CHAPTER 7
FINDINGS, CONCLUSION AND SUGGESTIONS

The aim of this study is to examine the seasonality, co-integration, causal relationship, volatility spillover and dynamic conditional correlation between commodities and their related stock indices. The secondary data has been collected from the official website of MCX, NCDEX and NSE. Econometrics tools like Generalized Autoregressive Conditional Heteroskedasticity Test, Johansen Co-integration Test, Toda and Yamamoto Test of Granger Causality Test, VAR-GARCH and Dynamic Conditional Correlation-GARCH models have been used to analyse the data. Based on the results and interpretations, the key findings and conclusion has been presented in this section. Based on the results, the suggestions are also provided for investors, brokers and policy makers.

7.1 Findings of the Study
The major findings of this study are given below:

7.1.1 Monthly Seasonality in Commodity Market and Stock Market
One of the objectives of this study is to examine the monthly seasonality in commodity market and stock market. Current study tried to examine whether the commodities and their related stock indices follow the efficient market hypothesis or there are chances to earn abnormal return from these markets.

However, going into deeper insights, the key findings from the results are given below:

- There is absence of monthly seasonality in three out sixteen agricultural commodities which are crude palm oil, RBD palm oil and soy oil.
- NSE FMCG index returns are negative and statistically significant in the month of February.
- April and September effect is present in the mean return of five out of sixteen commodities. July and August effect is present in three out of sixteen commodities followed by January, February, October and November effect
which is present in the mean return of two series. Further the coefficient of March and December months are statistically significant for only one commodity.

- The results indicating the presence of monthly seasonality in the volatility of commodities and stocks indicate that the seasonal effect is absent in the volatility of four out of sixteen commodities which are crude palm oil, RBD palm oil, soya oil and yellow peas.
- The results indicate the presence of monthly seasonality in energy commodities and energy stock index. The seasonal effect is present in the volatility of natural gas while it is absent in the volatility of crude oil and energy stock index.
- There is presence of monthly seasonality in the mean return and volatility of gold and silver while it is absent for NIFTY stock index.
- Monthly seasonality is present in the mean return of two out of five base metal commodities which are copper and zinc and in the volatility of three commodities which are aluminum, copper and Nickel.
- The seasonal effect is present in the mean return while absent in the volatility of metal stock index.

7.1.2 Co-integration between Commodity Market and Stock Market
The second objective of this study is to examine the long-run co-integration between the stock market and commodity market. Basically, the main theme behind the co-integration between two markets is that the variables in the long-run move jointly regardless of variables themselves drifted too apart themselves during long run. The divergence between these variables is considered to be constant. So this is defined as co-integration (Hall and Henry, 1989; Ahmed et al., 2017). There are large numbers of studies that explored short-term affect, but ignore the aspect of long run on the behavior of commodity market and stock market together.

- The overall results related to the long run relationship between the stock market and commodity market reveal that generally prices in these two markets of India are not unified. There is no long run interdependence between commodities and their related stock indices.
7.1.3 Causal Relationship between Commodity Market and Stock Market

One of the objectives of this study is to examine the causal relationship between commodity market and stock market. The studies done so far explored the causal relationship mainly between the commodities and overall stock price index and very few studies paid attention on the sectoral level (Dutta, 2017).

- The overall results related to causality between commodity market and stock market reveal that with the exception of five agricultural commodities (barley, cottonseed, jeera, mustardseed and wheat), granger causality test could not find causal relationship between the commodity market and stock market.

7.1.4 Return and Volatility Spillover across Commodity Market and Stock Market

The fourth objective of this study is to study the return and volatility spillover between the commodity market and stock market.

- The overall results related to the volatility spillover between commodity market and stock market clearly indicate that past own shocks and fluctuations in the volatility of commodity market and stock market are more important, while predicting current conditional volatility as the magnitude of impact of past own volatility is quite high as compare to cross market volatility coefficients. The results are consistent with the findings of Arouiri et al. (2012); Jouini (2013); Mensi et al. (2013) and Bouri (2015).

- Secondly, conditional volatility of commodities fluctuates very slowly over time as the magnitude of GARCH coefficient is relatively large.

- Further the results related to shock and volatility spillover indicate that out of 25 commodity-stock pairs, current conditional volatility of stock market depends upon the past shocks and fluctuations in the volatility of five commodities which are mustard seed, rubber, gold, silver and copper.

- The shock transmission from commodity market to stock market is statistically significant in crude palm oil, guargum and nickel, implies that past shocks in these commodities have significant impact on the current conditional volatility of their related stocks.
• In addition, the current conditional volatility of these stocks is also affected by past conditional volatility of cotton seed, crude oil and lead. The spillover effect is also found in the reverse direction from stock market to commodity market. The volatility and shock spillover effect is significant from metal stock index to copper.

• The current conditional volatility of crude palm oil, rubber, soya oil and nickel depends upon the past shocks in their related stock indices and the current conditional volatility of barley, RBD palm oil, aluminum, lead and zinc depends upon the fluctuation in the past volatility of their related stock indices.

• The results related to absence of volatility spillover in maximum pairs of commodity-stock are quite surprising because FMCG, Energy and metal companies are consumer of agricultural, energy and metal commodities respectively.

7.1.5 Dynamic Conditional Correlation across Commodity Market and Stock Market

• Results of dynamic conditional correlation between commodity market and stock market indicate that the correlation between the stock and commodity market is highly volatile throughout the study period.

• During the financial crises, the correlation between the commodity market and stock market decreased.

• The correlation between these two markets rises immediately after the financial crisis.

• The results further depict that there is negative correlation between the agricultural commodities and FMCG stock index. The results are in line with Demiralay and Ulusoy (2016); Nguyen et al. (2015).

• In the precious metals especially in gold, the correlation is mostly negative.

• There is negative correlation between crude oil and energy index prices.

• Last but not the least, metal commodities show positive correlation with stock market.
7.2 Conclusion
Co-integration between commodities and stock market is recent topic which received a lot of attention from researchers, investors and policy makers especially after financial crises 2007-08. The past literature lacked a study which studies the impact of change in commodity price on the sectoral stock index prices from Indian perspective. This study is first to empirically examine the co-integration between individual commodities and their related sectors’ stock index. The objective wise conclusion drawn from above discussed findings is given below:

7.2.1 Monthly Seasonality in Commodity Market and Stock Market
Seasonality in the commodity market occurs due to imbalance between demand and supply. Agricultural commodities follow seasonal patterns from planting to harvest. Before the harvesting, the price goes up because of less supply as compare to demand. The prices go down immediately after the harvesting because of ample supply. The scarcity of supply not only increases the price of the commodity, but there is also an increase in the volatility in the commodity market also during this time period.

- Seasonal patterns are observed in Barley Commodity in the month of April. The harvesting of barley is started in the month of April. Due to less supply during the month of April, there is increase in price of the commodity. The volatility is high in Barley in the month of March. As discussed earlier, the scarcity of commodity increases the volatility in the commodity prices. The sowing season starts from October. It can be the reason for seasonality in volatility of barley during October, November and December.

- The results suggest that cotton seed returns are negative in the months of April, September, October and November. The results are in line with the findings of Seamon et al. (2001). Cotton seed oil cake is the by-product of cotton. The prices of cotton are lowest during predominant harvest period from September to November. The seasonality in volatility in cottonseed oilcake is observed in the months of May, June, July, August, October, November and December. The results are consistent with Hudson and Coble (1999). The volatility is at its peak during October. The volatility is observed in these months because of “priori expectations” according to which during
crop development months, the fluctuations in the price of cottonseed is high. The new information disseminates in the market and creates instability in the current price.

- There is absence of monthly seasonality in return of crude palm oil. The seasonality in volatility is present in crude palm oil in the months of February, April and December. The fluctuations in the price of crude palm oil largely depend on the supply scenario of oil producing companies such as Malaysia and Indonesia. The crude palm oil production is lower in the month of February and after that the production starts increasing gradually and reaches at the peak during October. Then again production gradually decline towards December.

- The return and volatility seasonal patterns of guar gum and guar seed are similar because guar gum is the main product of guar seed. Any fluctuation in the guar seed prices causes variations in the price of guar gum also. The study indicates the presence of July effect in both the commodities. Similar results are drawn by Soni (2012). The possible explanation for this result may be the less supply of these commodities during the sowing season which in turn causes rise in prices of these commodities. These commodities are found to be highly volatile. One reason can be the over-speculation and manipulation activities in these commodities. The herding behavior of big firms as well as small traders might be the underlying cause of high volatility and price rise.

- Result indicates that in case of mustard seed, the seasonality in return is found in the months of January and February and the seasonality in volatility is found in the month of June, August and December. The sowing season of mustard seed is October to November and it starts growing in the months of November, December, January and February. The harvesting period is February to March. The presence of seasonality in volatility during January and February may be due to the priori expectations as discussed earlier.

- In case of pepper, the seasonality in mean return is found to be statistically significant in the month of April and seasonality in volatility is found in the months of July, August, September, November and December. It might be due to the fact that pepper has high degree of seasonality during a year especially
from June to December due to festival season that creates excess demand during this time period. The results of this study confirm the findings of Maitra (2018).

- In case of soybean June, July and August are considered as weak month because of harvesting.

- For wheat, the results indicate the presence of seasonality in the months of January, March and April. The results are in line with the findings of Meera and Sharma (2016). The harvesting season of wheat is March-April. The crop is arrived to the market immediately after the harvesting. There is heavy arrival of wheat during the harvesting and the impact of highest arrival of wheat on the prices is negative.

- For FMCG stock index, the findings suggest that there is existence of seasonality in the month of February. The results are in line with Elango and Pandey (2008). The possible justification for this finding is that March is the month during which the investors have to file their tax and the investors will pay 25% of taxes in the month of February and remaining at the end of financial year. This could create bearish trend in the market and the prices fell down during February.

- Findings suggest that seasonal effects are absent in crude palm oil, RBD palm oil and soy oil. One of the possible justifications is that India is amongst major importers of palm oil and soy oil due to which these commodities are less sensitive to the government interventions as compare to other agricultural commodities.

- In case of crude oil, the findings suggest that there is presence of monthly effect in the return in the month of February. It might be due to the spring anticipation of busy summer driving season.

- In case of natural gas, the results indicate the presence of monthly effect in return in the months of April, May, November and December. The results drawn in this study are similar with the findings of Fladmark and Grimstad (2013). The demand of natural gas is high during summer season (April and May). It might be due to the increased usage of air conditioner during summer season. The increased demand of natural gas during winter (November and
December) might be due to the increased usage of natural gas for heating purpose. The energy stock index mean returns are negative during November indicates the negative impact of increased natural gas prices on the energy companies’ stock price.

- In case of gold, the results indicated the presence of seasonality in the months of January, February, April, August and November. In case of silver, the seasonal effects are present in the months of January and February. It might be due to the festivals during these months.

- The results related to monthly seasonality in base metal indicated the absence of seasonal variations in most of the commodities. The results are consistent with the finding of Geman and Smith (2012) and Thiagarajan (2018). The possible explanation for these results is that the base metal commodities do not have seasonal variations in the supply. The minor seasonal variations are found which might occur due to the slight variations in construction activity. Unlike agricultural commodities, base metals do not follow seasonal patterns. The metals are mostly affected by global growth outlook rather than any other commodity grouping. The other possible explanation may be the indirect dependence of metal price on the price behavior of energy commodities as these commodities are used for the purpose of mining and refining of metals.

These results have important implications. The similar seasonal effect commodities and their related stock indices suggest the integration between these markets. The findings of this study imply that the monthly effect is not similar in both commodity market and stock market. It suggests that the inefficiencies in the market due to which it becomes easy for the investors to earn abnormal returns by taking opposite positions in both the markets.

7.2.2 Co-integration between Commodity Market and Stock Market

- The results of this study indicate that there is absence of long run co-integration between commodity market and stock market. The results are consistent with Nath and Verma (2003); Hammoudeh and Aliesa (2004); Kumar and Shollapur (2012) and Srinivasan (2014).
• The findings suggest that commodity market does not contain any significant information to forecast stock prices in India in the long run. This implies that when a common stochastic distress occurs in any one of the markets, both the markets do not move together in the long run.

• These findings also seem to recommend that commodity market is not directly linked with stock market and thus have no stock returns predictive power; independent markets do not seem to move together. Therefore in case of absence of co-integration relationship between both the markets, the variables move indiscriminately away from one another.

• If two markets are independents or not co-integrated with each other in the long run, investors can invest in both the markets for the sake of diversification of their portfolio. There is no transmission of shocks from one market to another in case of turmoil in any one of the markets.

7.2.3 Causal Relationship between Commodity Market and Stock Market

• Results of this study confirm the absence of causal relationship between commodity market and stock market. Secondly, there is uni-directional causal relationship between some of the agricultural commodities (Barley, cottonseed, jeera, mustardseed and wheat) and FMCG stock index.

• Barley and Wheat are the two cereal commodities currently traded at National Commodities and Derivatives Exchange of India. India is major producer, consumer and exporter of these commodities. The broken mustardseed and cottonseed have also been exported from India in large amount. Last but not the least, bulk production of jeera is used for export purpose.

• The uni-directional causality in these commodities and stock pairs might be due to the fact that the domestic and global demand together has influenced the Indian Commodity Market for Barley, Cottonseed, Jeera Mustardseed and wheat. When there is insufficient supply of commodity as compare to demand then the price may be move to high value due to which the speculators or the investors seeking large profits in equity market are attracted towards commodity market and continue to buy while ignoring the commodity fundamentals. When there is negative shock in any one of the market, the
speculators cut down their investment in the other market in order to avoid more risk, due to which prices fell down in that market also.

- The presence of uni-directional relationship from one market to another indicates that the informational efficiency exists in the second market. If the causal relationship does not exist in both the directions, it implies that both the markets are independent of each other. So investors can reduce risk exposure by diversifying their portfolio across the different markets. If the causality exists in both the directions, policy makers may intervene more effectively in the desired directions to take action within reasonable time horizon.

- From the investor’s perspective, the above results recommend that since there is no causal relationship between the commodity market and stock market, these stocks and commodities can be used as diversification tool in the portfolio. However this same thing cannot be said about the commodities that are having causal relationship with the NSE FMCG index and unlike the common perception, the investors should be careful while including these commodities in their portfolio. As the causal relationship does not exist in any of the directions, it suggests that the policy makers are required to do more efforts to increase integration between both the markets so that they can intervene effectively in the desired direction to take action within reasonable time during the period of uncertainty. The results are consistent with the findings of Reddy and Sebastin (2009); Yamori (2010) and Gormus (2012).

7.2.4 Volatility Spillover across Commodity Market and Stock Market

- The results suggest that the shock spillover from commodity market to stock market is statistically significant for crude palm oil, guargum and nickel. Further the results related to shock and volatility spillover indicate that out of 25 commodity-stock pairs, current conditional volatility of stock market depends upon the past shocks and fluctuations in the volatility of five commodities which are mustard seed, rubber, gold, silver and copper. In addition, the current conditional volatility of stock index prices is also affected by past conditional volatility of cotton seed, crude oil and lead. One plausible reason for the volatility linkage in some of the commodity-stock pairs is that
the trading volume is high in these commodities as compare to others. The rising inflow of funds into the commodity market has changed the pattern of co-integration and volatility linkage between stock market and commodity market. The swift expansion and increased trading of commodity futures increased the exposure of commodities to financial shocks and it makes the market more sensitive to financial investors’ sentiments which in turn increase the volatility spillover across the markets. Zhu et al. (2014) and Adams and Gluck (2015) has given similar justification for these results.

- One of the justifications for existence of negative transmission of volatility from commodity market to stock market is that rise in commodity prices increase the production cost of the companies which are using these commodities as raw material. The profits and therefore expected rate of return of the companies will shrink. The increase in volatility of commodity prices is due to increase in demand of commodities in the emerging economies. The volatility in commodity prices also affects the stock prices via the channel of inflation. Therefore, the relationship between the stocks and commodities is negative. The results are consistent with the findings of Killian (2009), Arouri et al. (2012), Broadstock et al. (2012), Meijden and Lansink (2015) Ghosh and Kanjilal (2016).

- The possible explanation for existence of positive volatility spillover from commodity market to stock market is that the increased financialization in the commodity market has changed this interpretation to some extent. In addition to the market fundamentals, the other thing that increased the linkage between commodities and equities is the investors’ sentiments and market speculation. A new class of financial investors came into sight in financial markets who regard commodities as an asset class just like stocks and bonds. Those who came under new class of investors, trades in various markets unlike existing investors, due to which the risk sharing in financial markets is improved in normal times. At the time of financial market stress, they transfer the shocks, crashes and economic weaknesses from one market to another. Further the investors take position in both the markets in order to hedge their risk. The positive linkage between commodity market and stock market is found after
the financial crisis. The reason behind this is that the investors become more careful and started responding more to the shock in these markets after the period of uncertainty. The similar conclusion is drawn by Buyukshan and Robe (2014), Silvennoinen and Thorp (2013), Lehecka (2014), Demirer et al. (2015), Du and He (2015), Girardi (2015), Nguyen et al. (2015), Oztek and Ocal (2017) and Maitra and Dawar (2018).

- Further most of studies focused on the volatility spillover from the commodity market to equity market and explained this phenomenon through a number of theories, but the spillover in the reverse direction has not been explained yet. One possible reason for these results is that the high volatility in equity market is a sign of the presence high risk facing investors. Therefore, the commodity market is also affected, if the speculative investors are also actively trading in the commodity market also. Secondly the rising stock prices are also an indicator of rising raw material consumption due to the increase in production activity. The similar justification is given by Jouini (2013).

- The results related to absence of volatility spillover in maximum pairs of commodity-stock are quite surprising because FMCG, Energy and metal companies are consumer of agricultural, energy and metal commodities respectively. It may be due to the fact that these companies have executed effectual hedging strategies against the fluctuations in the prices of raw material due to which these firms are able to manage the linkage between these markets.

- The magnitude of volatility transmission effect is quite high as compare to the shock spillover effect. The analysis depicts that the value of cross market ARCH and GARCH coefficients is much smaller comparative to the value of own one period lagged ARCH and GARCH coefficients, which suggests that the past own shocks and volatilities are more important to forecast current volatility. It further implies that commodities and stock indices do not belong to a similar group, rather these should be taken separately and to improve the weighted performance of a portfolio. Therefore, it is better to add both commodities and stocks.
7.2.5 Dynamic Conditional Correlation across Commodity Market and Stock Market

- Further the results of dynamic conditional correlation across commodity market and stock market indicate that the correlation between the stock and commodity market is highly volatile throughout the study period. Firstly, the volatility in the Indian financial markets is high during the FY 2007-08. It might be due to the financial crisis 2007-08. The Radiff Report (2008) suggests that there was huge negative gap in the SENSEX and NIFTY immediately after the announcement of Reserve Bank of India to increase the cash reserve ratio and REPO rate during this crisis. There was decrease in funds invested by foreign institutional investors in stock market as they wanted to shift their funds from risky emerging economies to the stable developed economies. Secondly in the year 2010-11, there is huge volatility persisted in the stock market which might be due to European debt crises. There was also decrease in the foreign funds in the Indian stock market during the crisis. Further there is increase in volatility during 2014-15. It might be due to the fact that there is decrease in the foreign investment in the stock market of India because of the ripple effect which occurred due to the slowdown in China. Then in the year 2016, there is crash in Indian financial markets due to the demonetization by Government. The major crisis in the Indian commodity market is the NSEL scam. During this period there is huge fall in the turnover of all commodity exchanges. It might have significant impact on the volatility of commodity market and stock market.

- During the financial crises, the correlation between the commodity market and stock market decreased. It might be due to the flight to quality phenomenon which states that during the time of financial stress, investors reduce their investments in risky asset class and shift these funds towards safer asset classes. Similar justification is given by Creti et al. (2013), Demiralay and Ulusoy (2016).

- The correlation between these two markets rises immediately after the financial crisis which might be due to the herding behavior of investors which states that participants replicate the trading strategies of other investors as they
become more cautious immediately after the crisis leading to the divergence of commodity prices from their fundamental value and hence there is increase in correlation between the markets. The prospects of recovery of the stock market from the financial stress due to strong economic growth and steady improvement in the currency, might also increased the confidence of the investor in the market, caused positive linkage between the stock market and commodity market. Similar conclusion is drawn by Zhu et al. (2014) and Demiralay and Ulusoy (2016).

- Thirdly the reason behind the booms and bursts in the correlation between commodity market and stock market is the increased financialization of commodities. The process of increase in the investment of commodities through financial instruments is known as financialization which states that due to the herding behavior of investors, they move funds in and out of commodities that lead to increase the volatility in the market. The change in the trading position of investors causes excess variability in the prices of financial securities.

- The results further depict that there is negative correlation between the agricultural commodities and FMCG stock index. Similar results are recommended by Jebabli et al. (2014), Nguyen et al. (2015) and Demiralay and Ulusoy (2016). Agricultural commodities are more volatile and sensitive to the shocks as compare to other commodities due to the fact that the production of agricultural commodities takes time and if the stock is not available, the supply alone cannot respond much to the price changes. The volatility of crude palm oil, RBD palm oil and soyoil is less comparative to other agricultural commodities. It might be due to less sensitivity of these commodities to the government interventions as compare to other commodities trading on Indian commodity market.

- In the precious metals especially in gold, the correlation is mostly negative, highlights the safe haven role of gold. Gold act as a stabilizing agent at the time of financial stress in the traditional asset classes like stock market through hedging by reducing the chances of fall in expected return from negative market shocks. The results of this study confirm the findings of Baur

- The negative correlation between crude oil and stock market might be due to the adverse effect of rising crude oil prices on the equity prices through either discount rate cash flows or inflation effect. The results are consistent with the findings of Bouko and Alagidede (2016). The correlation pattern of crude oil and natural gases are opposite to each other. The possible reason can be the close substitution between the crude oil and natural gas. The advancement in technology now allows the customers to switch between these two energy commodities. If the variation in the price is high in one of the commodities, the investors can switch to the other commodity to hedge their risk because of substitution effect in the real market.

- Last but not the least, metal commodities show positive correlation with the stock market in this study. It might be due to the ability of these assets to attract more financial speculation. Metal price rising is the indicator of economic growth in the country due to which there is rise in correlation between the metal commodities and stock market. Similar conclusion is drawn by Nguyen et al. (2015), Partaliduo et al. (2016) and Shalini and Parsanna (2016).

The overall results related to co-integration between stock market and commodity market indicates that there is monthly seasonality in commodity and related stock indices. Secondly there is absence of co-integration and causal relationship between commodity market and stock market. Last but not the least, there is weak volatility spillover and correlation in most of the commodity-stocks pairs. It suggests that both the markets are inefficient. The flow of information is not transmitted from one market to the other market. The reason for these results is the less participation of retail investors in the commodity market which might be due to lack of knowledge and expertise. Moreover, the commodity market is running without any institutional investors, thus lacking desired liquidity and depth in the commodity market. Developing an appropriate strategy to increase integration between commodity market and stock market is one of the growing concerns among policy markers. The
results of this study will help policy makers in framing their policies and strategies that can build confidence of investors towards commodity market and thereby increase integration between commodity market and stock market. This study has a lot many insights for the investors to gain from. The linkage between prices of raw material and their related stock indices will provide useful information to the investors about the possible substitution strategies between commodities and stocks. This study will help in increasing the confidence of investors in commodity market and stock market by providing optimal weights and hedge ratios, calculated on the basis of results of this study. Investors can use these weights and ratios to hedge their portfolio risk effectively.

7.3 Suggestions
For the retail investors, the key issue is whether there exists long run co-integration between the commodity market and stock market even though their price might diverge too apart individually in the short run. It is well known fact that investors can reduce their risk by swapping from stock portfolio to portfolio with stocks and commodities. From the policy point of view, Policy makers should make regulatory changes to promote deeper financial integration among these markets

7.3.1 Suggestion for investors and Brokers
This study will be useful to the investors and brokers. An understanding of the concept of volatility spillover across different markets is required for the market professional and investors such as hedgers, portfolio managers, financial analysts and asset allocators. It is required for the investors to amend their portfolio to make it better resist during the period of financial uncertainty.

If an investor is holding equities of a particular company and desire to hedge his position adjacent to the unexpected fluctuations in the commodity market. The main motive of investor is to reduce the chances of getting risk without sacrificing the projected return. The optimal weights and hedge ratio can help the investors to fulfill this motive.
Table 7.1 reports the optimal weight and optimal hedge ratio for individual Agricultural commodity-stock index pairs. The optimal weights of agricultural commodities and FMCG stock index pairs vary from 0.031% for guargum-FMCG to 91.5% for gur-FMCG. These results indicate that for the guargum commodity, the optimal weight of guargum commodity holding in the 100 rupees portfolio is 0.031% with the remainder of 99.969% in FMCG stock index while in case of gur, the optimal weight of gur commodity in 100 rupees portfolio is 91.5% with the remainder of 8.5% in FMCG stock index.

**Table 7.1: Optimal Weights and Hedge Ratio for Agricultural Commodities and FMCG Index**

<table>
<thead>
<tr>
<th>Portfolio</th>
<th>Optimal Weights</th>
<th>Hedge Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barley-FMCG index</td>
<td>0.832</td>
<td>-0.0278</td>
</tr>
<tr>
<td>Cottonseed- FMCG index</td>
<td>0.0366</td>
<td>-0.271</td>
</tr>
<tr>
<td>Crude Palm Oil- FMCG index</td>
<td>0.375</td>
<td>-0.0685</td>
</tr>
<tr>
<td>Guargum- FMCG index</td>
<td>0.00031</td>
<td>0.903</td>
</tr>
<tr>
<td>Guarseed- FMCG index</td>
<td>0.2999</td>
<td>-0.0508</td>
</tr>
<tr>
<td>Gur- FMCG index</td>
<td>0.915</td>
<td>0.223</td>
</tr>
<tr>
<td>Jeera- FMCG index</td>
<td>0.602</td>
<td>0.0109</td>
</tr>
<tr>
<td>Mustardseed- FMCG index</td>
<td>0.453</td>
<td>-0.0283</td>
</tr>
<tr>
<td>Pepper- FMCG index</td>
<td>0.194</td>
<td>-0.0491</td>
</tr>
<tr>
<td>RBD Palm Oil- FMCG index</td>
<td>0.395</td>
<td>-0.044</td>
</tr>
<tr>
<td>Rubber- FMCG index</td>
<td>0.518</td>
<td>0.068</td>
</tr>
<tr>
<td>Soybean- FMCG index</td>
<td>0.474</td>
<td>0.0124</td>
</tr>
<tr>
<td>Soyoil- FMCG index</td>
<td>0.477</td>
<td>-0.0459</td>
</tr>
<tr>
<td>Turmeric- FMCG index</td>
<td>0.474</td>
<td>-0.036</td>
</tr>
<tr>
<td>Wheat- FMCG index</td>
<td>0.727</td>
<td>-0.0271</td>
</tr>
<tr>
<td>Yellowpeas- FMCG index</td>
<td>0.396</td>
<td>-0.0324</td>
</tr>
</tbody>
</table>

Source: Author’s Calculations

The weight percentage of commodities is higher than FMCG Stock index in the portfolio for barley, jeera, rubber and wheat. In the remaining commodities, the
percentage of stock index in the portfolio is more than commodities. It implies that in most of the commodity stock pairs, the investors are required to have more stocks than agricultural commodities in portfolio to reduce chances of getting risk without sacrificing the projected return.

The hedge ratio results indicate that the positive value of hedge ratio in agricultural commodity-stock index portfolio ranges from 0.0105 to 0.903 for jeera and guargum respectively. These results suggest that 100 rupees long position in jeera should be shorted by about one rupee in FMCG index, while 100 rupees long position in guargum can be hedged for 90 rupees in FMCG index. It further implies that among all the agricultural commodity-stock pair with positive hedge ratio, the cheapest hedge is long position in jeera and short position in FMCG index. The low values of hedge ratio considered as highly effective hedge. Arouri et al. (2011) found the similar results in their study. The negative sign of hedge ratio indicates that a short position should be taken in commodity and long in the stock market (Sadorsky, 2014). The negative hedge ratio ranges from -0.0271 (wheat) to -0.271 (cottonseed). It indicates the 100 rupees short position in wheat and cottonseed can be hedged for 2 rupees and 20 rupees in FMCG stock index respectively.

Table 7.2 shows the optimal weights and hedge ratio for energy commodities and energy stock index. The optimal weight of holding crude oil in energy commodity-stock index portfolio of 100 rupees is 36.9% with the remainder 63.1% in FMCG stock index. For natural gas, the optimal weight of holding natural gas in the portfolio is 17.4% with the remainder 82.6% in energy stock index. The results are in line with Arouri et al. (2012).

Table 7.2: Optimal Weights and Hedge Ratio for Energy Commodities and Energy Stock Index

<table>
<thead>
<tr>
<th>Portfolio</th>
<th>Optimal Weights</th>
<th>Hedge Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crude Oil-Energy index</td>
<td>0.369</td>
<td>0.214</td>
</tr>
<tr>
<td>Natural Gas- Energy index</td>
<td>0.174</td>
<td>-0.072</td>
</tr>
</tbody>
</table>

Source: Author’s Calculations
Overall the findings suggest that investors holding energy commodities and stocks should have more stocks than energy commodities to reduce their risk with same expected return.

The hedge ratio results indicate that in case of crude oil commodity, 100 rupees long position in crude oil can be hedged for 21.4 rupees in energy stock index. While the optimal hedge ratio for natural gas-energy stock index is -0.072 which indicate that 100 rupees short position in natural gas can be hedged for 7.2 rupees in energy stock index.

Table 7.3 shows the optimal weights and hedge ratio for precious metal commodities and NIFTY index. The optimal weight of holding gold in precious metal commodity-NIFTY index is 54.3% with the remainder of 45.7% in the NIFTY index. For silver, the optimal weight of holding silver is 26.1% in the portfolio with the remainder 73.9% in NIFTY index. The results suggest that investors holding gold and NIFTY index portfolio should have more gold in their portfolio, while in case of silver, the investors should have more stocks to increase the weighted performance of portfolio.

<table>
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<tr>
<th>Portfolio</th>
<th>Optimal Weights</th>
<th>Hedge Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gold- NIFTY index</td>
<td>0.543</td>
<td>-0.128</td>
</tr>
<tr>
<td>Silver- NIFTY index</td>
<td>0.261</td>
<td>0.114</td>
</tr>
</tbody>
</table>

Source: Author’s Calculations

The hedge ratio results for precious metal commodity and NIFTY index indicates that a 100 rupees short position in gold can be hedged for 12.8 rupees long position in NIFTY index, while for silver-NIFTY index portfolio, a 100 rupees long position in silver can be hedged for 11.4 rupees in NIFTY index.

Table 7.4 presents the optimal weights and ratio of portfolio of base metal commodity-metal stock index. The results indicate that the optimal weight for holding metal commodity-metal index vary from 0.247 for nickel and 0.654 for aluminum. The optimal weights for aluminum, copper, lead and zinc are more than 50% indicate
that the investors holding base metal commodities and Metal stock index portfolio, should have more commodities than stocks.

**Table 7.4: Optimal Weights and Hedge Ratio for Base Metal Commodities and Base Metal Stock Index**

<table>
<thead>
<tr>
<th>Portfolio</th>
<th>Optimal Weights</th>
<th>Hedge Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aluminum- Metal index</td>
<td>0.654</td>
<td>0.192</td>
</tr>
<tr>
<td>Copper- Metal Index</td>
<td>0.619</td>
<td>0.259</td>
</tr>
<tr>
<td>Lead-Metal Index</td>
<td>0.520</td>
<td>0.248</td>
</tr>
<tr>
<td>Nickel-Metal Index</td>
<td>0.247</td>
<td>0.435</td>
</tr>
<tr>
<td>Zinc-Metal Index</td>
<td>0.589</td>
<td>0.273</td>
</tr>
</tbody>
</table>

Source: Author’s Calculations

The results for hedge ratio in base metal commodities and metal stock index indicates that the hedge ratio ranges from 0.192 (aluminum) and 0.432 (Nickel) which implies that a 100 rupees long position in aluminum can be hedged for 19.2 rupees in metal stock index while 100 rupees long position in nickel can be hedged for 43.2 rupees in metal stock index. Among all the pairs of metal commodity and stock index, the most effective hedge is long position in aluminum and short position in Metal index.

Overall the results suggest that making commodities a part of portfolio with different financial assets can improve its weighted performance and it also permits to hedge the commodities risk more effectively. The results also imply that the optimal weights and hedge ratios are different across sectoral indices.

The results exhibit the absence of co-integration between commodity market and stock market. Therefore the investors can reduce their risk by diversifying their portfolio in both commodity and equity. The results related to the non-existence of causal relationship between the commodity market and stock market is helpful for the stock investors to design optimal portfolio and hedging strategies in the presence of different commodities.
7.3.2 Suggestions for Policy Makers

- There is absence of Cointegration between commodity market and stock market in India. The co-integration between stock market and commodity market is required to extend the benefits of stock market to the participants of commodity market too in order to boost up the confidence and involvement of investors in the commodity. In the absence of co-integration between commodity market and stock market, SEBI has to formulate effective strategies to increase integration between both financial markets.

- There is existence of risk spillover in some of the commodity-stock pair which might be due to the fact that trading volume is high in these commodities. Therefore, in order to increase the association between commodity market and stock market, the policy makers should take necessary measure to increase the confidence of retail participants in the commodity market. The trading volume can be increased in the commodity market by providing the new and innovative products to the investors. The government can reduce the transaction cost to increase the trading in the financial markets. Further the financial education programs need to be introduced with practical training to enhance financial literacy.

- The risk return strategies need to be introduced which should be guaranteed by policy maker. In the absence of these strategies, the informed investors and financial analysts may move in the opposite direction to hedge their risk, due to which there is increase in the instability in commodity market and stock market. This study provides optimal weights and hedge ratios which can be provided by SEBI to the investors in order to lessen the financial instability in the stock and commodity prices and to raise the investors’ participation in commodity market which in turn increase the co-integration between commodity market and stock market.

7.3.3 Limitations and Future Scope

- The scope of this study is limited to only one emerging country that is India. Further studies can be conducted to study and compare the co-integration between commodity market and stock market in other emerging countries.
This study does not take into account the impact of exchange rates on the linkage between commodity market and stock market. Further studies can examine the association between commodity market, stock market and exchange rates.