order linkages such as second order linkages i.e., volatility spillovers. Besides, variability in results due to change of model and/or change of sample also points towards unpredictability of financial markets and market efficiency.

In conclusion, it can be said that both futures and spot markets serve price discovery function. Spot and futures markets are found to be linked through their first and second moments. It indicates that significant returns and volatility relationship exist between the two markets. These findings may prove to be useful by providing insight on price discovery and have implications for understanding information transmission mechanism and thereby assisting hedgers, arbitrageurs and portfolio managers in executing trading strategies.

6.2 LIMITATIONS OF THE STUDY

Besides the usual limitations of time and resources, the major limitations of the study are as follows:

- High frequency data is not easily available. The present study has used intraday data for only one year. Data for a longer time period would yield better results.
- For studying returns and volatility relationship corporate actions such as payments of dividends etc. have not been considered.
- Autoregressive family of models are generally a-theoretical in nature. Generalizing on the basis of these models should be done with great caution.
6.3 AREAS FOR FUTURE RESEARCH

The areas for future research are as follows:

- First, the study with a longer time span can be conducted.
- The future studies may use data at even higher frequency such as 1-minute.
- Returns and volatility relationship between spot and options markets and between futures and options markets are yet another prominent areas of research.
- Returns and Volatility spillovers among different stock markets of two or more countries can also be studied.
- Impact of trading activity on volatility spillovers among markets is another good area for future research.
- With the advancements in econometric techniques, future researches may be conducted utilizing newer techniques.