Review of Literature
2.1. Introduction

The financial systems throughout the world are solving the purpose of resource development. Firstly, they act as a channel of diverting the resources from one hand to other and secondly, the financial system is linked with the commodities markets. The commodities market act in a very important way in determining the returns that producers throughout the world earn for their output, as well as the risks they face. The commodities market stands as backbone of the financial markets throughout the world. As discussed before, the commodities market have very important role to play in any economy.

This chapter discusses the historical studies which have been done about commodities market, its size, the volatility and the lead lag relationship in spot and future markets of not only India but throughout the world.

2.2. Significance of Literature Review

This review of existing literature is an integral part of any research. The oxford dictionary describes literature review as “a critical discussion and summary of statistical literature that is of general and specialized relevance to the particular area and topic of the research problem in statistics. It is the section of available documents (published and unpublished) on the topic which contain information, ideas, data and evidence written from a particular standpoint to fulfil certain aims related to the topic and the effective evaluation of these documents in relation to the research being proposed”.

The chapter has been grouped under the following heads:

(i) The studies on the growth and size of commodities market globally
(ii) The studies on size of commodities market in India
(iii) The studies on volatilities in the commodities market
(iv) Studies on lead lag relationship in the derivative segment
Studies on Volatility in Non-Ferrous Metals

(vi) Studies on Volatility in Precious Metals with Special Reference to Silver

(vii) Studies on Volatility in Crude Oil Prices

2.3. Studies on the Growth and Size of Commodities Market Globally

The commodities market globally has witnessed a growth of 11.4% in 2011 (Acworth, 2011). “After a tough year in 2012, when the global listed derivatives markets suffered the largest decline in volume in more than a decade, trading activity rebounded slightly in 2013. The total number of futures and options traded on exchanges worldwide reached 21.64 billion contracts, up 2.1% compared to the previous year but still well below the levels seen in 2011 and 2010 “ as reported by Acworth (2014). Even though the growth rate was not as aggressive as that in 2010, but it was more or less on par with the growth rate in the years preceding the 2008 crisis. The huge size of the industry speaks volumes about its importance in the financial sector. In the global scenario, the exchange traded derivatives were most traded in Asia-Pacific region with largest share of the global market (39%) in 2011. The North America had share of 33% followed by Europe with a share of 20%. However, the growth rate in North America and Europe was higher than Asia Pacific in 2011, which was an exceptional trend than usual.

Acworth (2010) explored that in 2010, the exchanges in Asia and Latin America have exhibited a great growth rate of 42.8% and 49.6% respectively. The Asia-Pacific region contributed up to 39.8% of international volume, followed by North America with growth of 32.2% and Europe with 19.8% growth. The exchange based trading on derivatives in the Asia-Pacific region grew by 42.8% in 2010. The major contributors to this growth were the exchanges located in China, India and Korea. The growth in Indian derivative market was lead by trading in financial contracts and in particular foreign exchange contracts. The derivative contracts were first introduced on National Stock Exchange of India. These contracts were indexed based derivatives. The commodity based contracts were traded only in 2003. The
commodity trading in India has shown exponential growth which is lead by Multi Commodity Exchange (MCX) which has 87% of the market share in India (Forward Markets Commission, 2012-13).

Mihaljek and Packer (2010) in their study about growth of derivatives in emerging markets and developed nations commented that “turnover of derivatives has grown more rapidly in emerging markets than in developed countries. The growth of derivatives turnover in emerging markets remains more rapid than in advanced economies.” They acknowledged in their study that the Asian sub-continent has few of the largest derivatives markets of the world with great growth potential. Moreover, about “half of the derivatives turnover in emerging markets occurs over the counter, compared to one third in advanced economies”. This stands as an important feature of the emerging economies derivatives markets.

In support of the above research, Fratzscher (2006) also indicated that over 40% of equity derivatives trading products and one third of worldwide trading in foreign exchange based derivative products is done in Asian derivative markets. Few of the largest derivative exchanges in the world are located in Korea. Few of the world’s fastest growing exchange are located in India. The derivative exchanges in Thailand and the Philippines are yet to be established. The trading of derivative products has made the growth in Asian market more aggressive and has provided various developmental benefits to the Asian economies.

2.4. Status of Commodities Market in India

The concept and functioning of the Indian Commodity Market has been well discussed in the first section. The market has witness an exponential growth since its inception and stands as a centre of attraction for media, academicians and researcher. The commodity exchanges in India have made their place in top ten commodities market in the world (Press Trust of India, 2011). The current section highlights the studies which were undertaken to explore the status of commodities market in India.
Nair (2004) studied if the commodities markets in India are ready to take off using certain parameters like “Independent Clearing, Electronic trading, Settlement Guarantee Fund, Usage of Warehouse receipt and extent of participation from Modern Exchanges, Commodity stakeholders, Institutional brokers and others” and concluded that though certain parameters have grown from “absent/low to low/medium” in the commodity futures markets, the sketch of the securities markets show a commendable scale of enhancement with all the appropriate indicators being in the “high category”. The implementation of Straight Through Processing (STP) in the market from 1st July 2004 has been a big achievement. The study also commented that “the continuing dualism between the markets has been one of the major reasons for the emergence of the idea of convergence between the securities and commodity derivatives markets”.

Basu and Mukhopadhyay (2011) in their study commented that Asian derivative markets contribute to "one- third of the world wide foreign exchange and over 40% of equity derivative trading". Korea is home to the largest derivative exchanges in the world, while the fastest growing exchange in the world is located in India. The introduction of derivatives in Asian economy has made the Asian capital markets more aggressive.

In one of the study Gupta (2011) commented that the commodities market in India has huge growth potential. The derivative instruments were reintroduced in Indian market in early 2000s after a long period of suspension. Since then the Indian Commodity Market has witnessed exponential growth. The growth is apparent in the “spread of market network as well as in volume of trade”. The Indian Capital Market is now not just restricted to regional exchanges but also home to national commodity exchanges namely, MCX, NCDEX and NMCE which have a huge market share. The MCX (Multi Commodity Exchange Ltd.) has made its place in top ten commodity exchanges worldwide. The commodity exchanges in India offer a bouquet of over 150 agriculture, metals and energy commodities for trade on these exchanges. “The volume of trade has increased from Rs. 34, 84,485 crore in 2006 to Rs. 94, 94,725 crore in 2010”. He further emphasized that in “liberalized regime we should welcome
these exchanges and their huge growth potentials and treat the commodity derivative market as an integral part of the economy”.

In another study Mishra (2008) described in his research the sharp surge in trade volumes and turnover in recent years in Indian Commodities Market from “Rs. 66,530 crores in 2002-2003 to Rs. 3375336 (crores) in 2007 by approximately 50 times in a short span of 5 years”. The study also highlighted that the commodity futures are effective tools for portfolio diversification because of their less than-perfect (or negative, in the case of MCX Agri) correlation with returns from the Sensex. Consequently, the stakes are higher than ever before. As per his study, the investment in commodity futures is acting as a noticeable alternative to traditional investments in stock markets. Further, with a progressive FDI policy for commodity markets on the anvil, investor prerequisites include transparency and assurance on the enforcement of future contracts.

Gorham (2006) in an article examined how Indian derivatives have earned an important position on to the international scenario in barely a decade which is a very short period of time for such a tremendous growth. Commodities Market offer appealing bouquet of trading opportunities. But even today, it is not easy for international entities to invest in financial derivatives segment of India and virtually impossible to trade in physical commodity products. The commodities market no doubt are in a flourishing stage but entry of international entities in commodities trading can open a new growing horizon for the market.

Patra (2011) commented that the commodity futures markets are “the strength of an agricultural surplus country like India”. The commodity exchanges in India are the pillars of growth of the market and they play a “pivotal role in ensuring stronger growth, transparency and efficiency of the commodity futures markets”. These roles are well imbibed in their “functions, infrastructure capabilities, trading procedures, settlements and risk management practices”. However, the Indian commodity exchanges are still on an emerging point and there are several bottlenecks obstructing their growth. There are various “institutional and policy-level problems” in growth path of the commodity exchanges. Such issues need to be addressed by the
regulator of commodity exchanges in India, Forward Market Commission (FMC) in collaboration with Government of India. He emphasized that “if the commodities markets in India are given the right type of environment to grow then the commodities sector of India can develop from its current status of being a price taker to a price setter, with the national online commodity futures exchanges taking the lead”. As a word of caution, he emphasized that it is important that the participants comprehend the operations of commodity exchanges and functioning of the entire market for healthy growth. It is important for the investors to know the factors that can affect the commodity prices in short and long run.

Ahuja (2006) has pointed out that the expansion of commodities market in India should stand as an example for the policy makers in developing countries. As per his findings, the commodities market has made massive growth in terms of “technology, transparency and the trading activity but only after the Government protection was removed from a number of commodities, and market forces were allowed to play their role”. Hence, the “pricing and price risk management should be left to the market forces” rather than the exchanges try to accomplish them through “administered price mechanisms”. The task of administration of price risk will be a task of greater importance in future with the “promotion of free trade and removal of trade barriers in the world”. This further highlights the need for the commodity derivatives markets.

Chakrabarti (2005) commented that the level of involvement of “individuals, organization of trading, speed of price discovery” are all witnessing major changes worldwide and the Indian markets have swiftly adopted these changes which is an important element contributing to the growth of commodities market in India. The Indian Commodities Market have developed to a large extend from “a domain of barely legal bets to trading on multi-commodity national level exchanges with sophisticated products, technology and contract specifications”. Not only this, these exchanges have been performing well and made a place in the top 10 commodities exchanges of the world. The exchanges have provided the participants in the market a much needed platform to hedge their risks.
2.5. Studies on Volatility in Commodities Market

The problem of volatility in the capital market is as old as the market themselves. There have been various studies which have been conducted to study the causes and intensity of volatility in the various arms of capital market throughout the world but the exact cause, duration and intensity of volatility in any segment of capital market has not been precisely predicted or rationale. The commodities market has not been an exception. The current section summarize prominent researches conducted to study the causes, impact and other aspects of volatility in commodities market not only in India but in the world over but the problem of volatility is an unexplained mystery to a large extent.

In one of the unique study of its type, Bhanunurthy, Dua & Kumawat (2012) studied the impact of weather shocks on spot and future agriculture commodity prices in India. They came up with the conclusions that changes in rainfall affect both futures and spot prices. The authors controlled the impact of fuel prices on the agriculture commodities and then their results concluded that there is a transmission mechanism of weather shocks to prices. Also, this relation is found to be much stronger with the introduction of futures market. Hence, there can be a probable weather shock which can impact the volatility in commodities market but such impact is week as compared to other factors.

Fazil (2012) in his study on recent volatility sessions in Indian commodities market commented that it is the week Indian currency which is the root cause of such volatile sessions in the market, since all commodities are US dollar denominated. The on-going strength in the dollar is reducing the appeal for commodities globally. In fact, investment demand, which is one of the most important phenomenons since the last three-four years, has remained subdued recently. Hence, today, in the globalized and liberalized world, the exchange rate of the currency is also an important element for commodity volatility. To quote an example, gold has outperformed in the countries where the domestic currency has remained week as compared to US dollar. The metal has retained its property of safe haven as in India, the gold prices have remained stable even though the international prices of the
yellow metal have shown a steep fall. The study also defines the role of other factors in determining the prices of commodities. For example, there was a huge pressure by investors to sell crude oil contracts as International Energy Agency (IEA) reported that “the global oil demand in 2012 would be lower due to the weaker economic outlook for developed economies. The lower demand coupled with higher production (as OPEC had agreed producing 6% more oil than the formal quota of 30 mbpd at the group’s last meeting) would leave the oil market over-supplied for the coming months.

In a unique study of its type, Varadi & Kumar (2012) studied the role of speculation in volatility of commodity markets in India. The study recognizes multiple factors namely, “traditional supply and demand, excess global liquidity (i.e., monetary inflows in commodity markets), and financialization i.e., financial investors (portfolio investment and speculation) attitude” contributing to commodity market volatility. Further, the paper provided the evidence for speculation during the crisis period is a cause for excessive volatility in commodity markets. Hence, the paper suggested that the regulator or policy makers should take initiative steps in order to reduce the impact of excessive speculation in future. Morales & O’Callaghan, (2012) studied the persistence of volatility in the returns of precious metals in US and considered the impact on returns of the movement in the three important equity indices, namely Dow Jones Industrials, FTSE 100 and Nikkei 225 and oil returns on the returns of these metals using daily data. They both determined that "large changes in the volatility of each market returns occurs identifying major global events that would increase the volatility of these markets using the Iterated cumulative sums of squares (ICSS) algorithm to identify the break points or sudden changes in the variance of returns in each market using the standardized residuals obtained through the GARCH(1,1) mean equation". The results indicate that there is a strong relationship between oil prices and prices of precious metals while the performance of stock market is an independent factor among the three.

A prominent study was conducted by Ott (2013) on volatility in prices of agricultural goods in US economy. The researcher concluded that a prime role is played by volatility in prices of crude and foreign exchange rate in the extreme volatility of
agricultural goods in US economy. The study was conducted on prices of six agricultural commodities. The volatility in prices of these products was studied with reference to various market specific and common macro factors using the generalized methods of moments.

Turban Samson (2012) in their study analyzed the reaction of the commodities market to a particular type of political shock in US. The authors wanted to analyze if the investors react to local changes in political institutions. Parametric results showed that there is “substantial impact of political shocks: on average, the daily abnormal yield is 20 percentage points higher or lower than what would be expected from the yield behaviour before the event”.

In another study by Gay, Simkins, & Turac (2009) conducted to understand the role of forecasters in volatility of natural gas prices in US, it was concluded that forecasters play an important role speculation of prices and "market assigns greater importance to the forecasts of those analysts who have established a long-term track record of forecasting accuracy."

Oleg (2011) came up with an interesting conclusion while studying the volatility relationship between commodity futures and government bond in China using GARCH, ARCH model. He found that the “conditional correlation falls in period of recession; namely, when market risk rises, which is good news to asset managers since it is precisely when market volatility is high that the benefits of diversification are most appreciated. On the other hand, the negative correlation between the Government 10 year bond and commodity futures Indices rises with the bond volatility, suggesting that, unlike stocks, a bond and commodity portfolio should be tilted more towards commodity futures in periods of high bond volatility”. However, no such study has been done in Indian context to the best knowledge of researcher.

Carter, Gordon & Smith (2011) in their analysis on Commodity Booms and Busts analyzed the periodic movements of the commodities market in US markets. The study provided five major conclusions. The first major conclusion was that the major cause of booms and burst in commodity market are simultaneous supply and
demand shocks. Extensive booms in prices do not arise without “fundamental increases in demand or reductions in supply” for a wide array of commodities. Secondly, the profit motive of the storage firms for higher incentives is another cause for such shocks. Though these shocks might be visibly small, they might cause large price fluctuations especially because “short run demand and supply elasticity are small in absolute value for most commodities”. Third, both the 1973-74 and 2007-08 booms on which the study was based were lead by “strong economic growth in lower middle-income countries and low real interest rates in rich countries”. These factors contributed to the “tight supply-demand balance and draw down in inventories that made markets vulnerable to shocks”. Fourth, “cross-commodity linkages through input substitutability and complementarily cause spillovers to a broader set of commodities than those affected directly by fundamental shock”. Finally, policy responses such as “export embargoes” often aggravate rather than allay booms and busts in commodity prices.

Kumar & Pandey, (2011) investigated the impact of prominent futures market located out of India on trading of futures of nine commodities in India, namely, corn, soybean, aluminium, zinc, copper, silver, gold, natural gas and crude oil. The spill over effect for returns and volatility in these commodities is studied through "Johansen’s Cointegration Test, Error Correction Model, Granger Causality Test, Variance Decomposition Techniques and GARCH model (BEKK)." The findings indicate that futures prices of agriculture commodities traded on NCDEX are integrated with futures prices of agriculture commodities traded on CBOT while the futures prices of precious metals traded on MCX are integrated with NYMEX and futures prices are integrated with LME.

Falkowski (2011) in his study on global commodity prices indicated that there is little data which signifies that the volatility in commodity prices is caused by market fundamentals and not by speculation. The speculation is the main factor contributing to the volatility in commodities market. The data under study also indicated that financial market activity may have “exacerbated volatility, causing a temporary overpricing and under-pricing of commodity values”. It is important to note that the
impact on commodity prices can be caused by both – fundamentals and financial factors and it can be a tedious task to distinguish their impact on commodity prices. However in a long run “fundamental demand and supply factors” play a pivot role in price discovery of commodities. Besides, persistent rise in prices of commodities in the global scenario can be an outcome of high “demand and consumption of emerging economies like China and India”.

Le & Chang, (2011) studied the relationship shared by prices of gold and oil in international economy. The relationship was also studied through the channel of inflation and the interaction of the variables with index of US Dollar. The study used the Unrestricted Trivariate VAR system and the Granger Causality Test to test this relationship. It was concluded that there exists a long run relationship between inflation and oil price, gold prices and inflation and prices of gold and oil. But it is to be noted that the impact of oil prices on inflation is nonlinear and the nature of other relationships under study will change with the changing economic conditions.

Anzuini, Lombardi, & Pagano (2010) analysed the impact of monetary policy shocks on commodity prices in US by application of a standard VAR system. The use of VAR system is very common in analysing the effects of monetary policy shocks. The analysis was done separately on several classes of assets. The results suggest that “expansionary US monetary policy shocks drives up the broad commodity price index and all of its components”. While the effects were statistically significant, they however do not appear to be “overwhelmingly large”. Further, it was analyzed that the extraordinarily easing of monetary policy (which in today’s scenario be done to fight the financial crisis) is likely to push up commodity prices.

Gilbert (2010) in the United Nations Commodity Market Review commented that “commodity markets have become akin to foreign exchange markets where the weight of money outweighs the relative competitiveness (Purchasing Power Parity) fundamental”. This proves that the variety of factors which impact the volatility in the Commodity market have been increasing with increase in the volumes of trade.
Kaur, Kaur, & Chahal, (2012) in their study emphasized the need of commodities market in developing countries. They concluded that “development of financial derivatives is justified in developing countries by volatility in output, prices, currency, exchange rates, and interest rates”. They further appreciated the remarkable growth in of India’s commodities market and referring to India's case, they recommended the Sub-Saharan African economies for development of regional project of derivatives markets.

Lunieski (2009) in his study about the commodity price volatility and monetary policy uncertainty in context of US economy using GARCH model concluded that uncertainties regarding monetary policy increase volatility in gold futures markets. On the other hand, a reduction in monetary policy uncertainties may cause an increase in speculation and an uptick in prices for primary commodities. The study further emphasized the need and importance of providing smooth monetary policy as it helps to better understand the impact of financial tools on consumer and durable goods.

Kumar & Singh (2008) “conducted an empirical study of volatility, risk premium and seasonality in risk-return relation of the Indian stock and commodity markets using GARCH- in -mean model. The stock and commodity markets returns show persistence as well as clustering and asymmetric properties. Further, risk-return relationship is positive though insignificant for Nifty and Soybean where as significant positive relationship is found in the case of Gold.” Seasonality in return and volatility is explored through GARCH-in-Mean approach. Soybean does not show seasonality in return whereas seasonality is found in NIFTY returns. Volatility shows seasonal effect in all the cases. Seasonality in return raises question about the efficiency of the Indian stock and commodity markets.

Lokare (2007) in his study on Indian Commodity Market compared the volatility in the spot and future market in commodities market. He found that almost all the commodities under study provide for support of co-integration in spot and future prices, indicating that these markets are moving in the right track of achieving improving operational efficiency, even though at a slower pace. The author also
indicated that there were certain commodities under study wherein the volatility in the spot market has been higher than the future market which is a characteristic of inefficient exploitation of information in market. There are certain commodities on the commodities exchanges which attract a lot of speculative trading. There are some commodities for which it is possible to effectively hedge against adverse price movements while there are some which can be categorized as moderately or highly risky.

Hua, Lu, & Chen, (2008) indicated that there is an international link shared between Chinese and other major world copper futures markets located in London (on London Metal Exchange) and New York (on New York Mercantile Exchange). The study used the Gonzalo and Granger (1995), and Hasbrouck (1995) methods to study the information spill over effect. It was found that the London market contributes up to 45% of price discovery and hence dominates the process. The Shanghai Future Exchange is second largest copper futures market in the world but contributes to only 25% of price discovery.

Bekiros & Diks, (2008) explore the linear and nonlinear causality between spot and futures prices for West Texas Intermediate Crude Oil for contract maturity of one, two, three and four months for two periods October 1991-October 1999 and November 1999-October 2007. The above stated commodity is the underlying asset for New York Mercantile Exchange's (NYMEX) oil futures derivatives contracts. The study used the traditional Granger Causality Test (1969) and Dicks and Panchenko (2006) nonlinear Causality Test. The results indicated that the lead lag relationship in the market can change over the period of time. The direction of causality can be from one market to other in one time period and can be bidirectional in other case. Also, even though the process of price discovery is prominently played by futures market, the role of spot market is also important in the process.

Watkins & McAleer, (2004) did an extensive survey of "pricing and return models applied to exchange-based spot and futures markets for the main industrially used non-ferrous metals, namely aluminium, copper, lead, nickel, tin and zinc in various economies." They indicated that the research has been conducted using various
dimensions like "type of contract, frequency of data used, choice of both dependent and explanatory variables, use of proxy variables, type of model chosen, economic hypotheses tested, methods of estimation and calculation of SEs for inference, descriptive statistics, use of diagnostic tests of auxiliary assumptions, use of nested and non-nested tests, use of information criteria and empirical implications for non-ferrous metals". But the studies have ignored various important issues like "overlapping data, structural change, measurement error, correct use of proxy variables and non-stationarity of spot futures and forward price series, check for linearity of data, etc". This leaves scope for new research.

Gorton & Rouwenhorst (2004) in their study about commodities future in USA commented that as indicated by standard deviation, it can be concluded that a diversified investment in stock has slightly higher risk than investment in commodity futures. Talking about the volatility in the Commodities Market, they found that the “distribution of commodity returns is positively skewed relative to equity returns; commodity futures have less downside risk”. The negative correlation shared between commodity futures and the other asset classes is attributed to different behaviour of the assets over the business cycle. Also, commodity futures share a positive correlation with “inflation, unexpected inflation, and changes in expected inflation”.

Palakkod (2012) in his study on volatility spill over between capital, commodity and currency markets in India discovered that volatility spills over from currency and commodity markets to capital market. Likewise the volatility spill over from capital market to currency markets and there is no spill over from commodity market to currency markets. In case of commodity market there is no evidence of volatility spill over from other markets. Hence, the volatility in Indian Capital Market and currency market has no profound impact on the volatility in Indian Commodity Market.

Chen, Firth, & Xin, (2004) examined the lead lag relationship between the returns and trading volumes to justify the flow of volatility in prices of contracts in China for the four most traded commodity based futures in China. The commodities under study were wheat, aluminium, soybean and copper. The study used correlation
analysis coupled with granger causality test for the analysis. The study provided few interesting results: "the contemporaneous correlations between return and trading volume are not significant but the contemporaneous correlations between absolute return and trading volume are significantly positive in all futures markets and there is no linearly significant causality following from trading volume to return or from return to trading volume but there is significant causality following from trading volume to absolute settlement-to-settlement return in the copper."

2.6. Studies on Lead Lag Relationship in Spot and Future Market

The relationship between spot and future market in the derivative segment is important as it defines which of the two markets leads the other one. The leader market is definitely more efficient and more profitable for the investors. There have been different opinions from the academicians about the lead lag relationship in spot and future markets in the derivative segment. While, many researchers are of the opinion that the future market leads the volatility in spot market, the others take a vice versa opinion. But many researchers even conclude that there is no lead lag relationship in spot and future market while others say that the lead lag relationship in spot and future markets vary in long run and short run.

Let us now review few prominent literatures in this arena. In India, a lot of studies have been conducted on spot and index futures market. For example, Mall, Ball & Mishra (2012) studied the lead- lag relationship between spot and index futures market in India. The study was done using “Vector Error Correction Model (VECM) on S&P CNX Nifty and its futures”. It was concluded that the equilibrium relationship between the spot market price index and its futures price exits in long run. In other words, in India’s capital market futures prices lead the spot prices only in the long-run, but not in the short-run.

In another study on lead lag relationships between futures and spot markets for 31 different stocks of Indian stock market, Choudhary & Bajaj (2012) investigated if the spot and futures markets are playing a vital role in the integration of information and helping in “price discovery” in the Indian stock market. The authors used “Granger
causality test and VECM (Vector Error Correction Model)” to determine the direction of volatility. The results were interesting. The results of the indicated that there is a “bi-directional information flows or feedback between the spot and futures markets in case of 30 securities and one security is showing unilateral relationship from spot to futures. The study also indicated that futures market is leading the spot market in case of 12 securities whereas 19 securities are being led by the spot market”.

Debasish (2009) also studied the impact of futures trading on spot market in India. He well organized the scope and area of his study and specifically, examined if there is any significant change in volatility of spot prices of the underlying stock because of trade in the index futures in India and if trading in index futures has affected market/trading efficiency in the Indian futures and stock markets. The result shows that after the launch of Nifty index futures trading in India, the market has experienced a drop in spot price volatility and reduced “trading efficiency in the underlying stock market”. Hence, there exists a lead-lag relationship between two markets but the study failed to comment which of the two markets (spot or future) leads other.

In one of the interesting studies, Kumar (2009) investigated the lead-lag relationship between spot and futures markets for “agricultural, metal, precious metals and energy commodities in Indian commodity derivatives market”. The study investigated the association between “spot price volatility and futures trading volume and open interest”. The study used the Vector Autoregressive Model, Granger causality tests, forecast error variance decompositions and impulse response function to recognize the volatility between the variables under study. The findings indicated that the unexpected volumes of trade in futures for most of the commodities cause spot price to be highly volatile. This impact of unexpected high volumes of trade in futures on spot volatility is positive and continues for many days.

Srinivasan, (2011) used the spot and future indices of Multi Commodity Exchange (MCX), namely MCXAGRI which represents the agriculture sector in India, MCXMETAL representing the metals traded in India, MCXENERGY representing the energy trade in the nation and the composite MCXCOMDEX which denotes the
metals, energy and agro commodities traded. The study used the "Johansen cointegration, Vector Error Correction Model (VECM) and the bivariate EGARCH model" to study the daily spill over of volatility in spot and futures market in India. The long term association between spot and future market in various sectors was confirmed using the Johansen Cointegration Test while the VECM indicated that the spot market leads the futures market for various sectors and leads to effective price discovery meaning that the flow of information is from spot to future.

Tsuji (1996) studied about the lead lag relationships among precious metals in US economy. He concluded that among the three precious metals, lagged monthly changes in prices of neither gold nor silver exhibit cross-leading relationships with current monthly changes in prices of the other. For platinum prices, the research does not find lagged monthly changes in platinum prices exhibiting a leading relationship to current monthly changes in prices of gold and silver. However, when lagged monthly, changes in prices of gold but not silver exhibit a leading relationship to current monthly changes in platinum prices, which contrasts with previous results based upon ad-hoc, lag length structures. Therefore, the nature of lead lag relationship between the metals can vary. This can be attributed to the fact that different metals have different investment attributes.

Cuddington & Cordano, (2013) developed GARCH and VEC MGARCH models based on Fama and French (1988) to study the link between spot and futures prices of seven metals namely aluminium, copper, lead, nickel, tin, and zinc traded on London Metal Exchange. The model was developed to test the cost of carry model for future pricing and the model provided pragmatic evidences to support the cost of carry model. The study indicated that the "conditional correlation between percentage changes in futures and spot prices is very high (well over 0.9) regardless of whether markets are tight or not". Hence, for the metals traded on London Metal Exchange, the cost of carry model well explains the fluctuations in the spot and futures market for the metals under study.

Mukherjee & Mishra (2004) investigated the possible lead-lag relationship for the return and volatility, between the "NIFTY spot index and index futures market in
India” and tried to investigate if this relationship has changed when different sets of information are released in the market. The results relating to the impact of new information on the lead-lag relationship exhibit that “though the leading role of the futures market wouldn’t strengthen even for major market-wide information releases, the role of the futures market in the matter of price discovery tends to weakens and sometime disappear after the release of major firm-specific announcements”. They reasoned out that the “possible explanation behind such more or less symmetric lead lag relationship among Indian spot and futures markets may be the joint efficiency of both the markets”.

Though the above study show that there exists a lead lag relationship in spot and future markets may be in short run or long run, etc, there are certain researchers who are of the opinion that there is no lead lag relationships that exists in the spot and future markets. For example, in a unique study of its nature in India, Jackline & Deo (2011) studied the lead lag relationship between spot and futures prices of lean hogs and pork bellies markets during the sample period (January 2001 - May 2010). The study used Pairwise Granger Causality for the study. The commodities under study were non- storable and from the study the authors found that in short term future price series drive (Granger cause) the cash market and vice versa for both the selected markets. Therefore, “new information disseminating into the market place immediately reflected in spot prices and the futures prices simultaneously”. In other words, there existed no lead lag relationship in the two markets and the two markets react simultaneously towards any new information.

2.7. Studies on Volatility in Non-Ferrous Metals

The non- ferrous metals have been of wide interest for the researchers, academicians, and media in the developed economies because of their extensive use in the industries. However, these metals have not been given a due importance in the Indian economy. An extensive review of literature indicated that the aspects of data analysis consider various dimensions like types of contract traded, commercial and industrial uses of metals, frequency and size of sample, etc. Since the scenario
in Indian Non Ferrous Derivative Market is very different from the developed economies, in the current research, the researcher has quoted only those studies which are relevant to Indian scenario.

Sinha & Mathur (2013) undertook a study on behaviours of prices of five major base metals in India, namely- copper, nickel, zinc, lead and aluminium. They also accessed the impact of Global Financial Crisis on trading of these metals. The paper also studied the impact of volatility in equity market measured by India VIX on the prices of the metals under study. The researchers used GARCH model for their study and justified the application of model based of an extensive review of literature. The study concluded that the “future prices and returns on spot prices of base metals are linearly related, and there is presence of persistence in metal price volatility as estimated by GARCH (1,1) model.” The global financial crisis had a significant impact on the volatility of prices of the metals. The impact of volatility in equity market on non ferrous metals is not equal for all five. The influence is significant in case of “weekly price volatility of futures contract of aluminium, zinc and lead and it does not influence the weekly price volatility of futures contract of copper and nickel”.

Cochran, Mansur, & Odusami, (2012) examined the return and long memory properties of volatilities of four metals namely gold, platinum, silver and copper. The major and relevant issues for the studies were if the crisis of 2008 had any major impact on the prices of metals and if the volatility in equity market has any major impact on the price performance of the metals. The findings of the study give interesting results. The performance and volatility in the equity market is an important determinant in the price performance of the metals under study. The study establishes strong link between metal and equity market. Further, the impact of crisis of September, 2008 on the prices of the metals has been significant.

Heaney (2002) also emphasized the importance of futures and convenience yield approximation as important factors in determining the spot prices of copper, zinc and lead. In one of the very relevant study Agbeyegbe (1992) applied cointegration method to study the price discovery by futures in non ferrous metals traded on
London Metal Exchange. He did not rule out those studies which had indicated that the London Metal Market is efficient. The three non ferrous metals under study were, copper, lead and zinc. The study indicated that the data is seasonal. Though the study concludes that there is a common stochastic trend in price movements among metals and in spot and futures market, it has not ruled out any possibility of results being misleading on theoretical grounds.

Watkins and McAleer (2006) did an extensive survey of existing literature of lead lag relationship of spot and futures for non ferrous metals traded on London Metal Exchange and they concluded that though the price discovery of these metals have been given due importance in literature but the research has failed to check important empirical issues like overlapping nature of data, non-linearity of data, stationarity of data, etc. The current research seeks to address these issues.

2.8. Studies on Volatility in Precious Metals with Special Reference to Silver

The performance of bullion market has been a topic of interest for the academicians, corporate and media. The performance of precious metals, especially gold and silver has also been an area of keen interest for the general consumers in India because of various domestic uses the two metals can be used for. But there are no specific studies conducted in context of Indian economy for silver alone. However, the researcher could find a lot of relevant studies in context of developed economies.

Hammoudeh, Yuan, McAleer & Thompson (2009) examined the “conditional volatility and correlation dependency and interdependency for the four major precious metals (that is, gold, silver, platinum and palladium), while accounting for geopolitics within a multivariate system for US economy.” The study used the VARMA-GARCH and the more restrictive VARMA-DCC models for the analysis as the models are capable of providing more "interpretable parameters and have less computational and convergence complications". The results show that "almost all the precious metals are moderately sensitive to own news and weakly responsive to news spilled over
from other metals in the short run. There is however strong volatility sensitivity to own past shocks in the long run, with the strongest sensitivity bestowed on silver and the weakest on gold".

In another study by Conover, Jensen, Johnson, & Mercer (2007) in context of US economy it was concluded that investors can improve the performance of their portfolio considerably by adding a significant exposure to the equities of precious metals firms. Moreover, the study also concluded that the “benefits of precious metal are strongly tied to monetary conditions. The benefits of adding precious metals to a portfolio are rather small during periods when monetary policy is expansive; however, the benefits are substantial when monetary policy is restrictive." The study further concluded that "The improvement in the performance of the portfolio by adding a significant exposure to the equities of precious metals can be attributed to the ability of precious metals to mollify the poor market performance that tends to afflict many equities during periods when monetary policy is restrictive."

In another study by Lawrence (2003) in context of US economy, it was concluded that the performance of silver prices is impacted by changes in some macro-economic variables. The study compared the “rate real rates of return on durable commodities like as oil, zinc, lead, silver and aluminium with real changes in GDP, short-term interest rates and the money supply.” While, "Price changes in copper, lead and zinc are positively correlated with the growth rate of real GDP, while returns on oil, represented by the WTI index, are strongly correlated with inflation. The test results suggest that there is no contemporaneous correlation between the rate of growth of the money supply and returns on any other commodities under study". The study commented that the prices of silver are inversely correlated with bond yields and short-term interest rates while it is positively related to gold, copper and aluminium.

On the other hand, in few other previous studies like Michael & Swanson (1981) in context of US economy again, the efficiency in gold and silver market and the relationship between two markets was explored. The study considered investment in gold and silver as purely speculative in nature. The study failed to show any
correlation of any macro-economic variables with price movements of gold and silver. Further, the nature of performance of gold and silver prices made it difficult for application of any traditional model and hence the study failed to comment on the efficiency of the two markets. In a similar study by Fama and French (1988) about business cycles and behaviour of metal prices in US economy, the authors concluded that there is sharp rise followed by phases of declines in prices of all metals around business cycles. This movement is stronger in case of precious metals. The study further stated that there is a strong impact of inventory on prices of precious metals. "Inventory response spread the effects of demand and supply shocks between current and expected spot prices. The theory of storage predicts that when inventory is high, large inventory responses to shocks imply roughly equal changes in current and expected spot prices".

In another study by Ciner (2001) on prices of two metals on Tokyo Commodity Exchange (TOCOM) it was concluded that the cointegration of silver and gold market al. has disappeared in 1990's. The study uses the Johansen's (1991) maximum likelihood cointegration analysis for analysis. The study concluded that over the passage of time, the long term linkages between the prices of two precious metal has disappeared. The two markets should be separately approached and should not be regarded as substitutes to hedge against similar types of risks.

2.9. Studies on Volatility in Crude Oil Prices

Crude oil is the backbone of any economy. The volatility in the oil prices can disturb the economic activities in the entire economy worldwide. Hence, there is extensive literature available on the performance of crude oil derivative products worldwide. This section discusses few relevant studies for the proposed research.

Bekiros & Diks (2008) studied the “linear and nonlinear linkages between daily spot and futures prices of maturity with one, two, three and four months of West Texas Intermediate (WTI) crude oil.” The study uses the nonlinearity causality designed by Diks and Panchenko( 2006) after controlling the cointegration. The study indicated that "the pair wise VECM modelling suggested a strong bi-directional Granger
causality between spot and futures prices in both periods, whereas the five-variate implementation resulted in a uni-directional causal linkage from spot to futures prices only in PII. Moreover, the linear causal relationship disappears after cointegration filtering." More specifically, the study concluded that the lead lag relationship in crude oil market is changing over the passage of time. The relationship does not remain consistent.

Hamilton (2008) examined the factors which can cause changes in crude oil prices. The study "reviewed statistical behaviour of oil prices, relates these to the predictions of theory, and looks in detail at key features of petroleum demand and supply." The study concluded that the monopoly pricing by OPEC has been a strong factor in pricing of oil in international market. The other major cause is the "decrease in the price elasticity of demand and the strong growth in demand from China, the Middle East, and other newly industrialized economies." These factors have led to increase in the speculative demand. In another study about if speculators are capable of driving crude oil futures prices, Bu¨yu¨ks¸ahin and Harris (2011) used a "unique data set from the U.S. Commodity Futures Trading Commission (CFTC) to test the relation between crude oil prices and the trading positions of various types of traders in the crude oil futures market." The study employed the popular granger causality test to find the lead lag relationship between "price and position data at daily and multiple day intervals." The study concluded that the speculative position of "hedge funds and other non-commercial (speculator) position does not significantly changes the Granger-cause price changes; the results instead suggest that price changes precede their position changes." The study is supported by various studies, like that of Boyd, Buyuksahin, Harris, &Haigh, (2010) and Brunetti, Buyuksahin, & Harris, (2011). But it also contradicted the findings of studies like Shleifer and Summers (1990) and De Long et al. (1990). Deregulation of market is another important factor that has strong impact on crude oil prices Fleming &Ostdiek (1999).
2.10. Key Observation and Research Gap

After a thorough review of literature, the research would like to highlight few important aspects:

(i) The review of existing literature indicates that Indian Commodities Market is still an emerging forum in the arena of research. The numbers of quality research in the field are limited. The market has been applauded for its tremendous growth in relatively short span of time but the existing literature is not rich and opulent.

(ii) There are very few studies conducted in Indian Commodities Market on non-ferrous metals which have been given a due importance by academicians of developed nations. They believe that the non-ferrous metals are backbone of the economy due to their various industrial uses. However, in India, there are very few studies conducted for non-ferrous metals. Bulks of studies are conducted about behaviour of precious metals, especially gold prices in India. Studies on silver prices are also limited.

(iii) The studies conducted in Indian context have used outdated tools without thoroughly studying the properties of data. On contrary, the use of methodology has been modified as per the requirements and properties of data in case of studies conducted in developed economies.

The current study has been designed keeping in consideration the key observation from the review of literature. The studies which have been important in forming the research methodology are cited in research methodology.
References


