# An Analysis of Existence of Convergence Between Spot and Futures Prices in Selected Agricultural Commodities

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## Abstract

**In an efficient derivatives market, as the expiration of futures contract approaches, the spot prices of commodities tend to converge with the futures prices. At any point in time during the expiration period, if the spot prices are higher than the futures prices, it implies that there is a lack of dissemination of proper information at the time of setting the futures prices, and as a result, the futures are undervalued. The current study examined the existence of convergence between spot and futures prices of five selected agricultural commodities namely, chana, cumin, pepper, maize, and chilli during 2011 - 2017. The study also aimed at assessing the scope for arbitrage profit. The negative spread was observed in December 2015 and June 2016 chana futures contracts. In case of cumin, the spot prices were greater than futures at some point of time during the contract period of April 2010 and December 2010, and April and September 2011 contracts. In case of pepper futures, the backwardation was observed in July 2010 and July 2011 expiration, thereby providing scope for arbitrage profit. December 2011 maize contract had a negative basis in the beginning ; whereas, December 2013 maize contract had a negative basis throughout the contract period. In case of chilli, the spot prices were higher than the futures prices in April 2012, June 2013, and September 2015 futures contracts. The study revealed the presence of scope for arbitrage profit in these contracts. The study also found the presence of all three types of market patterns in one or the other selected contracts.**

***Keywords:*** **backwardation, convergence, commodity derivatives, contango, futures prices, NCDEX, spot prices**

**JEL Classification: D53, G1, G32, Q13**

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Commodity derivative trading has seen an unparalleled growth since the beginning of this century. Investment in commodity derivative is becoming the most sought after investment alternative for investors in the recent past. In comparison with the stock market, the overall liquidity is less in the commodity market, though some commodities are an exception to this. The important function of the derivative market is efficient discovery of spot prices based on futures prices. The level of volatility, scope for arbitrage profit, and convergence between spot and futures prices are the few important indicators to judge the efficiency of futures in discovering spot prices. In an efficient market, as the expiration period approaches, the spot prices tend to converge with the futures prices. It is a normal phenomenon in any market that the futures prices will be higher than the spot prices of all maturities. Spot prices happen to be higher than futures prices, which imply that there is a lack of dissemination of proper information at the time of setting futures prices; as a result, futures are undervalued. At any point of time before the maturity date, the spot prices are higher than the futures, giving scope for arbitrage profit.

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The growth of financial derivatives attracted the attention of scholars and academicians to undertake a research, and as a result, various studies have been carried out with respect to the price discovery, liquidity, and investors' awareness. There is a still deficiency of considerable research in the field of commodity derivatives, particularly on convergence analysis between spot and futures prices.

## Review of Literature

Kabra (2007) observed in his study that the market largely favors speculators. The futures market has to bring many changes to make it an effective instrument of risk management and price discovery for the benefit of growers, traders, processors, and other stakeholders. Rastogi and Vinay (2009) revealed that information dissemination is crucial for an efficient market. The stock market rapidly adjusts to the new information, but not to the commodity market. The commodity market needs to become mature and efficient. Inefficiency leads to bad price discovery and malpractices in the commodity market. The authors emphasized that every market requires participation of a large number of investors to come to the optimum price. This implies that informational efficient market requires some minimum amount of trading and more trading by numerous competing investors resulting in faster price adjustment, making the market more efficient.

Rajput and Handa (2010) opined that the integration of commodity market for the benefit of small and marginal farmers was essential. It was further stated that an efficient commodity derivative market has an immense potential for bringing price stability. Gaur and Bansal (2010) opined that gold as a commodity and as a currency continues to play its ancient role as the only true standard of value in times of war or crisis. Although now officially, gold is held to be of industrial value only, gold is the oldest and most respected currency in the world, and only one respected currency in the world when national paper money loses value. This is why every central bank of any significance bought and held gold in reserve in a world of almost universal paper money. The monetary use of gold, along with silver has been very wide spread since ancient times. Gold and silver coins have been the most readily acceptable medium.

Ali and Gupta (2011) examined the interrelationship between spot and futures prices of 12 selected agricultural commodities traded in NCDEX. The researchers used ADF test and non-parametric Phillips-Perron test to assess whether or not spot and futures prices were stationary. The interrelationship between two series of prices of selected commodities was explored using Johansen's cointegration analysis and Granger causality tests. The result of the test showed that there was a significant cointegration between spot and futures prices of all commodities excluding wheat and rice. The study of short-run association by causality test showed that futures prices were able to guide spot prices for chickpea, castor seed, soya bean, and sugar ; whereas, in case of maize, urad, and pepper, two way association was present in the short run.

Sehgal, Rajput, and Florent (2013) carried out cointegration analysis and found that the commodities in spot and futures markets reacted unreasonably to pricing news in the short term, but they converged in the long term. The reason is that a given market may not be active in accessing and incorporating new information. The study revealed the existence of long term symmetry in eight out of 12 commodities, and three out of four indices using Johansen cointegration method. The results of vector error correction model showed that if the spot and futures prices move away, both markets make adjustments to reestablish the equilibrium; the spot market makes greater adjustment to reach the equilibrium. The E-GARCH test outcome proved bivariate volatility spill out for three commodities in that stronger brim over from spot prices to futures prices. Thus, proficient hedging as well as profit making tactics can be formed for those commodities.

Maravi (2015) noted that the Indian economy has become promising in a tiny way with introduction of futures on commodities since 2003. The paper clearly stated that farmers in rural areas are not able to utilize the benefits of commodity futures market. The reasons highlighted were ineffective growth of commodity futures market in India, and the lack of modern infrastructural facilities. The paper gave a brief account of various agricultural

commodities grown and traded on futures segments, that is, soyabean, castor seed, mustard seed, wheat, chana, cumin, pepper, turmeric, cotton, cardamom, sugar, mentha oil, and potato. It mentioned that India is known as the 'the home of spices,' and is the leading producer, consumer, and exporter of spices in the world. India contributes about 48% to the world spices demand. Even though the agricultural futures market plays a vital role in the price risk management process, they have been utilized in a very limited scale in India. The production, supply, and distribution of many agricultural commodities are controlled by the government, and only forwards and futures trading are permitted in certain commodity items. There should be an opportunity to provide trading of all agricultural commodities in exchanges.

Kumar and Shollapur (2015) analyzed the returns and price fluctuations of the spot and futures markets for four major farm products. With respect to price discovery, it was observed that the futures market incorporated new information more rapidly and efficiently as compared to the spot market. With respect to volatility, the study found that the futures prices were more volatile than the spot market prices as standard deviation was higher for all commodities. The study showed the presence of long-run symmetry association of spot prices with futures prices in case of all commodities. The long-run causality was observed from futures to spot market for all commodities. With respect to short term equilibrium, the study found that there was a presence of one way causality from futures to spot market with respect to soy bean and horse gram; two way causality was observed in case of futures and spot market for soy oil in which futures had stronger influence on spot; whereas, bidirectional causality in which spot had stronger pressure on futures was noticed in case of mustard seed. The paper observed various forms of inefficiencies that were observed in spot market leading to price differences in the short run.

Goswami and Mukherjee (2015) provided a comparative analysis of risk-return on different groups of agricultural commodities futures such as metals, energy and oil, and oil related commodities futures. An effort was made by the authors to study the performance of these futures in the presence of risk- free assets and inflation. Commodity futures trading have been under severe criticism across the world over the last few decades; attributing commodity futures to excessive speculation and an upsurge in commodity prices. This has been rampant since 2008 with the rise in inflationary pressure on food and energy across the world. The research compared the returns among different classes of commodities. In addition, different forms of returns like nominal return, real return, and excess return were explicitly considered. The justification of taking all these forms of returns is to shed light on inflation - adjusted returns (that is, the real returns) and the risk premium (that is, the excess returns). The study considered data for a period of 8 years from 2004 to 2012, the reason being, in India, futures trading started in full swing from 2004 and the selected commodity futures were actively traded during this time frame. It is evident from the study that the forms of returns (nominal, real, and excess) were greater for oil and oil related products, and the volatility component was also higher for this group compared to other groups of commodity futures. For oil and oil related groups of commodity, futures performance was best in the year 2010 and the worst in the year 2012. Moreover, the standard deviation of the nominal rates of return of agricultural commodity futures was lower than the standard deviation of their real rates of return. Agricultural commodity futures and metal futures occupied a modest position with respect to both risk and returns. This paper confirmed that high returns were generally associated with high risk, which was in conformity with the general theory of risk - return.

Babshetti and Basanna (2016) observed that the participation of farmers in agricultural commodities futures was quite negligible in Karnataka. The lack of education among farmers, existence of excessive speculation, and lower liquidity in agricultural futures market are the reasons of non-participation of farmers in Karnataka. Shukla (2016) opined that monsoon not only affected agriculture commodities, but also the stock market. The study also observed that BSE Sensex returns were highest in the year when rainfall was most deficient with regards to long period average. Karthikeyan and Karthika (2016) observed that investment decisions are made based on the volatility in the stock market in addition to other factors like price, volume, and liquidity. Index futures are an innovative instrument introduced in the stock market to satisfy the needs of the investors and to enhance market efficiency.

## Objectives of the Study

We have set the following objectives for the current study :

**(1)** To examine the existence of convergence between spot and futures prices of selected agricultural commodities during 2011-17.

**(2)** To find out the scope for arbitrage profit.

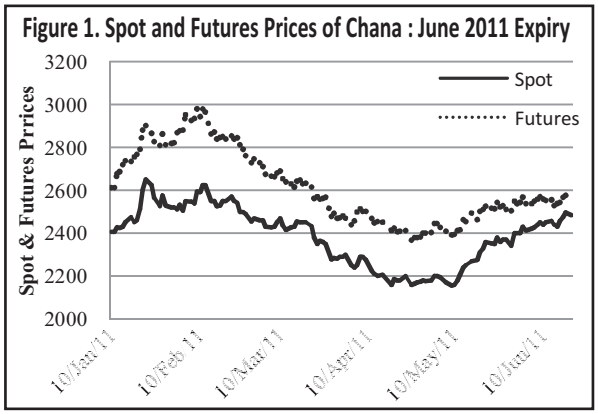
## Methodology

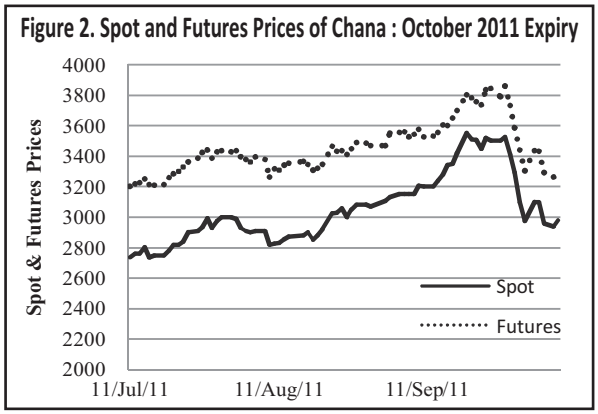
The current study is analytical and has a quantitative approach as it analyzes quantitative secondary data to examine the convergence between spot and futures prices. The researcher selected five agricultural commodities for the current study, namely, chana, cumin, pepper, maize, and chilli. The spot and futures prices of the selected commodities were collected for the period between 2011 - 2017 and analyzed to find out the existence of market patterns (contango and backwardation market), and to examine the convergence between spot and futures prices. The spot and futures prices of various contracts with different maturities during 2011-17 were selected randomly and obtained from the websites of National Commodity and Derivative Exchange (NCDEX) and Multi Commodity Exchange (MCX).

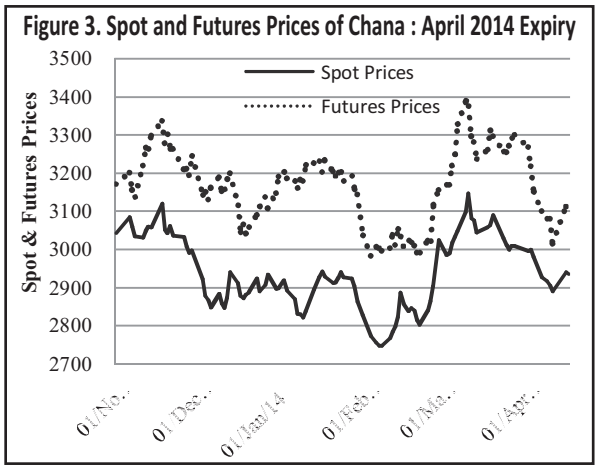
## Analysis and Results

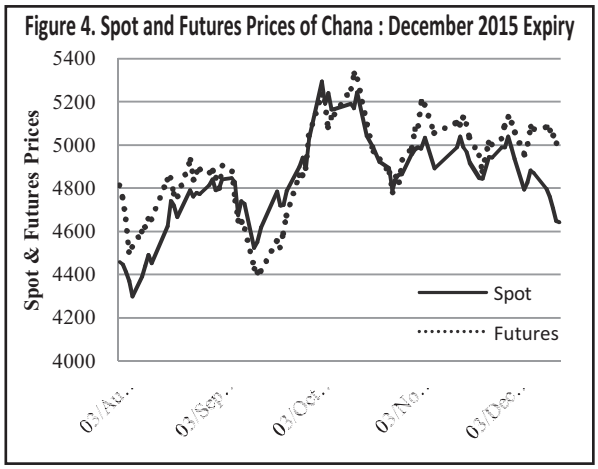
**(1) Convergence Analysis for Chana Futures :** In this section, the spot and futures prices of chana with contract size of 10 metric tonne, and the price quoted per quintal are analyzed.

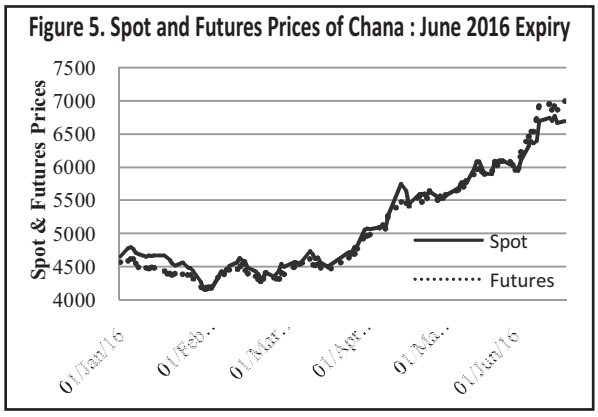
The Figures 1 - 6 explain the convergence between spot and futures prices of chana. In Figures 1, 2, 3, and 6 (June 2011, October 2011, April 2014, and September 2017 futures contracts), the futures prices are higher than spot prices, while in Figures 4 and 5 (December 2015 and June 2016 futures contracts), the spot prices are higher than futures prices during the contract period. It is evident from the analysis that there is a scope for arbitrage profit in December 2015 and June 2016 chana futures, as the market is showing negative spread. The investor can make profit by selling chana at spot rate, and going long in futures market. For the remaining June 2011, October 2011, April 2014, and September 2017 chana futures contracts, there is no scope for arbitrage profit as it is a normal market.

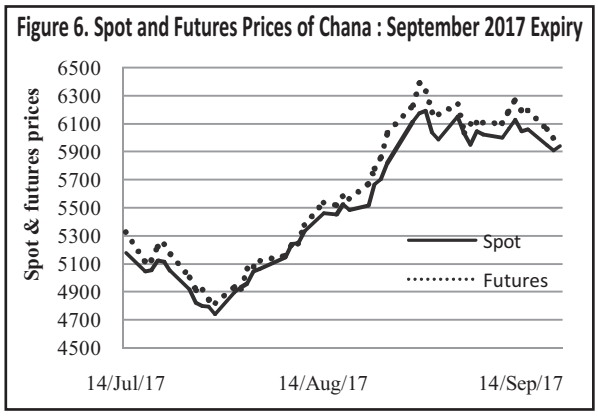




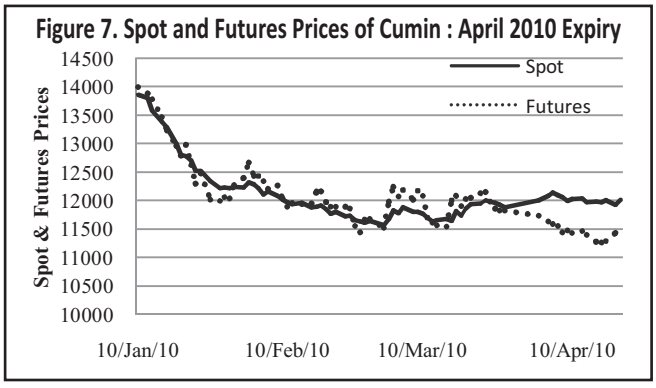



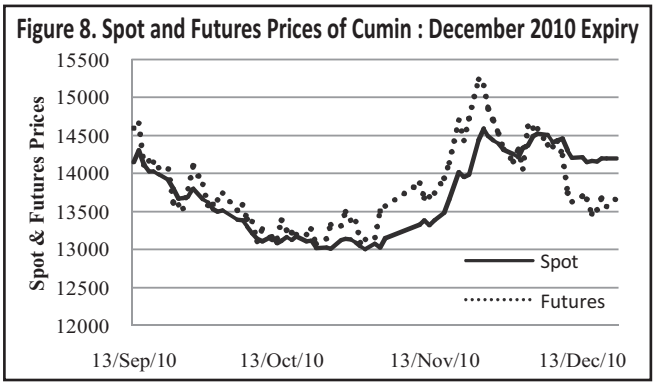



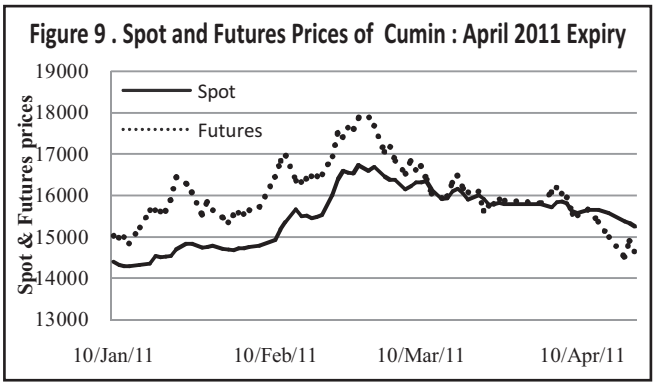



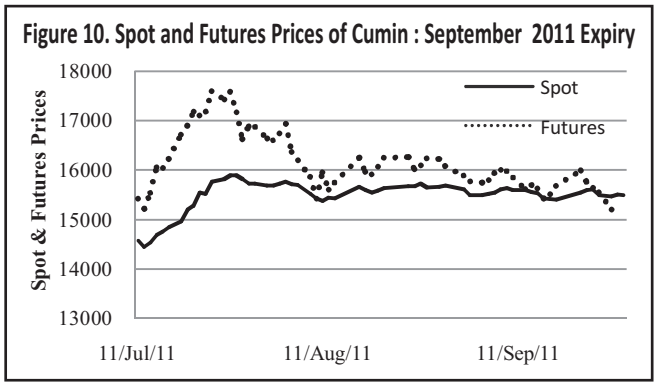

**(2) Convergence Analysis for Cumin Futures :** In this section, the spot and futures prices of cumin with contract size of 3 metric tonne and the price expressed per quintal are analyzed.

The Figures 7 - 10 explain the convergence between spot and futures prices of cumin. In Figures 7, 8, 9, and 10 (April 2010, December 2010, April 2011, and September 2011 futures contracts), at some point of time during the contract period, the spot prices are greater than the futures prices. An investor can make marginal profit by way of savings in storage cost and opportunity cost of the investment by selling in spot and buying the same through futures.

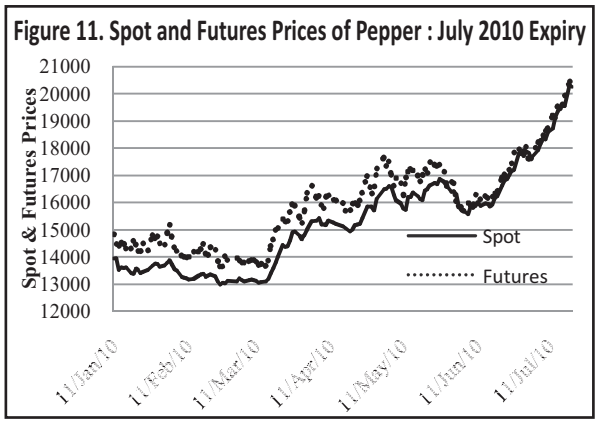


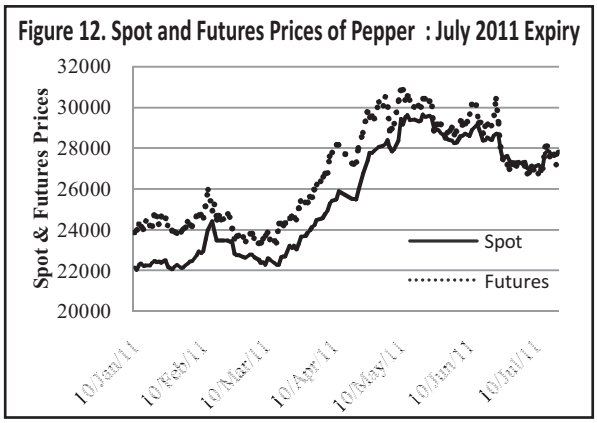






**(3) Convergence Analysis for Pepper Futures :** The spot and futures prices of pepper with contract size of 1 metric tonne and the price expressed per quintal are analyzed.



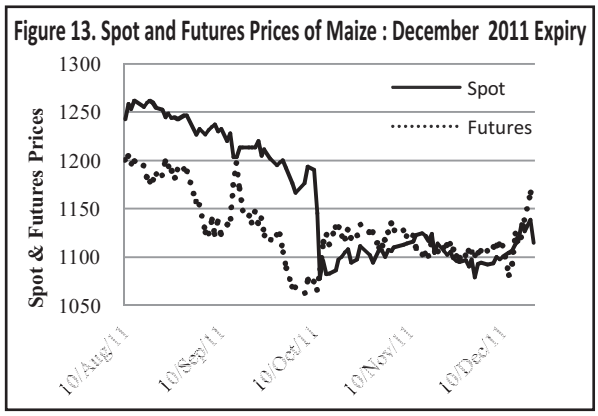

The Figures 11 and 12 explain the convergence between spot and futures prices of pepper. In Figures 11 and 12 (July 2010 and July 2011), the spot prices are higher than the futures prices thereby, providing scope for arbitrage profit. The investors can make arbitrage profit by selling pepper in the spot market and going long in the pepper futures contract.

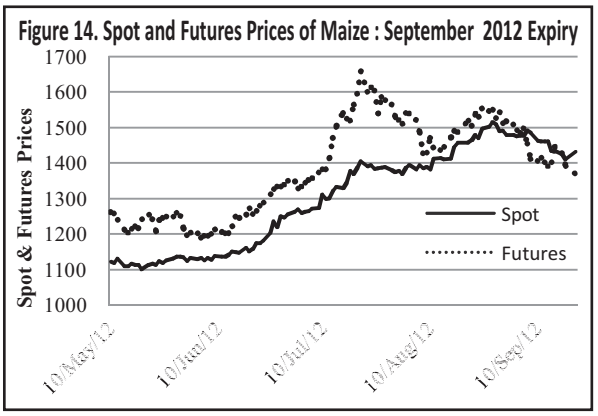
**(4) Convergence Analysis for Maize Futures :** In this section, the spot and futures prices of maize with contract size of 10 metric tonne and the price expressed per quintal are analyzed.

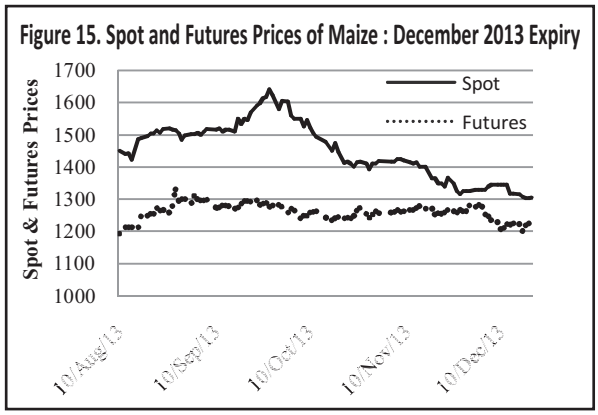
The Figures 13 to 18 explain the convergence between spot and futures prices of maize. The Figure 13 shows an overall declining trend in December 2011 maize contract with negative basis in the beginning and positive basis in the latter half of the contract period. Convergence was observed during the contract period. The investors can make arbitrage profit during the beginning of the contract period by selling maize in the spot market and going long in maize futures.

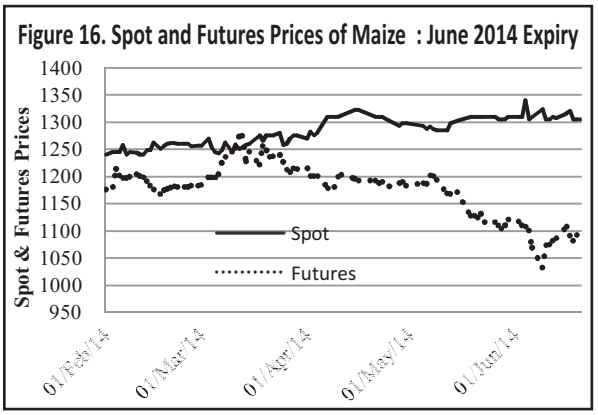
It is evident from the Figure 14 that the September 2012 maize contract had a normal price trend as the futures were higher than the spot price. Both the prices were moving together in the same direction. Convergence occurred at the end of the contract period, and after this, the market turned into backwardation. The investor can use this backwardation to indulge in arbitrage profit by selling in the spot market and buying the futures.

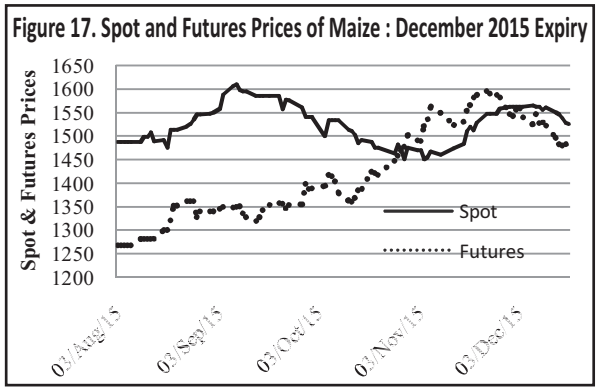
The Figure 15 shows the backwardation of the market for the December 2013 maize contract. The spot prices were higher than the futures prices throughout the contract period. The investors can make arbitrage profit as long as the spot prices are higher than the futures prices by going long in futures and selling the maize in the spot market.

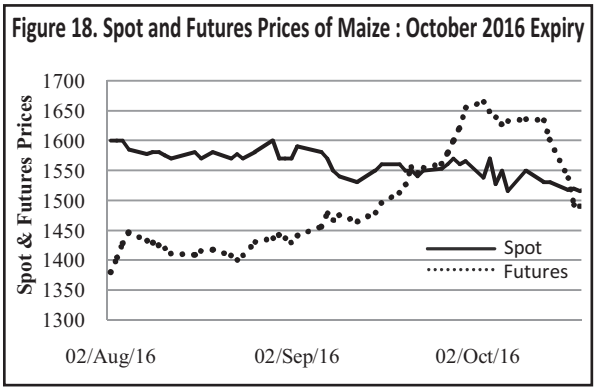


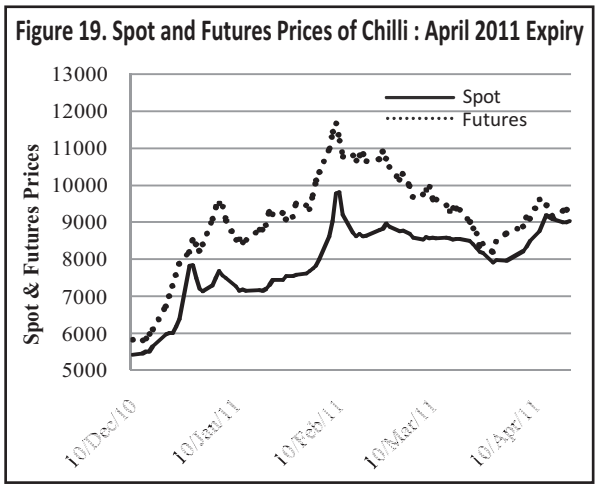



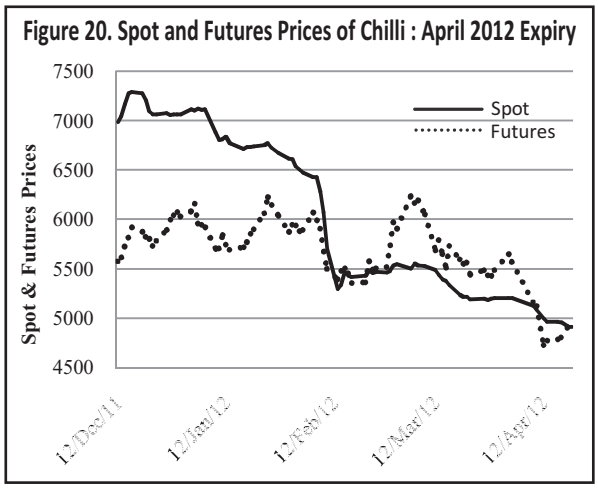



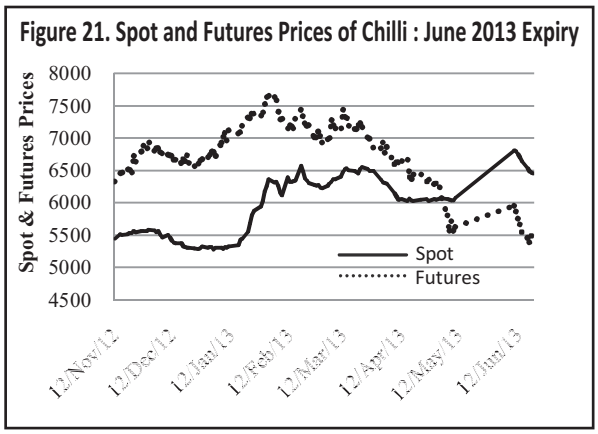

It is observed from the Figure 16 that for June 2014 maize contract, the spot prices were higher than the futures prices, except that both the prices converged once during the contract period. The spread widened as the expiration approached. Wherever the spot price is higher than the futures price, the investors will profit by buying futures and selling the underlying in the spot market.

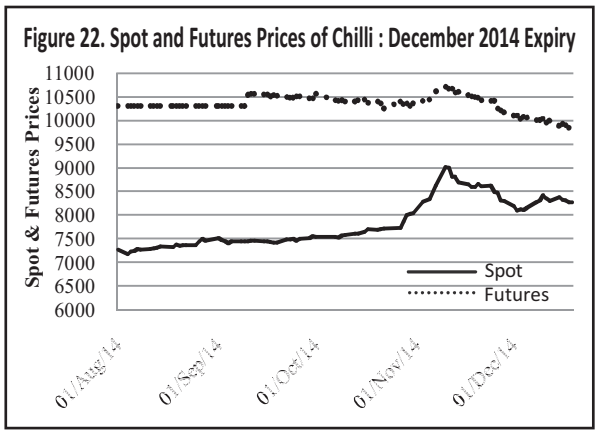
The Figure 17 shows the positive as well as the negative market for December 2015 maize contract. The market moved from backwardation to contango and returned to backwardation. The spread was wide in the initiation of the contract, and the spread narrowed as the expiration was nearing. The backwardation provides scope for arbitrage profit.

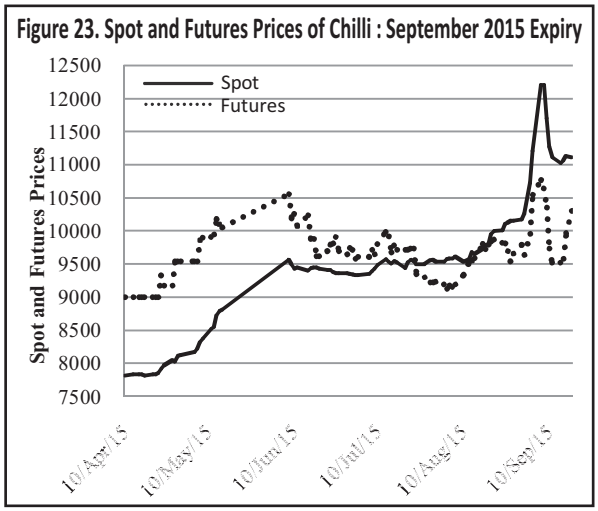
The Figure 18 shows the positive as well as the negative market for October 2016 maize contract. The market was negative in the beginning and turned positive later. Convergence occurred twice during the contract period.

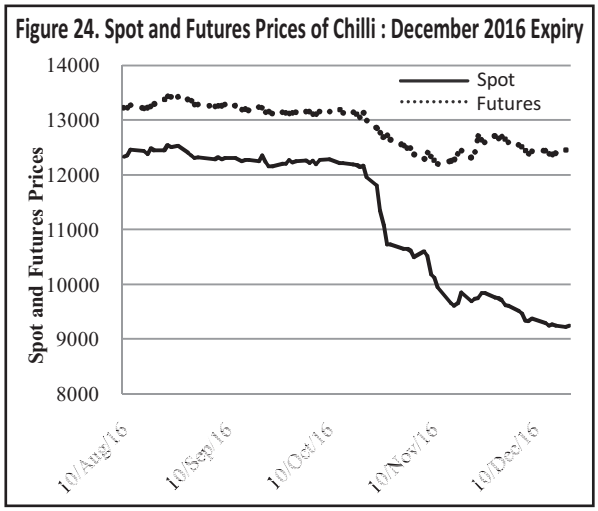



Wherever the spot price is higher than the futures price, the investors can make a profit by buying futures and selling the underlying in the spot market.

**(5) Convergence Analysis for Chilli Futures :** In this section, the spot and futures prices of chilli with contract size of 5 metric tonne and the price quotation per quintal are analyzed.

The Figures 19 - 24 explain the convergence between spot and futures prices of chilli. The Figures 20, 21, and 23 (April 2012, June 2013, and September 2015 futures contracts) show that spot prices are higher than the futures prices during the contract period, and this market pattern provides scope for arbitrage profit. One can indulge in the arbitrage process by selling the underlying in the spot market, and buying the same in the futures market at lower prices. However, in Figures 19, 22, and 24 (April 2011, December 2014, and December 2016), the normal market is observed wherein the futures prices are higher than the spot prices. Hence, these contracts provide the scope for arbitrage profit.

## Conclusion

The current study reveals that in many contracts, there is an opportunity for arbitrage profit and some futures contracts are properly priced. There are various supply side and demand side factors, which force the spot and futures prices to move in a particular direction. One of the reasons for a negative spread is that the investors would have held the commodities for consumption purpose rather than investment purpose. Such investors are not attracted towards arbitrage opportunities as they have convenience yield rather than indulging in arbitrage. As a result, the market does not reach equilibrium soon. It also reveals the presence of all three types of market patterns in one or the other selected contracts. The spot prices being higher than futures show the inefficiency of futures to discover spot prices.

Hence, the regulators are advised to initiate measures to disseminate information among market participants in a more effective way. The required infrastructure facilities such as warehouses, grading, testing, and road connectivity have to be built up. In addition to this, financing against warehouse receipts has to be introduced. The participation of all stakeholders in the commodity futures market needs to be strengthened. There is a need to create awareness about commodity derivatives, particularly among farmers in this direction. Thus, the integration of agricultural commodity spot market with the futures market is very essential as this enables both the markets to incorporate new information and to discover efficient prices.

## Research Implications

The convergence analysis between spot and futures prices throws light on taking various suitable positions in spot and futures market. It helps the market participants, that is, farmers and traders to hedge from price fluctuations and also to make arbitrage profit. It also helps policy makers to initiate suitable policy measures to ensure and encourage active participation of all stakeholders in the agricultural commodity derivatives market, thereby paving way for orderly development of the commodity derivative market. As the futures trading on commodities leads to efficient spot price discovery, the society will be protected from inflation and erratic price fluctuation.

## Limitations of the Study

The current study is subject to the following limitations :

- The current study is limited to agricultural commodities and that too to only five commodities, namely, chana, cumin, pepper, maize, and chilli.
- The convergence analysis is carried out randomly for a few specific contracts in a year for the selected commodities.
- The secondary data on selected commodities belong to specific period and particular contracts. The outcome of convergence analysis cannot be applied and generalized for the futures contracts of other commodities, and the same commodities with other maturities.

## Scope for Further Research

The current study was undertaken to examine the convergence between spot and futures prices of only five agricultural commodities, namely, chana, cumin, pepper, maize, and chilli. We feel that there is scope for further study on other agricultural and non-agricultural commodities. As the spot and future prices are dynamic in nature, the research on the interrelationship between spot and future prices has to be carried out on a continuous basis. There is also scope for further research to find out the factors responsible for existence of arbitrage opportunity in many contracts.

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