PRICE DISCOVERY IN COMMODITY MARKETS: A STUDY OF INDIAN CARDAMOM MARKET IN MULTI COMMODITY EXCHANGE

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ABSTRACT
Price discovery is one of important economic functions of commodity futures market as it provides competitive futures price from which spot price can be derived. This study analyses whether Cardamom futures market serves as a price discovery mechanism for spot market prices and vice versa. The analysis involves use of econometric tools like Augmented Dickey Fuller (ADF) test, Granger Causality test and Co-integration technique. The daily closing data from 1st Jan 2012 to 31st Dec 2013 has been taken for the study for analysis. Our findings suggest that, cardamom futures price movement can be used as price discovery vehicle for spot market transactions. This study can be further validated by comparing the results of international futures cardamom prices and there is scope to extend this model to other commodities for further validation of the results.

Key Words: Spot prices, Future prices, Cardamom, Johansen’s co-integration, Granger Causality.

INTRODUCTION
Cardamom is known as the “Queen of Spices”. It is known to be the costliest and unusual spices globally. Till 2000, India used to be the largest producer of Cardamom, and thereafter, Guatemala pushed her to the second position. Kerala, Karnataka and Tamilnadu are the major producers of Cardamom commodity. Its cultivation is concentrated on the Western Ghats in the country; and the Western Ghats are also known as “Cardamom Hills”. In 2012-13, as per provisional trade estimates, India’s production is around 12,000 MT. It is generally produced in the tropical regions of the world. Guatemala is the largest cardamom producing country followed by India. The total world production of this spice is around 35,000 MT per annum (source: Spices Board). Consumption of cardamom has sharply increased throughout the world during the last two decades.
Price discovery and hedging are the major economic functions of commodity futures market. Volatile raw material price is one of the prime concerns of business entities as they have direct and considerable impact on the profits margins of organisations. Therefore, price discovery becomes important in order to reduce fluctuations in commodity prices. In this regard, the present study has been undertaken to examine the price discovery process of Cardamom.

REVIEW OF LITERATURE

The execution of products futures business sector can be assessed on different wide parameters like premise danger, value revelation and effect of prospects exchanging on spot value instability. The value revelation is one of the essential parameters which measure the execution of futures markets. Despite the fact that extensive number of writing is accessible on created worldwide futures markets and extremely restricted endeavors are made to gauge the execution in Indian connection and that too on cardamom. Hypothetically, the relationship in the middle of spot and prospects costs can be gotten from the spot-future equality, which suggests that spot and futures costs ought to move together crosswise over time to evade consistent arbitrage opportunities in view of the spot-futures relationship. Zheng, Xu et al (2012) inspected the short run and long run value combination in new exchanging framework utilizing standard OLS and blunder rectification models in view of information from 2003 to 2010. The outcome demonstrated that the Chinese non-GMO soyabean futures business sector in light of information is productive, prospects costs react adequately to exogenous value stuns and that money costs move taking after these prospects costs. Consequently Baldi et al (2013) researched the long run relationship in the middle of spot and prospects costs for corn and soyabean for a long time which highlights that break identify with occasions that have fundamentally influenced the supply and interest of corn and soybeans for nourishment and vitality reason. Despite what might be expected Harper et al (2011) inspected the value unpredictability in the silver which demonstrates that both positive and negative stuns don’t have a huge impact on instability in the silver spot business sector furthermore watched that instability is not consistent after some time. The results provide evidence that both good and bad news have no significant effect on silver price volatility. Srinivasan (2013) in study confirmed the existence of trade off between the futures price and its underlying spot price of the commodity markets and also indicates that although bi-directional volatility spill over persists, the volatility spill over from spot to the futures market are dominant in case of all MCX commodity market. The same is evidenced by the examination by Yang, Bessler and Leatham (2001) who also claim that asset storability does not affect the existence of co-integration between cash and futures prices but it may affect the magnitude of bias in estimation of cash prices. A similar study of impact of climate shocks on spot futures prices of agricultural commodities in India by Bhanumurthy, Dua and Kumawat (2012) found that there is a bivariate relationship between rainfall and prices of rice, wheat and pulses showed non-linearity with the structural change happening after the introduction of future market, The present study is an attempt to analyse the existence and direction of price discovery process of Cardamom futures and spot prices in India.
OBJECTIVE OF THE STUDY

To analyse the Price discovery process of Cardamom future and spot price contracts

HYPOTHESIS

To achieve the above objective the following Hypothesis has been formulated

\[ H1 = \text{Future prices cause spot prices for Cardamom} \]

METHODOLOGY

The present study is an analytical study based on secondary data. Secondary data for the study consists of Cardamom futures prices from 01st January 2012 to 31st December 2013 and daily closing spot price of cardamom from 01st January 2012 to 31st December 2013. All the time series data are obtained from MCX (Multi Commodity Exchange) database. The study uses econometric tools like Augmented Dickey Fuller (ADF) test to check stationarity of data, Granger Causality to study the existence and nature of causality relationship between futures and spot prices of cardamom and Co-integration technique for examining the long term relationship between future and spot prices of cardamom.

Stationarity Test

Augmented Dickey–Fuller test (ADF) is a test for a unit root in a time series data. It is an augmented version of the Dickey–Fuller test for a larger and more complicated set of time series models. The augmented Dickey–Fuller (ADF) statistic, used in the test, is a negative number. The more negative it is, the stronger the rejection of the hypothesis that there is a unit roots at some level of confidence.

The test consists of estimating the following regression.

\[ \Delta R_t = \beta_1 + \beta_2 t + \rho R_{t-1} + \sum_{i=1}^{m} \alpha_i \Delta R_{t-i-1} \]  

Where, \( \Delta R \) is the first difference of \( R_t \), \( \beta_1 \) is the intercept, \( \beta_2, \rho \) are the coefficients, \( t \) is the time or trend variable, \( m \) is the number of lagged terms chosen to ensure that \( \epsilon \) is white noise, i.e., contains no autocorrelation and is the pure white noise error term, and

\[ \sum_{i=1}^{m} \alpha_i \Delta R_{t-i} \]  

is the sum of the lagged values of the dependent variable \( \Delta R \)

Causality Test

The Granger causality test is a statistical hypothesis test for determining whether one time series is useful in forecasting another. This study examines the lead-lag relationship between futures trading activity and cash price volatility using Granger Causality (1969) test. The dynamic linkage between the futures prices series and the spot prices series is given by the Pair-wise Granger Causality tests (Granger, 1986). Testing the causality between two stationary series \( S_t \) and \( F_t \) are based on the following equations:
\[ S_t = \sum_{i=1}^{n} \alpha_i F_{t-i} + \sum_{j=1}^{n} \beta_j S_{t-j} + \mu_{1t} \quad \ldots (2) \]

\[ F_t = \sum_{i=1}^{n} \lambda_i F_{t-i} + \sum_{j=1}^{n} \delta_j S_{t-j} + \mu_{2t} \quad \ldots (3) \]

Where, \( F_t \) is the future price return series and \( S_t \) is spot price return series. \( \lambda_i, \delta_j, \alpha_i \) and \( \beta_j \) are the coefficients of the respective variables. \( \mu_{1t}, \mu_{2t} \) are the error terms assumed to be uncorrelated. If all the coefficients of \( F_t \) in the regression equation (2) of \( S_t \) i.e. \( \alpha_i \) for \( i=1 \ldots n \) are significant that the null hypothesis \( F_t \) does not cause \( S_t \) is rejected, then it can be said there is a causality from futures to spot. If only one of the two variables causes the second variable but the second variable does not cause the first variable, it is called one-way causality. If both the variables cause each other, it is called as bi-directional (feedback) causality. However, the significance of the coefficient is evaluated by the help of F-statistic.

**Johansen Co-integration**

Co-integration of two price series is a necessary condition for market efficiency, since the Efficient Market Hypothesis implies that the future price is an unbiased predictor of the future spot price. If the two series are co-integrated, \( S_t \) and \( F_{t-n} \) move together and will not tend to drift apart over time. If this is the case, then the futures price is an unbiased predictor of the spot price.

**RESULTS AND DISCUSSIONS**

**Unit Root Test**

Results of Augmented Dickey Fuller test and Phillip-Perron tests are done to check the stationarity of the data series. We have identified that the absolute value of the ADF and PP test statistic is more than the critical value at 5% level (Refer Table 1 below). Therefore, the lag-differenced series can be taken to be stationary. The hypothesis that near month futures price and Spot close price has a unit root can be rejected and accept the hypothesis that time series data is stationary at first difference and not at level. For all our vectors, the lag differenced price series are considered to be stationary. From the result is found that cardamom futures and spot prices are integrated of order 1. Therefore, the necessary condition for testing co-integration is satisfied.

**Table 1 : Results of Augmented Dickey Fuller Test and Phillip-perron Tests**

<table>
<thead>
<tr>
<th>Unit Root Test</th>
<th>Spot At Level</th>
<th>Spot at 1st Differencing</th>
<th>Futures At Level</th>
<th>Futures at 1st Differencing</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADF Test Statistic</td>
<td>PP Test Statistic</td>
<td>ADF Test Statistic</td>
<td>PP Test Statistic</td>
<td>ADF Test Statistic</td>
</tr>
<tr>
<td>P Value</td>
<td>0.5095</td>
<td>0.4864</td>
<td>0.0000*</td>
<td>0.0000*</td>
</tr>
<tr>
<td>Conclusion</td>
<td>Non-Stationary</td>
<td>Stationary</td>
<td>Non-Stationary</td>
<td>Stationary</td>
</tr>
</tbody>
</table>
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Granger Causality Test

Granger causality tests shows that there exists a uni-directional causality relationship between the spot and futures prices of Cardamom. The test results indicate that future prices influence spot prices and not vice versa. The rationalization of the result is that futures influence spot market prices for cardamom due to lower transaction costs and flexibility of short selling and (Diks and Bekiros). Moreover, it helps hedgers with storage constraints to manage their exposure by purchasing future contracts. Therefore, both hedgers and speculators will react to the new information by preferring futures transactions for decision making. Hence we accept the hypothesis that future prices cause spot prices and not vice versa.

Table 2: Results of Granger Causality Test

<table>
<thead>
<tr>
<th>Null Hypothesis</th>
<th>Obs</th>
<th>F-Statistic</th>
<th>Probability</th>
<th>Decision</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPOT does not Granger Cause FUTURE</td>
<td>592</td>
<td>0.40898</td>
<td>0.6645</td>
<td>Accept</td>
</tr>
<tr>
<td>FUTURE does not Granger Cause SPOT</td>
<td>50.8596</td>
<td>4.00E-24</td>
<td></td>
<td>Reject</td>
</tr>
</tbody>
</table>

Johansen Co-integration Test

By using trace statistic and maximum Eigen value statistic, we have identified that there exists two co-integration equation between the futures and spot cardamom price (Refer Table 3 below). The hypothesis of zero cointegrating vectors is rejected, whilst the null of two cointegrating vector cannot be rejected at the 5% level. Thus, the spot and futures prices are I(1), with linear combinations being I(0), so the two price series are CI(1,1). The existence of co-integration between the cardamom spot prices and the near month futures prices, using both the Engle-Granger and Johansen tests, confirms the first necessary condition for long-term market efficiency.

Table 3: Result of Johansen Co-integration Test

<table>
<thead>
<tr>
<th>Hypothesized No. of CE(s)</th>
<th>Eigen Value</th>
<th>Trace Statistic</th>
<th>Critical value at 5% level</th>
<th>Prob.**</th>
<th>Max-Eigen Statistic</th>
<th>Critical Value at 5% level</th>
</tr>
</thead>
<tbody>
<tr>
<td>None *</td>
<td>0.0626</td>
<td>42.5866</td>
<td>15.49471</td>
<td>0</td>
<td>38.10519</td>
<td>14.2646</td>
</tr>
<tr>
<td>At most 1 *</td>
<td>0.0076</td>
<td>4.481409</td>
<td>3.841466</td>
<td>0.0343</td>
<td>4.481409</td>
<td>3.841466</td>
</tr>
</tbody>
</table>

Trace test indicates 2 cointegrating eqn(s) at the 0.05 level
*denotes rejection of the hypothesis at the 0.05 level
***Mackinnon-Haug-Michelis (1999) p-values

CONCLUSION

This study attempts to examine the evidence of price discovery in cardamom futures market. The co-integration test shows that cardamom futures and spot prices are co-integrated and there exists 2 co-integration equations which confirm the long-term relationship between the futures and spot price series. The Granger causality test shows
that there is uni-directional relationship between cardamom futures and spot prices and futures price significantly influences spot price. Similar to the studies on various other commodities, the inference that futures price serve as a price discovery tool is valid for cardamom. This study, thereby, contributes to the existing literature by providing evidence for the presence of price discovery process in cardamom market. Overall, our findings suggest that, cardamom futures price movement can be used as price discovery vehicle for spot market transactions. This study can be further validated by comparing the results of international futures cardamom prices and there is scope to extend this model to other commodities for further validation of the results.

REFERENCES