Chapter 5 Conclusion & Recommendations

5. Introduction

This is the final chapter of the work and provides conclusions stemming from the work. Implications of the study, policy suggestions/recommendations and limitations with further scope for future research are encompassed in the current chapter.

For commodity markets to function efficiently and without any friction; the necessary condition is return of the spot and future market would be expected to be contemporaneously correlated i.e. changes in both markets are expected to occur at the same time.

The issue of increase in volatility of agriculture commodities is policy relevant. Over the past decade the price of many of the commodities have seen a deep trough and peak leading to serious question about what induced the rise in volatility. The crunch observed in agriculture commodities and diversion of them for biofuel production raised serious concerns. Derivative market product like Futures are ever blamed to induce speculative trading further aggravating the rise in agriculture market. India has emerged as a major agriculture commodity exporter and many economic activities other than fundamental demand supply balance may have significant impact on the prices. In the wake of this issue; the current study explores the price discovery role played by futures market. Further impact of Crude oil is studied on agriculture prices to understand whether movement in crude oil price has significant impact on agriculture market. The study also explores the lead-lag relation between agriculture commodity and Sensex; which is considered as a barometer of investment climate in India. If causality is found then the movement in Sensex can be used to forecast the movement in price of agriculture commodities. Increasing evidence of financialization of commodity market hints towards it. Further the causal linkage between Forex and commodity prices will help to frame appropriate strategy in wake of decelerating INR/USD relationship.

The recommendations based on research findings are analysed and produced for each of the commodity analysed is subsequent paragraphs.
<table>
<thead>
<tr>
<th>Research Questions</th>
<th>Soy Bean</th>
<th>Chana</th>
<th>Turmeric</th>
</tr>
</thead>
<tbody>
<tr>
<td>i. Can structural breaks be identified in the price series of commodities?</td>
<td>Yes, 2 Break points identified</td>
<td>Yes, 3 break points identified</td>
<td>Yes, 4 break points identified</td>
</tr>
<tr>
<td>ii. Is there presence of lead-lag relationship between spot and futures price of commodities? Has this relationship changed with occurrence of breaks in the prices?</td>
<td>Yes. The relationship has remained consistently from Future to Spot.</td>
<td>Yes. The relationship has remained consistently from Future to Spot.</td>
<td>Yes. The relationship has remained consistently from Future to Spot.</td>
</tr>
<tr>
<td>iii. Is there any lead-lag relationship between spot price of commodity and Sensex? Has this relationship changed with occurrence of structural breaks in the prices?</td>
<td>Yes, The relationship has changed with breaks and has been very dynamic.</td>
<td>Yes, The relationship has changed with breaks. In periods of Financial turmoil, Sensex is observed to lead the volatility in Chana spot price.</td>
<td>No cointegration observed between Spot price and Sensex. Hence lead lag relation is not tested. Only in phase IV; they are found to be cointegrated and causality is observed from Spot to Sensex.</td>
</tr>
<tr>
<td>iv. Is there any lead-lag relationship between spot price and Forex? Has this relationship changed with event of breaks in the prices?</td>
<td>Yes, The relationship has changed with breaks and has been dynamic.</td>
<td>No lead lag found. Largely movement in forex has no predictable power on Chana Spot prices and vice versa.</td>
<td>No lead lag relationship has been observed between Forex and Spot price.</td>
</tr>
<tr>
<td>v. Is there any lead-lag relationship between spot price and Crude? Has this relationship changed with event of breaks in the prices?</td>
<td>Yes, The relationship has changed with breaks. Largely; Soy Bean Spot Price is found to lead Crude.</td>
<td>No lead lag relationship is found between volatility in crude price and Chana spot prices.</td>
<td>No cointegration was found between Spot price and Crude. Only in phase IV and V; they are found to be cointegrated and no lead lag relationship is observed between them.</td>
</tr>
<tr>
<td>vi. Is there any lead-lag relationship between Future price and Sensex? Has this relationship changed with event of breaks in the prices?</td>
<td>No lead lag found in Future and Sensex; except in phase II when bidirectional linkage is observed.</td>
<td>Yes, The relationship has changed with breaks. In periods of Financial turmoil, Sensex is observed to lead the volatility in Future price.</td>
<td>No cointegration observed between Future and Sensex. Only in phase IV; they are found to be cointegrated and no lead lag relationship is observed between them.</td>
</tr>
<tr>
<td>vii. Is there any lead-lag relationship between Future price and Forex? Has this relationship changed with occurrence of breaks in the prices?</td>
<td>Yes, The relationship has changed with breaks. Largely; Forex is observed to lead Future.</td>
<td>Yes, the relationship is found from Forex to Future in the period when the demand for Chana is higher than supply leading to the need to import.</td>
<td>Largely no lead lag observed between volatility in Future price and Forex.</td>
</tr>
<tr>
<td>viii. Is there any lead-lag relationship between Future price and Crude? Has this relationship changed with occurrence of breaks in the prices?</td>
<td>Yes, The relationship has changed with breaks and has been dynamic.</td>
<td>Yes, The relationship has changed with structural breaks and has been quite dynamic.</td>
<td>No cointegration observed between Future and Crude. Only in phase IV and V; they are found to be cointegrated and no lead lag relationship is observed between them.</td>
</tr>
</tbody>
</table>
5.1 Concluding Remarks for the Commodity Soy Bean

5.1.1 Structural Break Points in Soy Bean

After subjecting the spot and future price of Soy Bean to the methodology of assessing the sequential break points as suggested by (Bai & Perron, Estimating and Testing Linear Models with Multiple Structural Changes, 1998); the study finds two (2) break points in each series. The first break was caused in November 2007; after the steep rise in international Soybean prices in 2006 due to shift by US and EU in major portion of arable land for cultivation of Maize for biofuel production. Indian Soy bean prices appear to be largely insulated due to ban imposed by government on import of Soy bean seeds to protect Indian producers. Large domestic demand for Soybean oil and international demand for Soya meal lead to the rally in the prices. This break is observed during the time world is going through food crisis. From the global economic perspective; this can be attributed to the increase in demand for food from the developing countries (BRIC), steep increase in their income level “the income effect” and quantitative easing by US increasing money supply in the global markets (Josling, Anderson, Schmitz, & Tangermann, 2010), (Abbott, Hurt, & Tyner, 2008)).

Another break in Soybean series happens to occur in March 2012 just before the steep rise in the price of commodity backed by strong demand in spot market. Limited stocks of the oilseeds coupled with lower sowing in the producing regions due to decline in rainfall led to strong upward movement in the prices (Kapoor, A, 2012). To curtail price rise by increase in output, the government of India increased the Minimum Support Price for Soybean seeds by 33% to 2,200 per 100 kilogram in July 2012.

The Soy Bean seed prices in India are observed to have structural breaks which are result of response to fundamental demand-supply imbalance caused by weather conditions, low production leading to tighter inventory levels and
5.1.2 Causality between Spot and Future Price of Soy Bean

The lead lag relationship between spot and future price is estimated using the non-parametric test proposed by (Diks & Panchenko, "A new statistic and practical guidelines for nonparametric Granger causality testing", 2006). Lead-Lag relationship is vital to understand whether markets function efficiently or there is a scope for arbitrage. Role of price discovery can also be explained by studying this relation estimating which market captures the new information at first; thus playing a dominant role in price discovery process. For Soy Bean; it is observed that the lead-lag relationship has consistently prevailed in all the phases and the occurrence of structural break had no impact on it. Future market is consistently seen to lead the spot market for Soy Bean giving rise to possible arbitrage positions being taken by the market players. However; we must understand that this relationship is evident from daily price data and it would be difficult to make any profit from such identified opportunity. The observation of Future market to assume dominant role in price discovery could be attributed to following factors

a. Low cost of futures trading may induce excessive trading/speculation which, in turn, make it easy to discount the information as it arrives (Baldi, Peri, & Vandone, 2011).

b. Contracts sold on futures markets generally do not require the compulsory delivery of the commodity but can be implemented immediately with little up-front cash. This feature makes futures markets generally react more quickly than spot markets (Silvapulle & Moosa, 1999).

5.1.3 Causality between Sensex and Soy Bean

The lead lag relationship between Soy Bean spot price and Sensex has changed with occurrence of structural break. In the phase before the first break in the series is identified, Spot price leads Sensex. During this period Sensex is observed to have highest volatility compared to other phases. To recollect; this period was marked by the US subprime crisis and global financial meltdown. Thus exogenous shocks could be the possible reason of this relationship observed. In Phase II, no lead lag relation was observed between Spot and Sensex which was followed by bidirectional influence in phase III.
Return of future price of Soy Bean exhibit to have no lead lag relationship with Sensex except in case of Phase II; wherein bidirectional linkage is observed. Agriculture commodity markets have thin trading compared to stock markets due to restrictions imposed on the various class players to trade in commodity market i.e. financial institutions, banks, foreign institutional investors, etc. This may be the possible reason for no causality between the series.

5.1.4 Causality between Forex and Soy Bean

The lead lag relationship between Forex (USD/INR exchange rate) and Soy Bean spot price is inconsistent and is observed to change with the occurrence of structural break. In phase I, no lead-lag associationhip is found between them to be followed by movement in Forex leading the movement in Soy Bean spot prices. Phase III observes bidirectional causality between movement in Forex and Spot price.

In two (phase II and III) out of three phases, movement in forex is observed to influence movement in soy bean future prices. As already explained in “Data Analysis and Findings” chapter; soy bean derived products like soy meal and soy oil have seen great demand from other countries and this could be stated as the possible reason for this observation. (Chen, Rogoff, & Rossi, 2008) observed, “Exchange rates embody market expectations regarding future price dynamics of the respective country’s commodity exports”. Therefore the finding suggests that shocks in foreign exchange market can be used to forecast the commodity future price. The findings are consistent with other studies stressing the impact of exchange rate on agriculture prices like (Frank & Garcia, 2010), (Rezitis, 2015).

5.1.5 Causality between Crude and Soy Bean

No linear cointegration is revealed by the study. However nonlinear cointegration test suggest crude oil and Soy Bean spot and future prices to be cointegrated. Nonlinear cointegration technique better represents the real market which are characterised by asymmetric information, frictions and transaction costs causing nonlinear outcomes (Peri & Baldi, 2010), (Natanelov, Alam, McKenzie, & Van Huylenbroeck, 2011), (Bakhat & Würzburg, 2013). Moreover; the nonlinear causality study showed that Soy Bean spot price led the
Crude oil price movement in two out of three periods (phase I and III) and crude oil movements to lead the spot price in phase II. Food price movement impacting movement in oil seems an interesting observation and likely reason associated with the findings are increased role of biofuel market and diversion of arable land to produce crop relevant for producing biofuel (Bakhat & Würzburg, 2013), (Peri & Baldi, 2010)).

Further the nonlinear causal finding for movement in crude oil and future price are not found consistent and have undergone change with occurrence of breaks. No lead lag is observed in phase I, followed by bidirectional causality in phase II and movement of crude oil causing movement in soybean future price in phase III. Limited evidence is found of movement in crude oil impacting the agriculture commodity price which is in contrast to researchers who found past increases of oil prices to result in higher agricultural commodity prices through cost-push (Rezitis, 2015).

5.1.6 Recommendations

The study of volatility of Soy Bean price and relation with select macro-economic variables enables the researcher to suggest following strategies for the investors and/or participants interested in the commodity

1. Spot market in case of Soy Bean is observed to be more volatile compared to future market in all the phases. The possible reason could be that in the wake of rising prices and further expectation of escalation therein; the speculators tend to hoard the commodity as Soy Bean falls under “storable commodity” class. As a result of this speculative activity of major players; the prices move northwards giving rise to increase in the volatility. The study suggests increase in market participation by allowing larger class of investors in commodity markets.

2. The price of soy bean exhibit structural break with change in fundamental demand-supply balance, weather condition i.e., rainfall, economic and technological reforms, and financial shocks in world economy. Hence the investors cannot follow the same investment strategy and need to revise it with change in the factors stated above.

3. Soy bean spot and future prices are found to be cointegrated in long run and movement in future market consistently leads to movement in spot market irrespective of the break in the slope of the series. Hence it can be said that future
market are more efficient in absorbing new information which gives rise to possible arbitrage opportunity in case of Soy Bean market. However further intraday prices with high frequency data needs to be analyzed to assess arbitrage strategy.

4. Soy bean prices are cointegrated with BSE S&P’s Sensex (30-share index). Largely the nonlinear causality reveals no lead lag relationship between soy bean price and Sensex. It means movement in one market cannot be used to predict the movement in other market. This will provide the investor’s benefit of risk diversification as no market leads or lags the other (Dania, 2011). These findings are useful for portfolio risk managers who are always on lookout for diversifying the risk by investing in different class of assets. This diversification benefits are also observed by (Mensi, Hammoudeh, & Kang, 2015).

5. Movement in Forex (USD-INR exchange rate) is observed to lead movement in future price of soy bean in phase II and III. Both of these phases fall after the effect of global financial meltdown which led to increase in volatility in the exchange rate.

6. Relationship between movement in crude and soy bean spot and future price has changed with occurrence of break. Limited evidence is found of volatility in crude price leading the agriculture price. Movement in Soy bean spot price is observed to lead crude oil in two out of three phases. Investors interested in taking position in crude oil should follow the movement in agriculture prices as biofuel is increasingly used as substitute for crude.

5.2 Concluding Remarks for the Commodity Chana

5.2.1 Structural Break Points in Chana

The study finds three break points in the spot and future price of Chana. First structural breaks in case of Chana price series appeared in April, 2006. This period saw very high volatility and substantial price rise. To support increasing domestic demand and check price rise Indian Government banned the export of pulses including desi Chana in June 2006. Further the second break point the slope of in Chana series appears in August 2011. The break in series appeared just prior to the beginning of sowing season of 2011 primarily led by
low stocks and higher domestic demand. The imports from Australia, Canada and other
countries could not meet the shortage in supply led to hoarding by stockists further pushing
prices northwards. Very high volatility is observed in the chana prices in phase III (the period
from 2011-2013) and the prices shot up to all time high of the decade. The last break
appeared in February 2013 after which sharp downward trend in Chana prices is observed.

5.2.2 Causality between Spot and Future Price of Chana

Lead-Lag relationship is important phenomenon and largely studied with reference to
financial and economic variables. It helps to understand whether markets function efficiently
or there is a scope for arbitrage. Role of price discovery can also be explained by studying
this relation estimating which market captures the new information at first; thus playing a
dominant role in price discovery process. For Chana; it is observed that the lead-lag
relationship has consistently prevailed in all the phases except phase II. Future market is
found to lead the spot market for Chana giving rise to possible arbitrage positions being taken
by the market players except in phase II where bidirectional causality is observed. However;
we must understand that this relationship is evident from daily closing price data and it would
be difficult to make any profit from such identified opportunity. Future market plays a
dominant role in the price discovery process in case of Chana and is observed to lead spot
market can also be attributable to ease of trade in future market due to electronic trading
contracts, which results in more transparent and widely accessible prices. Also low
transaction cost and investment need may re-sound its success. Efficiency of futures contract
in case of Chana are also reported by (Elumalai, Rangasamy, & Sharma, 2009) and (Chauhan

5.2.3 Causality between Sensex and Chana

“Study of linkage between commodity and stock markets is of particular interest for financial
players as raw materials enter many investment portfolios, together with stock classes” (Silvennoinen & Thorp, 2010), (Vivian & Wohar, 2012)). The issue of financialization of
commodity market and it being a separate homogenous investment class has attracted the
attention of many researchers (Creti, Joëts, & Mignon, 2013), (Silvennoinen & Thorp, 2010), (Mensi, Hammoudeh, & Kang, 2015) to name a few).

The study observes that relation between movement in Sensex and that of Chana spot and future market is time varying and volatile. This means the relationship change with occurrence of structural break. No lead lag relation is found between volatility in Sensex and Chana spot and future in phase I and IV. These phases are characterised by low volatility in commodity as well as stock market. Efficient functioning of markets led to no lead lag associationship.

Sensex is observed to lead Chana prices in phase II and III which is the period that observed the global financial turmoil. Increase in stock market volatility may have turned the attention of investors towards the commodity market. The investors need to keep in mind that exogenous shocks like financial turmoil and low investor confidence in stock markets leads to excessive volatility in equity markets. During such period observing the movement in stock market may help in predicting volatility in Chana prices.

5.2.4 Causality between Forex and Chana

The lead lag relationship between Forex (USD/INR exchange rate) and Chana spot price is inconsistent and is observed to change with the occurrence of structural break. In phase I, II and IV, no lead-lag associationship is found between the movement in Forex and Chana prices. India is the largest producer and consumer of Chana and imports certain quality of Chana to satisfy domestic consumption. The study observes that largely movement in forex has no predictable power on movement in Chana prices and vice versa.

5.2.5 Causality between Crude and Chana

Relationship between volatility in Crude and prices of Chana is largely consistent over the period even with occurrence of structural breaks. No lead lag relationship is found between volatility in crude price and Chana spot and future market. This implies that movement in crude cannot be used to predict movement in Chana prices. One variable have no predictive
power for the other variable and vice versa. This enables to say that neutrality hypothesis prevails between shocks in crude and Chana market.

5.2.6 Recommendations
The study of volatility of Chana price and relation with select macro-economic variables enables the researcher to suggest following strategies for the investors and/or participants interested in the commodity

1. Spot market in case of Chana is observed to be more volatile compared to future market in all the phases except Phase II. Chana falls under “storable commodity” class and is amenable to hoarding by the participants in expectation of rise in price. As a result of this speculative activity of major players; the prices exhibit increase in the volatility. The study suggests increase in market participation by allowing larger class of investors in commodity markets.

2. The price of Chana exhibit structural break with change in fundamental demand-supply balance, weather condition i.e., rainfall and economic and technological reforms. Hence the investors cannot follow the same investment strategy and need to revise it with change in the factors stated above.

3. Chana spot and future prices are found to be cointegrated in long run and movement in future market consistently leads movement in spot market irrespective of the break in the slope of the series. Future market can be viewed to be performing the role of price discovery effectively. Hence it can be said that future market are more efficient in absorbing new information which gives rise to possible arbitrage opportunity in case of Chana market. However further intraday prices with high frequency data needs to be analysed to assess arbitrage strategy.

4. Chana prices are cointegrated with BSE S&P’s Sensex (30-share index). Largely the nonlinear causality reveals limited evidence that change in Sensex leads the movement in Chana prices (phase II and III). The findings suggest that in times of major exogenous shocks like financial turmoil, reduction in liquidity from the financial system etc. Sensex movements can be used to predict the movement in Chana prices.
5. Largely movement in Forex (USD-INR exchange rate) is observed to share no lead lag association with movement in future and spot price of Chana. The study observes that largely movement in forex has no predictable power on movement in Chana prices and vice versa. Investors interested in building portfolio of different asset classes can include both forex and commodity Chana as they would provide benefit of risk diversification.

6. Relationship between volatility in Crude and prices of Chana is largely consistent over the period even with occurrence of structural breaks. No lead lag relationship is found between volatility in crude price and Chana spot and future market. This indicates limited predicting power of crude on Chana prices.

5.3 Concluding Remarks for the Commodity Turmeric

5.3.1 Structural Break Points in Turmeric

After subjecting the spot and future price of Turmeric to the methodology of assessing the sequential break points as suggested by (Bai & Perron, Estimating and Testing Linear Models with Multiple Structural Changes, 1998); the study finds four break points in each series. First structural breaks in case of Turmeric price series appeared on October, 2007. The period from 2005-2007 saw the turmeric price to be range bound. After the first observed break date i.e. from October 2007 to October 2009, the prices are seen to make new highs with greater volatility. From the global economic perspective; this can be attributed to the increase in demand for food from the developing countries (BRIC), steep increase in their income level “the income effect”, turmoil in the world financial markets and quantitative easing by US increasing money supply in the global markets (Josling, Anderson, Schmitz, & Tangermann, 2010), (Abbott, Hurt, & Tyner, 2008)). The period after second break point in October 2009, that is in the period of October 2009 to May 2011; there appear to be unprecedented rise in turmeric price with an average of RS. 12990/quintal compared to the average price of Rs. 4305/quintal in October 2007 to October 2009 period. This was primarily led by rise in export demand and lower crop yield due to diversion of cultivation by farmers towards more
remunerative spices (Sharma, R., 2010). The last break was observed in December 2013. In the period following this break date, the prices remained range bound.

### 5.3.2 Causality between Spot and Future Price of Turmeric

Role of price discovery can also be explained by studying this relation estimating which market captures the new information at first; thus playing a dominant role in price discovery process. For Turmeric; it is observed that the lead-lag relationship has undergone a change with the occurrence of structural break. No lead lag association is observed in phase I between the variables. However, in all the other phases (II, III, IV and V) Future market is consistently seen to lead the spot market. Thus it can be concluded that futures market are quick to absorb new information that arrives in the market and transmit them to the spot market. Similar findings are reported by (MURUGANANTHI, SHIVAKUMAR, AJJAN, & SIVAKUMAR, 2013).

Role of price discovery of Futures market can be attributed to the low investment need in the future contracts, benefit to square off the transaction without actual delivery and majority of participation by different interest groups (producers-hedgers, arbitrageurs, speculators, etc.) giving it liquidity and showcasing the expectations on arrival of information. The lead lag relation for Turmeric may give rise to possible arbitrage opportunities. However; we must understand that this relationship is evident from daily price data and it would be difficult to make any profit from such identified opportunity.

### 5.3.3 Causality between Sensex and Turmeric

No linear or nonlinear cointegration is found between Sensex and Turmeric spot and future price in phase I, II, III and V. Cointegration test indicate whether the series move together in the long-run. In other words, the variables may wander from the relationship in short-run; however will return to their previous relationship by correcting in the long-term. If there were no cointegration, there would be no long-run relationship binding the series together, so that the series could wander apart without bound. In some sense; no cointegration favour efficient
market hypothesis (random walk). Thus findings suggest that the investors or portfolio managers can gain substantial diversification. As no cointegration is found, the study did not proceed to test for causality between the variables in phase I, II, III and V.

In phase IV (May 2011 – Dec 2012), Sensex is found cointegrated with turmeric spot and future market. Thus the study proceeded to test the nonlinear causality between variables. Surprisingly, movement in spot market is found to lead the Sensex whereas no lead-lag relationship is observed of Sensex with Turmeric future market. During this period the turmeric prices were tumbling from their highs of phase III.

5.3.4 Causality between Forex and Turmeric

India is the worlds’ largest producer and exporter of turmeric. The relationship between volatility in forex (USD-INR exchange rate) and Turmeric spot and future market has undergone change with occurrence of structural breaks. Forex and turmeric spot and future prices were found to be cointegrated in phase I, II and III. No cointegration was found in phase IV and V. The study proceeded to check for causal linkage between them only for the periods in which they were found cointegrated. This can be justified by arguing that in the periods of increasing demand and price of turmeric; forex and turmeric prices move together within bounds. However in period of falling prices characterised by drop in demand/excessive supply this relationship is broken and they move apart without bounds.

Largely the study finds no lead lag relation between movement in forex and that of turmeric prices thus supporting the neutrality hypothesis. Thus, it can be concluded that forex cannot be used to predict movement in Turmeric market.
5.3.5 Causality between Crude and Turmeric

The cointegration study employing linear method proposed by (Johansen, 1988) and nonlinear method proposed by (Breitung, 2001), found limited evidence of cointegration between Crude and Turmeric. The variables are found to be cointegrated only in phase IV (May 2011 – December 2012) and phase V (December 2012- August 2014). During this phase; crude prices were trending upwards and remained above USD100/barrel for majority of the period. The mean of crude price put together for both this period (2011-2014) was USD110/barrel. Thus investors can expect that when crude prices are high; turmeric price share cointegrating relation with it.

The study proceeded to check causal linkage between the movements in variables for the stated period only. Largely the findings suggest that no lead lag relation is found between movement in crude and that of turmeric prices. Thus neutrality hypothesis is upheld and no one variable can be used to predict the other variable.

5.3.6 Recommendations

India is the largest producer and exporter of turmeric and contributes nearly 75% of world trade in turmeric. Considering its importance, increase in global demand and varied uses; the commodity was selected for studying the relationship between movement in prices and shocks from macro-economic variables. The study proposes following recommendations,

1. The price of Turmeric exhibit structural breaks with change in fundamental demand-supply balance, weather condition i.e., rainfall, economic and technological reforms, impact of large international events as financial turmoil in US, speculative pressures etc. Hence the investors cannot follow the same investment strategy and need to revise it by being watchful of change in the factors stated above.

2. Turmeric spot and future prices are found to be cointegrated in long run and movement in future market consistently leads movement in spot market irrespective of the break in the slope. Future market can be viewed to be performing the role of
price discovery effectively. Hence it can be said that future market are more efficient in absorbing new information which gives rise to possible arbitrage opportunity in case of turmeric market. However; further intraday prices with high frequency data needs to be analysed to assess arbitrage strategy.

3. No linear or nonlinear cointegration is found between Sensex and Turmeric spot and future price (except in phase IV). Thus findings suggest that the investors or portfolio managers can look for substantial diversification of risk by including them as unrelated asset classes in their portfolio.

4. Turmeric prices are found to cointegrated with Forex in the periods of increasing demand and prices (phase I, II and III). However; this relation is broken in the period when prices recede due to fall in demand/excessive supply. Investors in turmeric can use forex as a hedge in the period of rising prices. No causality is found between volatility in forex and turmeric prices. Investors interested in building portfolio of different asset classes can include both forex and commodity turmeric as they would benefit from diversification of risk.

5. Turmeric prices are found to be cointegrated with Crude price for limited period; when the crude prices were high. Thus investors can expect that when crude prices are high; turmeric price share cointegrating relation with it. No lead lag relationship is found between volatility in crude price and turmeric spot and future market. This indicates limited predicting power of crude on turmeric prices.

5.4 Policy Remarks and Recommendations on Agriculture Markets in India

1. The study intends to recommend introduction of alternative instruments to address excessive volatility in agriculture markets like options contracts and also continuous operations of future market should be ensured with strong circuit breakers. Efficient functioning of derivative markets can address the volatility related issues (nath Mukherjee, 2011). There is also an urgent need to differentiate the hedger from pure speculator and higher margins be imposed on speculative trades.
2. Shift in the policies of excessive governmental intervention in agriculture market to more market-based approaches would lead to addressing of concerns regarding management of risk in these markets.

3. Wider market participation along with strict regulatory vigilance should be allowed in Futures contracts to minimize price rigging and to efficiently discover the future spot price. The current merger of FMC with SEBI is a welcome step in this direction. SEBI has promised to look into opening the futures market for participation by Foreign Institutional Investors and banks. Participation by these players are allowed in developed countries; however in India they have been restricted to trade in commodities. Their involvement is sure to increase the liquidity; however to avoid excessive financialization of commodities market; strict limits on open position should be enforced for these non-commercial players.

4. Increase of awareness amongst farmers as regards the functioning of the derivatives market should be enforced. Dissemination of prices through electronic price ticker boards in all mandis is appreciated; however the major need is to educate farmers and make them aware of the benefits and modalities of using the derivative market. This can be achieved by active participation of National as well as Regional stock exchanges in launching of nationwide awareness programme series. Further Bankers community as a large agriculture credit lender should also play an active role in educating and consulting of the small and medium producers of agriculture commodities.

5. Further conditions of spot markets and regional mandis need to improve on technology front with electronic execution of transactions. The warehousing facility provided by the exchanges and government machinery need to strengthen; which would allow the farmers to store his proceeds at a reasonable storage cost enabling him to profit from off season sale when prices of agriculture commodities generally tend to rise.

6. Exchanges are recommended to have major penalties if the delivery contracts are not honoured to curb excessive speculative activities.
5.5 Limitations of Study and Scope for Further Research

The present study comprehensively researches the relationship between agriculture commodity prices and select macroeconomic factors in presence of structural break. Since testing tools for non-parametric time series are still evolving; the current research applies only some of those tests. The present study will be confined only to three Macroeconomic Variables viz. Crude oil, Foreign Exchange rate and BSE-Sensex Index. It leaves scope of testing relationship between agriculture commodities and other very dominant factors like movement in interest rates, consumer price index, agriculture credit flows, etc.

The study covers three vital agriculture commodities (Turmeric, Soy Bean and Chana). This can be further extended for studying many other agriculture commodities to further generalize the findings in a comprehensive manner. Researcher has used daily quotation of the prices; this leaves scope for dealing with more dynamic tick-by-tick data for better understanding of the relations amongst variables. Further the volume and open interest in futures contracts with different maturities can provide significant insight about the relationships tested.