Chapter -2
Review of Literature

Hedgers, arbitrageurs, speculators, regulators, policy makers, portfolio managers and academicians are interested in understanding futures and spot market relation for obvious reasons. Therefore, relationship between spot and futures markets has been a matter of vast theoretical and empirical research. Across the globe, researches have been conducted by employing varied methodologies and using data at different frequencies. This chapter reviews relevant existing literature on price discovery, lead-lag relationship and volatility linkages between futures and spot markets. The literature reviewed in the present study is grouped into the following two broad categories:

- Studies on relationship in the first moment, i.e., returns relationship

- Studies on relationship in the second moment, i.e., volatility relationship

The remainder of the chapter is organised as follows. Section 2.1 covers the research studies pertaining to price discovery and lead-lag relationship for returns between spot and futures markets. Section 2.2 presents the studies on volatility spillover between the two markets; and, section 2.3 concludes with the research gap.
Based on the main objectives of the study, the literature reviewed is grouped into two categories as follows:

2.1 Studies on lead-lag relationship for returns between spot and futures markets.
2.2 Studies on volatility spillovers between spot and futures markets.

### 2.1 STUDIES ON LEAD-LAG RELATIONSHIP FOR RETURNS BETWEEN SPOT AND FUTURES MARKETS

**Cox (1976)** examined how the information in spot market is affected by organized futures trading. He suggested two reasons for futures market being informative for spot market. First, futures markets may attract speculators, and second, futures markets have lower transactions costs. For studying the effect of futures trading, Cox developed a model of spot-price behaviour and market information. Analysing the data for six commodities, he concluded that existence of futures trading seems to make the working of the spot market more efficient.

According to **Brannen and Ulveling (1984)**, futures market would develop for information exchange if the current spot prices are noisy and hence fail to convey all information. They studied how the existence of futures trading alters information and price expectations differences among traders. Analysing data from the commodities markets, they found that price differences among traders reduce with the addition of the futures price.

**Kawaller, Koch, and Koch (1987)** used high frequency minute-to-minute data for all the transaction days during 1984 and 1985 to examine price relationship between S&P 500 index and the associated futures contracts. They studied the price discovery role of futures market and also investigated price relationship on and around expiration
day. Using three stage least squares, they concluded that futures market consistently leads spot market by twenty to forty five minutes and spot market very infrequently leads futures market by not more than one minute. Their study did not find any substantially different contemporaneous price relationship on the expiration day than on non-expiration days.

Using Granger Causality test, Ng (1987) examined the informational efficiency of futures market for a variety of financial assets including S&P 500 and the Value Line Composite Index. Ng suggested some of the reasons why a lead-lag may exist between futures and spot markets. Transaction cost and short-selling restrictions have been suggested as some of the reasons which may cause futures market to lead the spot market. Using daily data for the time period from April 21, 1982 to December 31, 1986 for S&P 500 index, Ng, on the basis of the rejection of the null hypothesis that futures market does not granger cause spot market, concluded that new information is first reflected in the futures market. Similar conclusion is drawn regarding the Value Line Composite Index.

Laatsch and Schwarz (1988) investigated the relative price discovery roles of Major Market Index and MMI futures by employing both daily and minute-by-minute data from July 24, 1984 until September 19, 1986. They used a partial equilibrium model suggested by Garbade and Silber (1983). The study found that during the market evolution phase the pattern of lead-lag relationship between spot and futures markets was fluctuating. However, as the futures market evolved, MMI futures largely perform the role of price discovery. Further, they concluded this leadership of futures market is due to variables other than non-synchronous trading of the component stocks in the index.
**Stoll and Whaley (1990) studied** the temporal relation between S&P 500 and Major Market Index in a multiple regression framework. They used 5-min data from April 1982 until March 1987. First, they examined in detail the time series characteristics of intraday returns in spot and futures markets for both the indices. They developed a model for describing the effects of bid-ask spreads and infrequent trading of component stocks and used ARMA type models for removing these effects. Even after controlling for the effects of the infrequent trading and bid-ask spreads, they reported that futures market lead spot market by about five to ten minutes. However, spot market was also found to have mild predictive power to affect futures market.

**Chan (1992) made an investigation whether MMI futures and S&P 500 futures contracts lead/lag MM cash index and the underlying stocks. Using 5-min data for the time periods (August 1984 through June 1985 and from January 1987 through September 1987) in the framework of a multiple regression model, they provided evidence that lead-lag relations exist between MM cash index and the futures contracts (MMI futures as well as S&P 500 futures). However, lead from futures to spot market was much stronger than from cash to futures. In addition, the leading role of the futures market was reported to be stronger in the presence of market wide information.

**Wahab and Lashgari (1993) employed cointegration analysis to investigate the causal relations between stock index and associated futures contracts for S&P 500 and FTSE 100 indexes. Using daily closing prices data over the period from 1988 to 1992, they reported a feedback relationship between spot and futures markets for both the indexes. However, they found that spot market played a stronger leading role.**
Ghosh (1993) investigated whether spot and futures price changes are forecastable. He employed intraday data for S&P 500 index and daily data for CRB index. The result supported the existence of stable long term relationship between the spot and futures markets. The study found that the direction of flow of information is from futures to spot in case of S&P 500 index and from spot to futures in CRB index.

Abhyankar (1995) used hourly data from 1986 through 1990 to examine the lead-lag relationship between FT-SE 100 stock index and the associated futures index under varying market conditions. Using a multiple regression approach, he found that futures market leads the underlying index under varying phases of trading activity and during periods of high conditional volatility. He further reported that during periods of moderate (normal) news, the futures market is found to lead; during good news, no market is found to lead/lag; and during periods of bad news, no discernible pattern of lead/lag exists.

Hung and Zhang (1995) analysed the long-run equilibrium relationship between the Municipal Bond Index (MBI) and its futures contract by using Cointegration analysis and short-run dynamics and price movements in both the markets by using Error Correction Model. The results suggest that price movements are contemporaneous and there is a two way feedback system between the markets. By splitting the sample period from June, 1985 to April 1993 into two sub periods, it was reported that spot market serves a major role in making adjustment towards the long-run equilibrium relationship in the first sub-sample period. On the other hand, in the second sub-sample period futures market plays greater role in restoring long-run equilibrium.

the lead-lag relationship between them. He analysed daily data by using two version of Error Correction Model depending upon the postulated long-run relationship between markets. The findings are indicative of price discovery function of futures market. Further, univariate time series model and VAR model were also employed in the study but the performance of the Error Correction Model was found to be superior.

**Hasbrouck (1995)** suggested an information share based econometric approach for measuring the price discovery role of markets. He applied this technique to measure the price discovery for stocks traded on NYSE and the regional stock exchanges. He stated that the random walk component of a security's price can be viewed as its implicit efficient price. Hasbrouck defined the information share as the proportion of the variance of the efficient price innovation attributed to a market which in turn is a measure of a market's contribution to price discovery. His study concluded that the price discovery role is largely performed by NYSE.

**Fleming, Ostdiek and Whaley (1996)** tested the trading cost hypotheses by analysing the temporal relationships among returns of S&P 500 futures, S&P 100 options and there underlying stock index portfolios. Using 5 minute return data they evidenced that S&P 500 index futures and S&P 100 index options were leading the underlying spot market index in terms of returns. Besides, S&P 500 futures were also found to lead the S&P 100 option index, supporting the trading cost hypotheses. Their study concluded that price discovery takes place in index derivatives market where trading costs are considerably lower than the stock market. However, for individual stocks price discovery takes place in the stock market because of lower trading cost than option market.
By using daily data, Huang, Masulis and Stoll (1996) examined relationship between returns of oil futures and U.S. stock returns. They analysed the repercussions of energy shocks from the perspective of financial markets. Utilizing vector autoregressive (VAR) approach, they found that oil futures returns are uncorrelated with stock market returns. They further reported that oil futures returns significantly lead oil stocks returns by one day. However, they added that such lead has small economic significance.

Fortenbery and Zapata (1997) made an attempt to study the price discovery and long-term relationship between Cheddar Cheese cash and futures market. Their study found no evidence of presence of stable long-term pricing relationship between the markets. Besides, neither of the markets was found to lead the other in price discovery process.

Chathrath and Song (1998) studied the intraday behaviour of Japanese yen spot and futures rates (traded on CME), around a sets of 20 macroeconomic announcements over the period from January 1992 through December, 1995. Their study provided evidence regarding futures rate leading the spot rate of Japanese yen and making spot market volatile. They concluded that futures markets’ are reacting more efficiently to new information.

Pizzi, Economopoulos and O’ Neill (1998) attempted to investigate the price discovery process in the S&P 500 cash index and its 3-month and 6-month futures contracts. By using minute-by-minute data for the period January, 1987 through March, 1987, they found significant cointegration among futures index (both 3-month and 6-month) and cash index, indicating existence of long-term equilibrium. The result of their study revealed that both the three and six month futures market of S&P
500 index lead the spot market by at least 20 minutes. Besides, they also reported that spot market very infrequently leads the futures market by three to four minutes.

**Jong and Donders (1998)** tested the intraday lead-lag relationship between derivatives and cash market by dividing the sample period into two sub-periods. They concluded that futures market leads both option and underlying cash market of AEX Index by five to ten minutes on an average.

**Abhyankar (1998)** used 5-min intraday data for FT-SE index and for four FT-SE futures contracts expiring in 1992 for the months of March, June, September and December. Using raw, ARMA filtered, and EGARCH filtered returns in the framework of a linear causal test, he reported that futures market leads the cash market by about 5 to 15 minutes. However, using a nonlinear causality test based on Baek and Brock approach, the study found bidirectional causal relationship between futures and spot markets.

**Booth, So and Tse (1999)** in their article empirically examined the price discovery process among stock, futures and options indices of DAX securities traded on FSE in Germany. They showed that the FDAX and DAX respond to new information faster than ODAX. They further observed that because FDAX supports transaction costs hypothesis, they contribute more to price discovery as compared to ODAX.

**Cohen (1999)** tested two hypotheses, first, whether derivatives leads to excess volatility in the cash market, and second, whether they facilitate price discovery. Using bond and equity indices of US, Japan and Germany, they concluded that there is no clear evidence that derivatives destabilizes the spot market and makes price discovery more stable.
Min and Najund (1999) examined the lead-lag relationship between KOSPI 200 and associated futures index in Korea. Using 10-min intraday data from May 3, 1996 through October 16, 1996 in the framework of three stage least squares, they reported that returns in the futures market lead spot market returns by about 30 minutes.

Silvapulle and Moosa (1999) investigated causal relationship between spot and futures prices of WTI crude oil during the period between 2 January, 1985 and 11 July, 1996. The study showed that both markets react to new information simultaneously and there exists bidirectional non-linear causality between the markets. Using linear causality test they found that daily futures prices lead spot prices, but the leading pattern of futures changes over time.

Using Hasbrouck (1995) cointegration model, Tse (1999) found that in intraday price discovery DJIA futures dominates cash market. For this purpose, he used minute-by-minute cash and futures prices data for DJIA for the period from November 1997 to April 1998.

Kim, Szakmary and Schwarz (1999) attempted to study the trading cost hypothesis that market with lower trading cost will react more quickly to new information. They used intraday data of S&P 500, NYSE Composite and MMI futures indices and their respective cash indices for the period from January, 1986 to July, 1991. They focused on the intraday price leadership across these futures indices and their respective cash indices, rather than between each spot and its associated futures index. They found that among the futures indices S&P 500 leads the other two (NYSE composite and MMI) by five minutes because of its lower trading cost. They further reported that in cash market indices leadership role is played by the MMI cash index, following the
proposition of trading cost hypothesis. In short, their study revealed that market with lower trading cost plays the price discovery role.

In the Australian markets, Frino, Walter and West (2000) empirically examined the lead-lag relationship between SPI futures contracts (futures index) and All Ordinaries Index (spot index) around information release. Using minute-by-minute data for the period from August 1, 1995 to December 31, 1996, they found that the leading role of stock index futures over spot index strengthens around the release of macro-economic information and weakens around firm specific information. Besides, feedback from spot to futures is found to strengthen around the release of stock specific information.

Brooks, Rew and Ritson (2001) used 10-min intraday data and found that for FTSE 100 index, futures returns lead the cash returns. They compared various forecasting models for finding if any profitable trading can be made. They concluded that the best model is the error correction model.

Chan and Lien (2001) examined the impact of cash settlements on the ability of futures market to predict futures prices. They took two commodities- Feeder cattle and live/lean Hog futures, on which futures contracts are available. By adopting Geweke feedback measure, they found that cash settlements of contracts improve the price discovery function of Feeder cattle futures contracts and the two markets become integrated. They further concluded that replacement of physical delivery by cash settlement makes the price discovery function of lean hog futures contracts less effective as before.

Thenmozhi (2002) examined the effect of futures trading S&P CNX Nifty futures traded on National stock Exchange of India. She found that futures trading transmits
information to spot market and futures market is also faster in processing information and leads spot market by one day.

Using 5-min data from January, 1999 to June, 1999, **Roope and Zurbruegg (2002)** compared the informational efficiency of Taiwan Futures Exchange and Singapore Exchange for the Taiwan Futures contracts listed in the two exchanges. Employing the Hasbrouck (1995) and Gonzalo-Granger (1995) information content based methodologies, they reported that futures markets dominate price discovery over spot markets and Singapore futures market over Taiwan futures market.

**Sahadevan (2002)** analysed data of six commodities futures, traded on four Exchanges and found that these exchanges fail to provide efficient hedge against the risk emerging from the volatility of prices of commodities. In other words, the results of the study indicated that futures market of these commodities is not efficient. He also reported that both futures and spot markets are not integrated.

**Beaulieu, Ebrahim and Morgan (2003)** investigated the price discovery role of the futures contract and exchange-traded fund available for the same market index by dividing the sample period into two sub-periods. Their findings are indicative of the role of futures that remains the same, i.e. leading in price discovery in both sub-periods, as compared to ETFs. They argued that the possible reason behind this may be small tick size.

**Lien and Yang (2003)** employed the Geweke measure of information flow to examine whether the price discovery function increased after the cash settlement was replaced by physical delivery in case of futures contracts on individual shares in Australia. For cash settlement as well as for physical delivery, their study found a significant flow of information from spot to futures market. They added that this role
of spot was further enhanced after switching from cash settlement to physical delivery of the futures contracts. Thus, they ended up finding domination of spot market over futures in price discovery process.

**Raju and Karande (2003)** studied the price discovery and volatility effect of Nifty futures on Nifty spot index traded on NSE of India. Analysis of daily closing values on Nifty Index revealed that price discovery takes place in both the markets.

Adopting a non-parametric Genetic Programming (GP) approach for identifying structural changes for examining lead-lag relationship between daily returns on Nikkei 225 spot and futures indices, **Lien, Tse and Zhang (2003)** concluded that spot market play a dominant role in price discovery during extreme periods. They also employed linear Granger Causality test and reported leading role of futures market.

**Covrig, Ding and Low (2004)** studied how Singapore Exchange, a small satellite market contributes to price discovery. They also attempted to explain the possible reasons behind this. For this purpose they took Nikkei 225 index traded on three different markets, viz., TSE, OES and SGX. These three markets are informationally linked and compete for trade flow. The methodology employed includes the information share based approach of Hasbrouck (1995) and the common factor component method of Gonzalo and Granger (1995). They found that the overall futures market contributes 77% to price discovery. They stated that contribution to price discovery of satellite market lies in its careful design of contract details and trading mechanisms.

**Zhong, Darrat and Otero (2004)** investigated the price discovery process between IPC index and associated futures contracts in Mexico. Using daily data from April 15, 1999 to July 24, 2002 in the context of bivariate error-correction EGARCH (EC-
EGARCH), they concluded that price discovery function is largely performed by the futures market.

**So and Tse (2004)** studied the information transmission mechanism for the Hang Seng index (HIS), the Hang Seng futures index and the tracker fund. Using minute-to-minute data from November 12, 1999 through June 28, 2002 in the framework of information share based approaches of Hasbrouck (1995), and Gonzalo and Granger (1995), they found that futures market dominates price discovery followed by spot market. They also reported that Tracker fund contributes little in the matter of price discovery.

**Sah and Omkarnath (2005)** found that futures rate is not a predictor of spot rate. Taking the daily values of near month contract of S&P CNX Nifty futures traded on NSE for the period from 12 June, 2000 to 29 January, 2004, they concluded that futures market is not efficient.

**Tse, Bandyopadhyay and Shen (2006)** explored the price discovery role of futures between the DJIA index and three futures contracts available on this index- the DAIMOND exchange traded fund, the DJIA futures and the electronically traded mini-futures. The authors also used S&P 500 index (ETF and futures) to do duplicate analysis for checking the robustness of the result. They found that ETF derivatives dominate over ETF shares for price discovery function. Their results remained robust when the analysis was performed using the S&P 500 regular futures, and the E-mini futures. Among the three futures contracts, Mini-futures were found to dominate others in price discovery role and contributed about 69.1%. Whereas ETF and S&P 500 futures contributed 28.6% and 49% respectively in price discovery function.
Using daily data for CNX Nifty, Gupta and Singh (2006) examined the price discovery role of the futures market. Their study provided evidence in support of the hypothesis that futures market in India serves as a price discovery vehicle.

Gupta and Singh (2006) determined the weak form efficiency of Indian futures market by taking Nifty futures index and 24 stock futures available on NSE. They found that at index level no lead-lag relationship exists whereas at the level of individual stocks, futures market leads spot market.

Mukherjee and Mishra (2006) used 1-min intraday data from April to September 2004 for investigating lead-lag relationship between CNX Nifty and associated futures index as well as between the spot and futures markets of five individual stocks. By employing a multiple regression approach, they found that feedback relationship exists between CNX Nifty and CNX Nifty futures, however, CNX Nifty plays a dominant role in the matter of price discovery. For the five individual stocks also, they found a feedback relationship with spot market playing a dominant role.

Praveen and Sudhakar (2006) in their study empirically investigated the price discovery mechanism of India’s Commodity futures market. By taking the daily figures of Nifty futures traded on NSE and Gold futures traded on MCX of India for the period of April, 2002 to June, 2005, they tried to compare the commodity futures market with mature equity futures market available on NSE. Their results support the presence of mature stock markets which facilitates the price discovery function at NSE. Contrary to this, the commodities futures market is less mature making itself a platform of price discovery process by assimilation of market flow of information. The reason behind this may be that spot gold in India is not confined to one place like single futures market available at NSE for equity futures.
Mukherjee and Mishra (2006) used the daily data of Nifty index and some selected Nifty stocks for the period from June 2000 to September 2004, to find out how the co-movements of price in both spot as well as derivatives market depends upon flow of information in these markets and how it varies with time. They applied ‘Geweke Measure of Feedback’ to both index as well individual stocks of Nifty. The results confirmed that there is a significant flow of information from spot to futures at index level of CNX Nifty and there is instantaneous flow of information between spot and futures market. At the stock level, except for 8 stocks, all the other stocks futures were found to be leading spot during the whole study period. In short, the results provide mixed evidence on the lead-lag relationship which is dynamic and stock specific.

Kakati and Kakati (2006) examined the informational content of the basis and price discovery role of the Indian futures market. They found that there is bidirectional flow of information between spot and futures market followed by a moderate feedback system when long lags are taken. They also found the informational role of basis in predicting the direction of change in futures prices and also spot prices but to a lesser extent.

Sah and Kumar (2006) employed Engle-Granger ECM and Cointegration model to test the price discovery of Indian futures market over spot market. The findings support the leading role of futures and provide evidence that there exists a feedback mechanism between Nifty spot and futures.

Pradhan and Bhat (2006) studied the price discovery and causal relation between the futures and spot market of Nifty Index, by using near-month, mid-month and far-month contracts and employing J-J Cointegration and VECM model. Their analysis
established the leading role of underlying cash market in information transmission and price discovery.

**Gupta and Singh (2006)** investigated the hypothesis whether Indian futures market serves as an efficient price discovery vehicle for the spot market. They found the leading role of futures with bilateral causality.

**Brandt, Kavajech and Underwood (2007)** undertook regression analysis to investigate whether price discovery takes place in US treasury cash and futures market and how environmental forces impact the information flow from one market to another. Utilizing both market prices and net orderflow it was observed that the direction and magnitude of price discovery in the two markets is influenced by environmental variables considered in the study. They reported that although price discovery takes place in futures market but the presence of illiquidity due to wide bid-ask spreads in the cash market is the reason for more price discovery in the cash market as asymmetric information is high.

**Bose (2007)** made her contribution by investigating whether stock index futures market plays an important role in the assimilation of information and price discovery process by taking the futures prices data of Nifty Index traded on NSE. She found that significant information flows from futures to spot over the period of four years and seven months indicating that the prices/returns of futures are more informative than that of spot.

Using 5-min data from April to March 2006 and employing error correction model, **Bhatia (2007)** found that price discovery takes place in both the futures and the spot markets. However, futures market is found to be more efficient and leads the spot market by 10 to 25 minutes.
Gupta and Singh (2007) investigated the arbitrage efficiency of futures market in India. Using data from June, 2000 to December, 2005, they found presence of long-run (equilibrium) relationship between the two markets. In addition, they reported bilateral flow of information, indicating that neither of the markets was leading each other.

Anand (2007) examined the efficiency of Indian Commodities Futures Market by studying 12 commodities traded on NCDEX for contracts expiring on May 2006. The results showed that only Gur and Gold have achieved market efficiency to recognizable extent while the other commodities exhibited this relationship with a considerable lag and in some cases, with a bilateral causality or reverse causality.

Using a non-parametric approach, Illueca and Lafuente (2008) analyzed the destabilizing effect of mini-futures trading in Spanish stock market on the distribution of returns in the spot market and to test their contribution in the process of price discovery. By estimating the conditional densities of the returns in spot market under varying levels of trading volume in mini futures of IBEX index, they tested effect of mini futures trading on the distribution of spot returns. Empirical evidence suggested that trading of mini futures does not destabilize the spot market as the spot returns do not depend on the expected trading in mini futures.

Further, results also revealed that with the introduction of mini-futures price discovery enhanced.

Kavussanos, Visvikis and Alexakis (2008) employed daily data from February, 2000 to June, 2003 to examine the informational efficiency of two futures indexes viz., FTSE/ATHEX-20 and FTSE/ATHEX Mid-40 contracts in Greece. They reported bi-
directional linkages between futures and cash markets, however, the lead from futures to cash is found to be much stronger than in the reverse direction.

Shastri, Thirumalai and Zutter (2008) found the price discovery role of 137 Single Stock Futures traded on OneChicago exchange. The results of their study supported the price discovery function of SSFs market. It was also reported in the study that SSFs trading improved the quality of underlying stocks.

Fung and Tse (2008) used intraday data of bid-ask quotes of the Hong-Kong Single-Stock futures (SSFs) contracts and their underlying stocks over the period from August, 2001 to June, 2003, to investigate their operational and pricing efficiency. They concluded that the futures market is informationally efficient and futures quotes provides for one-third of price discovery despite of their low volume because they were fairly priced.

Kang and Park (2008) in their article focused on the liquidity and the information effects in market dynamics of returns and order imbalances across stock, futures and options of KOSPI index securities. Their evidences suggest that information effect is more pronounced than the liquidity effect and returns are more predictive of futures prices than order imbalances. In short, they found that derivatives market generally leads their underlying spot market because informed traders prefer to trade in these derivatives contracts.

Mallikarjunappa and Afsal E M (2008) used 1-min data for 12 stocks traded on NSE for studying lead-lag relationship between futures and spot markets in India. Using VECM-EGARCH specification, they found feedback relationship between the two markets.
Bose (2008) studied the characteristics of the Indian Commodity futures market, in order to determine whether these markets were having the same features as present in the equity futures market. The study used spot and futures prices data of multi-commodity and agricultural commodities indices. It was found that in terms of informational efficiency multi-commodity indices behave similar to equity indices. She concluded that futures market can serve as an effective hedging instrument for commodities.

Reddy and Sebastin (2008) employed the entropic analysis approach for studying the temporal relationship between spot and futures markets in India. For this purpose, they used data over the period of October, 2005 to September, 2006. They concluded that information dissemination first takes place in futures market and then it is transmitted to spot market.


Cabrera, Wang and Yang (2009) studied the three foreign exchange markets – the CME GLOBEX regular futures, E-mini futures and the EBS (electronic Broking Services) interdealer spot market, to investigated the price discovery of Euro and Japanese Yen Exchange Rates. They found evidence of spot leading the futures market. Foreign exchange spot prices are found to be more informative than the regular futures and mini-futures markets, thus for both the exchange rates (Euro and Japanese Yen) spot market leads the futures in price discovery process.
Li (2009) combined markov switching process with vector error correction model for studying the dynamic relationship between spot and futures markets under high-low volatility regimes. For this purpose, he examined three mature markets namely, USA (S&P 500), UK (FT-SE 100), Germany (DAX 30) and two emerging markets namely, Brazil (Bovespa) and Hungry (BSI). Using daily data from April, 1995 through December, 2005, the study reported that during low variance state price discovery takes place in the futures markets, however, during volatile periods (high variance state), spot markets serve the role of price discovery.

Schlusche (2009) used the German DAX ETF, Futures and spot to determine the price discovery role of futures market. The analysis showed clear price leadership of futures over both spot and ETF. They contented that volatility is the main force behind price discovery as conjectured by trading cost hypothesis. They also found that in periods of low to high volatility, price formation decreases in the futures market.

Using daily data for CNX Nifty futures and the underlying index, Karmakar (2009), on the basis of a Vector Error Correction Model (VECM), concluded that price discovery function is performed by futures market.

Pati and Padhan (2009) examined lead-lag and causal relationship between CNX Nifty and CNX Nifty futures by using VECM and Toda-Yamanoto-Dolado-Lutkepohl (TYDL) causality test. Using daily data from January 2004 to December 2008, they found that there is uni-directional causality from futures to spot market. They also used impulse response and variance decomposition and reported that futures market leads the spot market.

Srinivasan (2009) examined the relation between commodities derivatives and the underlying assets for nine selected Oil and Gas industry stocks in India. Using daily
data series from May 12, 2005 to January 29, 2009, he found that there exists a long-run relationship between spot and futures price of these commodities. Out of nine stocks of oil industry, four are found to have bidirectional relationship, three stocks have unidirectional relationship from spot to futures and rest two have unidirectional relationship from futures to spot.

Using 1-min data from 2004 to 2007, Gupta and Singh (2009) investigated the price discovery and lead-lag relationship between futures and spot markets in India. They carried out the analysis for CNX Nifty index as well as for fifty actively traded stocks. They used Granger Causality test and reported that Nifty futures leads Nifty by five minutes. Further, they found that individual stocks lead/lag in the range of five to fifty five minutes. They concluded that price discovery takes place in both the markets with futures market playing a larger role.

Wats and Mishra (2009) found that both the spot and futures markets aid each other in determining the price in the other market, however, significant role is played by the futures market. These findings are in conformity with other studies undertaken in Indian markets.

Reddy and Sebastain (2009) used the entropy analysis approach to examine the dynamic relationship between spot and futures markets for commodities as well as equities. They found that there exists feedback relationship between the two markets and past information for up to 6 days is relevant.

Srinivasan (2009) found that both spot and futures markets of S&P CNX Nifty index observes a stable long run relationship. He also concluded that there exists bidirectional causality and both the markets are informationally efficient. Thus, the study provides evidence that both the markets contributes to price discovery.
Shakeel (2009) used daily data for studying price discovery and lead-lag relationship between CNX Nifty and its futures index. Using cointegration analysis and Granger Causality, he found that it is the spot market which leads the futures market.

Using intraday data at the frequency of 3-min from March 5, 2004 through July 1, 2004 in the framework of a Threshold Regression Model (TRM), Tse and Chan (2010) examined the lead-lag relationship between S&P 500 and associated futures index. They found that lead from S&P 500 to S&P 500 futures diminishes due to presence of short selling restrictions in the spot market. Consistent with previous researches, they reported that in the presence of market wide information futures market play a stronger leading role over the spot market. In addition, their study also found that during periods of directionless trading, spot market exhibits stronger leading effect over futures market.

Chang (2011) examined the informational content of basis (spot price minus futures price) for studying the price discovery function of SGX CNX Nifty futures traded on Singapore Stock Exchange. He found stronger/weaker role of futures market in terms of strengthening negative/positive basis under negative prior shocks.

Using 5-min data from March 1, 2007 through January 31, 2008, Pati and Rajib (2011) investigated the relationship between Nifty futures and the underlying spot index. On the basis of Granger Causality test, they concluded that uni-directional causality runs from futures to spot market.

Jackline and Deo (2011) studied the intertemporal relationship in Indian Stock Market between cash and derivative segments. They concluded by using VECM model that for CNX Nifty cash market plays a leading role over the futures market.
Debasish (2011) reported the directional causality in spot and futures market of six leading sectors by taking 40 individual stocks of S&P CNX Nifty. Using pair wise Granger Causality test, they found bidirectional causality in all the stocks of automobile sector except one i.e. Tata Motors. In banking sector seven out of nine stocks showed bidirectional causality. Out of the seven stocks of Gas, Oil and Refineries sector, only four stocks exhibited bidirectional causality. Similarly, bidirectional causality is also observed between the spot and futures markets of all six Pharmaceuticals stocks. However, in cement sector unidirectional causality is found except ACC which does not show causality. These findings are specifically important for stock exchange officials in designing the trading mechanism and contracts specification of Derivatives contracts.

Ali and Gupta (2011) tested the significance of hypothesis that futures prices are unbiased predictors of spot prices by taking 12 commodities traded on NCDEX of India. The result of the cointegration test showed the presence of long-term relationship in all ten commodities except wheat and rice. In short-run, futures market was found to act as a predictor of spot prices for wheat, castor seed, chickpea, guar seed, soybean, and sugar as compared to black lentil, maize, and pepper where bidirectional causality was observed. In case of rice, red lentil and cashew, futures market was lagging the spot market.

Abuk (2011) studied lead-lag relationship between the ISE 30 spot and futures indices of Turkey over the period of 5 years and 10 months using 5 minute intraday data. To empirically test the objective, the author applied Cointegration and Causality tests. To check the robustness of the result, the author used both the raw prices and filtered prices (using ARIMA) of the index. The study found that futures market led
the spot market in 2008 and 2010, whereas bidirectional causality was observed in 2006, 2007 and 2009.

**Jiang, Chang and Chiang (2012)** employed the Autoregressive distributed lag cointegration framework (ARDL-ECM) for examining the intraday dynamic relationship between TAIEX stock index, TAIEX futures index and mini-TAIEX futures traded on Taiwan stock exchange. Using data from January to September 2004, they concluded that there exists unidirectional lead-lag relationship between futures and spot markets. They reported that futures market leads the spot market by about 30 minutes.

**Kovalchak (2012)** used 5-minute intraday data and employed three-stage-least-square regression to estimate the possible lead-lag relationship between the derivatives and cash markets of Russia. Although a bidirectional relationship was reported in the study, but during the time of expiration of the futures contracts, only recent movements in the one market are important for determining the future direction of the another market. In other words, this relationship tends to decline when futures contracts approaches expiration.

**Mall, Bal and Mishra (2012)** undertook a study on Indian Market by taking Nifty futures and cash indices. Their daily data of 10 years confirmed the presence of long-run relationship. They reported that futures market leads the spot market over the period of June, 2000 to May, 2011.

**Srinivasan (2012) conducted an** empirical study on Indian Commodities Market (MCX) by taking four spot and futures indices traded on it. The empirical results obtained provide evidence in support of the dominant role of commodities spot market over the futures market of all four indices in the matter of price discovery.
Yang, Yang and Zhou (2012) studied the price discovery between CSI 300 index and associated futures index in China. They used 5-min data from April 16, 2010 to July 30, 2010 and reported that spot market play a dominant role in price discovery. They ascribed leading role of spot market to restrictions in the futures market.

Srinivasan and Ibrahim (2012) examined the lead-lag relationship between the Gold spot and futures market traded on National Commodity Derivatives Exchange (NCDEX) of India. The results evidenced the leading role of Gold spot market over Gold futures market.

Choudhary and Bajaj (2012) employed VECM and Granger Causality test for studying the informational efficiency of spot and futures markets in India. They analyzed 5-min intraday data from April 2010 to March 2011 for CNX Nifty and 31 individual stocks. Their results indicate that price discovery takes place in both the markets, however, the role of futures market is more prominent.

Dey and Maitra (2012) explored the price discovery mechanism of commodities futures market using a series of econometric techniques- Granger causality, J-J cointegration, VECM, error correction with weak exogeneity, and forecast error variance decomposition tests. The results of the tests reported that there is unidirectional causality from futures to spot.

Theissen (2012) employed a modified Threshold Error Correction Model (TECM) to account for dynamic transaction costs for examining the price discovery roles of spot and futures markets. He investigated the relationship between DAX index and DAX index futures using data for the quarter of 1999. Besides, the relationship was also examined between DAX-EX (the most liquid ETF in Germany) and DAX futures employing data from the last quarter of 2010. Using midquotes data, he empirically
demonstrated that futures market is informationally more efficient than the spot market. In the presence of arbitrage opportunities, he reported that DAX futures leads the underlying index, however, DAX-EX leading role over DAX futures is found to be stronger.

Stoyu I. Ivano (2013) examined the relationship between gold, silver and oil exchange traded funds (ETFs), their futures instrument and underlying commodities by using intradaily data. It was found that due to presence of ETFs, price discovery shifted from futures to ETFs for gold and silver commodities only, whereas for oil still price discovery takes place in futures market but with increased role of Oil ETF.

Sehgal, Rajput and Florent-Deisting (2013) in their study of intertemporal relation between the derivatives and its underlying used twelve commodities belonging to agricultural, metal and energy products (Chana, Gold, Naturalgas, Guar Seed, Silver, Crudeoil, Soybean, Zinc, Kapas, Lead, Potato Agra, Copper) as well as commodity indices (Mcx-Comdex, Mcx-Agri-Index, Mcx-Metal-Index and Mcx-Energy-Index) actively traded on Multi Commodity Exchange (MCX). The results indicate that there exists a long run equilibrium relationship among the spot and futures indices of 8 out of 12 commodities and in case of 3 indices out of four. It was also found that if the spot and futures markets deviated from their long term equilibrium level, they tend to adjust themselves to re-establish equilibrium. This was mostly found with 10 commodities whose spot prices make greater adjustment in order to re-establish the equilibrium level. Although there is bi-directional lead relationship between spot and futures in the MCX-Energy Index, Chana, Lead, Zinc, Copper, Crude Oil and single lead relationship in case of MCX-Condex Index, generally the results confirm the price discovery role of futures markets of most of the commodities.
Ersoy and Bayrakdaroglu (2013) undertook a study using Istanbul stock cash index and its futures contract, and determine that there is bidirectional causality between both the markets but no significant lead-lag relationship was observed. They also reported that both the markets were cointegrated.

Chauhan, Singh and Arora (2013) made an attempt to analyse the price discovery function of Indian Agri Commodities market using sample data of Guar Seed and Chana. In case of Gaur seed, they found bidirectional flow of information between spot and futures with futures market playing a dominant role in terms of price discovery. On the other hand, unidirectional causality is observed in case of Chana.

Chhajed and Mehta (2013) had taken nine commodities traded on MCX and NCDEX in India on which futures are available, in order to study their market behaviour and price discovery function. Price discovery was found to be effective for most of the commodities. They stated that the causality effect can be used to hedge or speculate on futures prices. Except for the two commodities, all other commodities showed significant effect of futures prices on spot prices.

Edward J and Rao TV (2013) reported the price discovery and causality presented in Turmeric futures and spot traded on NCDEX of India. They divided the sample period 1 April, 2007 to 31 March, 2013 into three sub-periods representing separate panels of data. The results suggested that there is no lead-lag relationship between the markets of Turmeric spot and futures.

Kumar and Chaturvedula (2013) employed the information share (implicit price) approach suggested by Hasbrouck (1995) for studying the contribution of Nifty spot and futures indices in price discovery. They found that the information share of futures and spot markets is 36% and 64% respectively.
Mishra, Malik and Pore (2013) addressed the issues of price discovery in futures, options and spot market of NSE of nifty index and ten selected stocks traded on Nifty index plus price discovery among futures and options markets under three different regimes of Securities Transaction Tax. By using the synchronous daily prices of spot, futures and options of stocks, they found the increasing role of spot over the derivatives market (futures and option), followed by decreasing role of futures over option with increase Securities Transaction Tax.

Choudhury and Bajaj (2013) investigated the price discovery function in Indian futures and spot markets by considering Nifty index and 41 individual stocks. Using daily data, they found that price discovery takes place in both the markets but futures market play a dominant role.

Hou and Li (2013) employed 5-min data from March 1, 2011 to March 31, 2011 for studying the price discovery roles of CSI 300 index and associated futures contracts in China. Their study found that futures market serves as a price discovery vehicle. Their findings are in sharp contrast to Yand et al. (2012) who reported dominant role of spot market.

Ullah and Shah (2013) examined the lead-lag relationship between spot and futures markets in Pakistan. They used daily data from 1995 to 2012 for 140 firms and concluded that futures market is more informationally efficient and largely performs the price discovery function.

Atif and Naseem (2014) used 1-min data for examining the lead-lag relationship between CNX Nifty and CNX Nifty futures. Using VECM and Granger causality test, they found that price discovery happens in both the markets, however, futures market play a stronger role.
2.2 STUDIES ON VOLATILITY SPILLOVERS BETWEEN SPOT AND FUTURES MARKETS

Chan, Chan and Karolyi (1991) investigated the 5-min intraday temporal relationship between the spot and index futures market of S&P 500 from 1984 to 1989. They found evidence of presence of strong inter market linkage in the volatility of both the markets. Using a bivariate GARCH model with AR (1)-GARCH (1,3) specification, they reported that price innovations in either of the market is helpful in predicting the futures volatility in the other market.

Using hourly data from 1986 to 1990, Abhyankar (1995) empirically examined the volatility relationships between FT-SE futures index and the underlying cash index. Using an EGARCH model, he first estimated two series of conditional variance for cash and futures markets and subsequently used these conditional variance in the framework of multiple regression to examine volatility linkages and predictive power of volatility in one market for volatility in the other market. He reported that there is no evidence of a systematic pattern of lead-lag in volatility. He further concluded that the tests for lead-lag based on the conditional estimates of volatility do not reveal any significant consistent leading behavior of one market over other during varying market conditions.

Using hourly data Crain and Lee (1995) examined the impact of scheduled macroeconomic announcements on the futures and spot markets of Eurodollar and Deutsche mark. They employed Granger Causality test based on VAR and found clear evidence that volatility in futures market leads volatility in spot market, however, no causality from spot to futures is reported.
Koutmos (1996) examined the returns and volatility linkages among the four major European stock markets namely, UK, Germany, France and Italy by employing a multivariate VAR-EGARCH model. The major contribution of the study is the extension of univariate EGARCH model into its multivariate counterpart. This model allows for studying the asymmetric influence of standardized Innovations in own as well as cross-markets on conditional volatility in each market. Using daily data from January, 1986 to December, 1991, the study found that there exists asymmetric volatility linkages among the four stock markets.

Koutmos and Tucker (1996) examined the second moment linkages, i.e. volatility spillovers between S&P 500 spot and futures indices. They used an error correction model (ECM) and allowed the residuals to follow a bivariate-EGARCH (1,1) process. Using daily data from April, 1984 to December, 1993, they found that volatility spillovers are unidirectional from futures to spot and not vice versa. Besides, volatility in each market was reported to be asymmetric in nature.

Huang, Masulis and Stoll (1996) investigated association between oil futures volatility and stock price volatility and found that oil futures volatility granger causes volatility in oil stocks and not vice versa.

Sim and Zurbreugg (1999) developed a quadvariate simultaneous-equation EC-ARCH model for the purpose of studying the intertemporal effects of the foreign cash and futures market upon the local cash market and local futures market in a single framework. Their study sought to determine the spillover effects of foreign stocks (Futures and Cash) on the domestic market (Futures and Cash). After analyzing the SPI futures and cash index and Nikkei 300 futures and cash index from July 24, 1997 to October 24, 1997, it was found that Australian futures is weak in price discovery
process as compared to Japanese futures market. Further, it was found that volatility spillovers are uni-directional and runs from futures to cash market. They hypothesized that traders perception was formed in futures market (because of lower transaction cost and ease of trading) and later on transmitted to cash market in the form of volatility spillovers from futures to cash. They reported that the volatility in the Japanese futures market (Nikkie 300) first affects the Australian futures market and then Australian futures market in turn affects the Australian cash market. Thus, their study concluded that markets that are linked to international markets, a large part of spot-futures dynamics is affected by foreign market behavior.

Tse (1999) examined the volatility spillover mechanism of six months intraday data of DJIA futures and cash indices. For this purpose, he has used minute-by-minute cash and futures prices data for DJIA for the period from Nov 97 to Apr 98. Tse suggested a two step approach for studying volatility linkages in the two markets. In the first step, he estimated a VECM and obtained residuals. In the second step, he used bivariate-EGARCH with constant conditional correlations for studying volatility spillovers. Employing bivariate EGARCH, he concluded that both spot and futures markets innovations significantly affect volatility in the other market.

Min and Najund (1999) studied returns and volatility relationship between Kospi 200 index and associated futures contracts in Korea. They employed a VAR model and used absolute innovations from the returns equations as proxy for volatility in the two markets. Using 10-min intraday data from May to October 1996, they found that volatility interactions are interdependent in futures and spot markets.

Soydemir and Petrie (2003) examined intraday volatility transmission between the DJIA futures and spot markets. In their study, volatility series are derived using
univariate GARCH models and later analysed in the framework of a VAR model. Using minute-by-minute data from March to August 1999, they found that there exists two way causality in returns volatility of spot and futures markets. However, futures market is reported to have greater impact on spot market.

Pok and Poshakwale (2004) undertook a study by taking the data of underlying stocks on which futures are available and non-underlying stocks on which futures trading is not available in Malaysian Stock Market. The study was conducted with the purpose of examining the impact of futures trading on volatility of spot market and determining the lead-lag and causal relationship between them. The study found that stocks on which futures contracts exist respond more quickly to new information than the stocks for which futures contracts do not exist. In addition, it is reported that trading in futures market causes spot market volatility with a lag of one day.

So and Tse (2004) examined the volatility spillovers among the three markets viz., the Hang Seng Index, the Hang Seng Index futures and Tracker fund. Using a multivariate GARCH model with 1-min data, they found that volatility spillovers run from futures to spot market and vice versa. Besides, it is also reported that volatility in the futures and spot market affect volatility of the Tracker fund but volatility in the Tracker fund does not affect volatility in the Hang Seng Index or the Hang Seng Index futures.

Using daily data from Mexican Securities markets, Zhong, Darrat and Otero (2004) examined volatility spillovers between IPC futures and the underlying cash index. Employing bivariate-EGARCH model with error correction term, they reported that innovations from either market affect volatility in other market.
Mukherjee and Mishra (2006) analyzed volatility spillovers between CNX Nifty futures and the underlying index as well as between futures and spot markets for five stocks. Using returns innovations as proxy for volatility in the context of a VAR model, they found that volatility spillovers run in both the directions, however, spillovers from spot to futures market are stronger.

Bose (2007) studied the characteristics of volatility in the spot and futures market in India. Volatility is found to exhibit the feature of mean reversion, volatility clustering, asymmetry and persistence in both spot and futures markets. Using daily data in the framework of the threshold GARCH model, she reported the leading role of futures market volatility over volatility in the spot market.

Kuo, Hsu and Chiang (2008) examined the volatility linkages between the Taiwan Stock Index and its associated contracts before and after the introduction of foreign investment (FI). The sample period is from July 21, 1998 to February 20, 2001 which is equally divided into pre and post foreign investment periods. By employing bivariate-EGARCH (1,1) model, they found that volatility spillovers are bidirectional in nature both before and after the participation of foreign investment. However, spillovers from futures to spot are larger in magnitude in the post FI period.

Using 1-min data from July to December 2006, Mallikarjunappa and Afsal E M (2008) have studied volatility linkages between futures and spot markets for 12 individual stocks in India. They used VECM-EGARCH (1,1) model and found that there exists bi-directional volatility spillovers between futures and spot markets. Besides, they also reported that volatility shocks are persistent and asymmetric in nature.
Using daily data from February, 2000 to June, 2003, Kavussanos, Visvikis and Alexakis (2008) investigated volatility spillovers between futures and spot markets in Greece. They examined volatility dynamics between FTSE/ATHEX-20 and underlying cash index and FTSE/ATHEX Mid-40 and its underlying cash index. Employing VECM-GARCH-X model, they reported that volatility spillovers run from futures to spot for both indices and not vice versa.

Lafuent-Luengo (2009) in their study employed realized volatility measure to empirically examine the dynamic relationship between market volatility of S&P 500 futures and its corresponding cash index. They used 15-min intraday data over the period from January 17, 2000 to November 26, 2002 and reported a unidirectional causal relationship of volatility from derivative market to cash market.

Karmakar (2009) used a bivariate-BEKK model for studying volatility spillovers between CNX Nifty and associated futures contracts. Using daily data, he reported that persistent volatility spillovers run bi-directionally. Further, he found that past innovations originating in the futures market have significant explanatory power for spot market volatility but past innovations from the spot market have no predictive power for futures market volatility.

Shakeel (2009) examined volatility linkages between Nifty and associated futures contracts. Using GARCH variance series as proxy for volatility, he found that volatility in the futures market affects spot market volatility and not vice versa.

Sakthival and Kamaiah (2010) used daily data from July 2001 through February 2008 for studying volatility spillovers between CNX Nifty futures and the underlying index. Using a TGARCH model, they found that volatility spillover takes place in
both directions, however, futures market volatility is found to have greater influence on spot market volatility.

**Wang and Ho (2010)** used the data from 2 January, 2004 to 28 April, 2006 to examine the volatility relation between the underlying cash index, near-month and near-quarter TAIFEX index futures. The results based on GARCH model and Granger Causality test revealed that one-way volatility spillover takes place from futures to cash market and two-way spillovers run between the near-month futures contracts and near-quarter futures contracts.

**Pati and Rajib (2011)** used 5-min intraday data for studying lead-lag relationship for returns and volatility between CNX Nifty and CNX Nifty futures. Using a bivariate-GARCH (1,1) model with BEKK parameterization, they found that volatility transmissions occur in both the directions, however, the effect of futures market is more pronounced.

**Srinivasan and Ibrahim (2012)** examined lead-lag and volatility interactions between gold futures and spot markets in India. Using daily data from April, 2009 to May, 2011 and employing two step VECM-EGARCH suggested by Tse (1999), they found that gold spot market dominates price discovery. However, volatility linkages are reported to be bidirectional with futures market showing stronger spillover effects.

**Yang, Yang and Zhou (2012)** examined the 5-min intraday volatility transmission mechanism between CSI 300 index and associated futures index in China. They employed an asymmetric ECM-GARCH model and concluded that volatility in one market affects volatility in the other market.
**Kang, Cheong and Yoon (2013)** used intraday data of KOSPI 200 cash and futures indices to study the volatility spillover mechanism between the two markets. By employing bivariate GARCH-BEKK model they found that there is a bidirectional spillover of volatility between the two markets.

**Chauhan, Singh and Arora (2013)** examined the spillover effects between the cash market and the futures markets for three commodities, viz., Guar Seed and Chana. They found evidence confirming that the flow of information between spot and futures is bidirectional with futures market showing stronger spillovers in case of Guar seed. Further, in case of Chana, unidirectional causality is reported with spot volatility influencing the volatility in the futures market.

**Sehgal, Rajput and Florent-Deisting (2013)** studied intertemporal relation between the commodity derivatives and the underlying spot markets by using twelve commodities belonging to agricultural, metal and energy products (Chana, Gold, Naturalgas, Guar Seed, Silver, Crude oil, Soybean, Zinc, Kapas, Lead, Potato Agra, Copper) as well as 4 commodity indices (Mcx-Comdex, Mcx-Agrı-Index, Mcx-Metal-Index and Mcx-Energy-Index) actively traded on Multi Commodity Exchange (MCX). They reported bidirectional volatility spillovers from spot to futures for three commodities namely- Soyabean, Zinc, and Natural Gas, whereas, no significant volatility spillovers were found in case of other commodities.

**Rajput, Kakkar and Batra (2013)** used daily data from June, 2000 through March, 2012 to examine volatility spillovers between Nifty and Nifty futures. Employing a bivariate-EGARCH model, the study provided evidence that CNX Nifty leads the Nifty futures in terms of price discovery and volatility spillovers. They reported unidirectional volatility spillovers from spot to futures with persistent volatility being
bidirectional. Their results are in sharp contrast to many previous studies. However, they employed daily data and volatility dynamics are best studied with intraday data.

**Kim and Ryu (2013)** investigated the intraday volatility relationship among the KOSPI200 index, KOSPI200 futures index, and VKOSPI (implied volatility index). They employed a VAR (1) model with errors following a multivariate GARCH distribution with BEKK parameterization with asymmetry, i.e., VAR(1)-asymmetric-BEKK-GARCH(1,1). They found bidirectional volatility linkages between futures and spot markets with innovations in futures market having greater influence on spot market volatility.

### 2.3 CONCLUSION

Of all the studies reviewed in this chapter, most relate to equity derivatives and a few are concerned with commodity derivatives. Almost all the studies have found the leading role of futures market over the underlying spot market. It is reported that lead from futures to spot is by 10 to 50 minutes i.e. Kawaller, Koch and Koch (1987), Pizzi, Economopoulos and O’Neill (1998), Min and Najund (1999), Pok and Poshakwale (2004), Bhatia (2007), Gupta and Sing (2009), Abuk (2011) and Jiang, Chang and Chiang (2012). However, a few studies have also reported the leadership of spot market. Further, most of the studies supporting the leading role of spot market have employed daily data and it is well documented that for uncovering the dynamics of lead-lag relationship in financial markets intraday data is required.

Srinivasan and Ibrahim (2012), Dey and Maitra (2012) and Rajput, Kakkar and Batra (2013) provided evidence in favor of unidirectional causality.


For volatility spillovers, most of the studies found bidirectional relationship between the two markets. However, spillovers from futures to spot market were reported to be stronger than in the reverse direction. VAR based Granger Causality and Bivariate/Multivariate-GARCH family of models were mostly employed for uncovering volatility interactions.

From the above discussion, it is clear that there is voluminous literature on first-moment i.e., returns relationship between futures and spot markets. However, second-moment i.e., volatility relationship is still under researched. Besides, a close scrutiny of the above studies reveals that in India most of the studies have used daily data which is of little use for understanding market micro-structure and cannot provide useful information to traders and arbitrageurs. In addition, most of the previous studies are confined to the analysis of index spot and futures relationship.
Overall, the review of literature provides the following research gap:

- Use of high frequency data
- Analysis of individual stocks
- Volatility interactions

The present study is an attempt to fill this gap by empirically investigating the dynamic interactions and interdependence of the spot market and the futures market returns for CNX Nifty and all its component stocks.