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COMMODITY FUTURES AND RISK MANAGEMENT - A STUDY BASED ON SELECTED COMMODITIES FROM THE INDIAN COMMODITY FUTURES MARKET

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ABSTRACT

This paper examines whether commodity futures are an effective mechanism of price discovery and risk transfer in agricultural commodities. Using the co-integration analysis of Johansen and the methodology perfected by Ribba, the study found significant evidence of market efficiency in commodity futures market. Futures market performs its twin functions of price stabilization and price discovery efficiently as evident from the flow of information from future market to spot market.

KEYWORDS: Commodity Futures, Unit Roots, Co-Integration, Error Correction, Price Discovery

INTRODUCTION

Price volatility is perhaps the most pressing issue facing producers of primary agricultural commodities especially in less developed countries (LDCs). High price volatility coupled with low prices of agricultural commodities make it difficult for them to plan agricultural operations efficiently and optimize the use of their limited resources. It has been observed that price volatility is generally much higher among primary agricultural commodities compared to other non agricultural commodities due to highly inelastic nature of demand and supply characterizing these commodities.

Alarmed by the adverse consequences of commodity price volatility, various measures were taken in the past at the national and international levels to stabilize commodity prices. In the international level most of these measures shared the common feature of being based on intervention. Buffer stock schemes such as International Commodity Agreements were based on this philosophy. In the national level, governments of many underdeveloped countries took elaborate interventionist policies to stabilize prices of agricultural commodities. The common feature of these interventionist policies was the creation of a planned and regulated system of prices coupled with price controls and subsidies. Markets were not allowed to operate freely to perform its role of price discovery. The main concern being that speculative activity in the futures markets could reinforce price instability and volatility in essential commodities and lead to further problem of food security.

Government intervention to artificially stabilize prices, thus, prevented the development of a market based price management system. However, the setting up of the World Trade Organization (WTO) in 1995, easing of quantitative restrictions on international trade, increased market access in commodities including agricultural commodities and widespread reduction of tariffs and similar measures in the international level forced many national governments to develop market based risk management tools. Thus in the recent past countries have begun to liberalize commodity markets and in a reversal of earlier trends, development of commodity futures markets. As World Bank notes: “market based management instruments, despite several limitations, offer a promising alternative to traditional stabilization schemes …….” price risk management instruments allows governments to disengage from costly and distorting policies.

India has a long history of futures trading in agricultural commodities dating back to 1800s. The development of the commodity derivative markets in India has been subject to various policy reversals due to concerns regarding its effects on prices and supplies of essential commodities. Though commodity derivatives were introduced in India in the post independence period, it was banned in the late 1960s. However, it was revived in the 1980s. in line with the economic reforms in the 1990s, Government of India suggested that the Minimum Support Price (MPS) as a price hedging instrument could be replaced with derivative markets. National level multi commodity exchanges were permitted to set up on conditions of being backed by internationally prevailing best practices of trading, clearing and settlement. At present22 exchanges are recognized for futures trading in commodities. There are four national level multi commodity exchanges. These exchanges are;

- National Multi Commodity Exchange of India (NMCE)
- National Board of Trade (NBOT)
- Multi commodity Exchange of India (MCX)
- National Commodity and Derivatives Exchange of India (NCDEX)

At present, 103 commodities have been approved for trading out of which 92 commodities are actively traded.

ADVANTAGES OF COMMODITY FUTURES

Futures markets are generally considered to perform two major roles in commodity markets; namely, a risk transfer role and a price discovery role. The risk transfer role results from the fact that a futures market is a place where risks are reallocated between hedgers (producers) and speculators. Hedging is the practice of offsetting the price risk inherent in any cash market position by taking an equal but opposite position in the futures market. Hedging involves buying and selling oaf a standardized futures contract against the corresponding sale or purchase respectively of the equivalent physical commodity. By taking a position in the futures markets that is opposite to that held in the spot market, the producers can potentially offset losses in the latter with gains in the future. Futures market thus offer a mechanism for dealing with price risk. Future prices also transit information to all economic agents, especially to uninformed producers, who, in turn, may base their supply decisions on the futures price. It can also be argued that physical traders use futures prices as a reference to price their commodities due to the greater transparency of futures prices. The informative role of futures markets could also have a stabilizing effect on spot prices and, thus, can potentially reduce price volatility.

However, the price discovery function of futures markets depends on whether new information is actually reflected first in changes in futures prices or in spot prices. Identifying the direction of information flows between spot and futures prices then appears to be an empirical issue.

STATEMENT OF THE PROBLEM

As stated above, the most important role of commodity futures market is to provide price stability through hedging. The benefits of hedging flow from the relationship between the prices of commodities and those of futures contracts. So long as these two sets of price move together, losses in the physical market are offset, substantially, by the gains in the futures market. Hedging thus performs the function of reducing significantly the losses emanating from the price risk in commodities.

Derivatives contracts can perform their role as good hedging instruments only when they are efficiently priced. An efficient market is one in which prices always fully reflect available information. For efficiency of the futures market, it is essential that the current futures prices contain all available information to predict future spot price.

The present study addresses the following issues. Do changes in future prices lead changes in spot prices? Or do price changes in spot markets lead price changes in futures markets? Or are there bidirectional information flows between spot and future markets?

OBJECTIVES

Following are the objectives of the present study:

- To assess the extent of integration between spot and future prices of agricultural commodities
- To examine the nature of information flows between spot and futures markets.

REVIEW OF LITERATURE

There are a large number of empirical studies examining the relation between commodity futures and spot markets. The empirical literature which enquires whether commodity futures lead spot prices began with Garbade and Silver (1983). In their study using seven different storable commodities including corn and wheat, they have discovered that spot prices in commodity markets discovered future markets. This was confirmed by Brorsen, Bailey and Richardson (1984). Crain and Lee (1996) also find that the wheat futures market carries out its price discovery role by transferring volatility to the spot market. Sahadevan (2002) opines that commodity derivatives have a crucial role to play in managing price risk especially in agriculture dominated economies. Benavides and Snowden (2006) state that administered commodity price schemes in developing countries have proved ineffective in raising farmer's incomes and hence, suggested price stabilization through futures markets. Gurpreet and Gaurav (2006) observed the dependence of commodity futures market on spot market for price discovery. Kedarnath (2008) discussed the significance of price discovery and risk management by commodity futures for the development of commodity spot market in India. Ranjit and Asima (2010) applying cointegration analysis and GARCH model on agricultural commodities confirmed the role of futures market in terms of price discovery of agricultural commodities.

Studies relating the effectiveness of future market as an effective hedge against are mixed in terms of their conclusions. Gopal and Sudhir (20010 pointed out that whereas some commodity markets are efficient, others are not due to low volume of trading and poor participation. Jatinder Bir (2004) observed that hedging performance of agricultural commodity futures are efficient and unbiased while others are not. Of the six commodities selected, only two were found to be efficient and unbiased. The factors responsible for inefficient hedging were found to be low volume, poor participation and deficient information system of commodity exchanges. Ram and Ashis (2007) observed that agricultural commodity derivatives efficient protection against price volatility risk. Brijesh, et.al. (2008) observed that Indian commodity derivative market provide useful risk management tools for hedging and for portfolio diversification. The same conclusion was arrived at by Brajesh and Ajay (2009). Iyer and Pillai (2010) in their study on the role of futures market in price discovery found that in the case of commodities like chickpeas, nickel and rubber, the convergence of price worsens during the expiration week indicating the non usability of futures contracts for hedging.

METHODOLOGY AND DATA

The study is based on daily closing spot price and daily closing futures price of near month contract from February 2009 to December 2014. The data have been collected from the official website of NCDEX. The prices are named “Spot” and “Future”. The commodities selected for the study are Rubber, Cardamom and Pepper.

A number of methodological issues should be resolved when time series data is used for empirical analysis. We outline below the methodology used in the present analysis.

Testing for Unit Roots

An important issue that has received much attention from time series econometricians in recent times when using time series data for analysis is the phenomenon of nonstationarity. Regressing one nonstationary time series on another give rise to the problem of spurious regression; that is, absence of any meaningful relationship between variables. To guard against the possibility of spurious regression, a number of testing procedures are available to determine stationarity/nonstationarity of time series variables. The present study utilizes the Dickey Fuller test in augmented form to check for stationarity. The test is available in three forms depending on no intercept, intercept, intercept and trend in the data. The test in its most general form is:

$$\Delta Yt = \mu + \gamma Yt - 1 + \sum_{i=1}^{p} \lambda i \Delta Yt - i + \varepsilon t \qquad \textbf{(1)}$$

The test statistic known as τ statistic is based on the value of γ obtained from the sample.

Johansen Cointegration Test

The introduction of cointegration analysis by Engle and Granger (1987) provided a new technique for testing market efficiency. The theory of cointegration to study the efficiency of futures market is stated as follows: let St be the spot price at time t and Ft-i be futures price taken at i periods before the contract matures at time t, where I is the number of periods of interest. If the futures price can provide a predictive signal for the spot price I periods ahead, then some linear combination of St and Ft-i is expected to be stationary. If St and Ft-i are not cointegrated, they will drift apart without bound, so that the futures price provides little information about the movement of the spot price. Since cointegration is a necessary condition for market efficiency, inefficiency can be concluded if the futures price and the spot price are not cointegrated. However, cointegration by itself cannot indicate where the new information is processed and which market adjusts to the other. The price discovery function of the futures market depends on whether new information in the market is reflected first in the changes in futures prices or changes in spot prices. For the futures price to be an unbiased predictor of subsequent spot price the futures price should lead the spot price and not vice versa.

The cointegration analysis originally introduced by Engel and Granger in context of single equation regression models was subsequently extended to multi equation regression models by Johansen (1991). Johansen procedure is the most widely used procedure for determining the existence of cointegration among a set of nonstationary I (1) variables is the Johansen procedure. In the Johansen framework, the first step is the estimation of a p^{th} order Vector Autoregression

(VAR) in k variables, namely:

$$Yt = \Pi 1Yt - 1 + \Pi 2Yt - 2 + \cdots + \Pi pYt - p + \varepsilon t \tag{2}$$

Where Yt is a (kx1) vector of non-stationary I (1) variables, πi is an (nxn) matrix of parameters and εt is an (nx1) vector of innovations.

If there is co-integration between variables in Yt, equation (2) can be re-parameterized into Vector Error Correction model (VECM) of the following form:

$$\Delta Yt = \Pi Yt - 1 + \Gamma 1\Delta Yt - 1 + \Gamma 2\Delta Yt - 2 + \cdots + \Gamma p - 1\Delta Yt - (p - 1) + \varepsilon t \tag{3}$$

Where $\Pi = \Pi 1 + \Pi 2 + \cdots + \Pi p - I$ and $\Gamma i = -(\Pi i + 1 + \Pi i + 2 + \cdots + \Pi p);\ i = 1{,}2 \ldots p - 1$

Johansen co-integration test is based on two test statistic namely trace statistic and λ max statistic based on the Eigen values of the Π matrix from equation (3) namely;

$$\lambda_{trace(r)} = -T \sum_{i=r+1}^{k} l_n(1 - \hat{\lambda}_i) \tag{4}$$

$$\lambda_{\max(r,r+1)} = -T\ l_n(1 - \hat{\lambda}_{r+1}) \tag{5}$$

As stated earlier, co-integration by itself cannot predict the direction of causality between spot and future prices. Granger causality test is the most preferred testing procedure to ascertain the direction of causality. However Granger causality test is applicable only if the variables are stationary. So we adopt the strategy of Ribba (2003) to test for cointegration and impose restrictions on the speed of adjustment parameters to infer whether future price causes current price or vice versa. These restrictions are imposed on the adjustment coefficients on the Π = (αβ’) matrix in equation (3).

THE EMPIRICAL RESULTS

The first step in any empirical investigation using time series data is a test for the order of integration of the individual series. The Augmented Dickey Fuller Test (ADF) is used to test the order of integration of the variables. The test results are presented in table1.

Table 1: Unit Root Tests

Commodity	Prices	Level First Difference
Rubber	Future	-0.92540 (0.9514) -32.52730 (0.0000)**
	Spot	-0.888671 (0.9555) -20.96261 (0.0000)**
Cardamom	Future	-1.137037 (0.9212) -38.15794 (0.0000)**
	Spot	-1.278880 (0.8925) -17.99375 (0.0000)**
Pepper	Future	0.751255 (0.9932) -43.86019 (0.0001)**
	Spot	-0.679323 (0.9736) -0.679323 (0.0000)**

****Indicates significance at 1% level**
Figures in parentheses are P values

The results indicate that the null of unit root is rejected at 5% significance level for all the prices in first differences while it is accepted in levels. This confirms that the prices are difference stationary and are integrated of order one, I (1). Since spot and future prices of all the commodities are integrated of the same order we can proceed with testing for cointegration between spot and future prices for all the commodities.

Cointegration analysis is used to identify whether there is a long run relationship between variables. The results of Johansen system cointegration analysis between spot and future prices for all the commodities are furnished in Table 2.

Table 2: The Johansen Cointegration Test

Commodity	Hypothesis	Eigenvalue	Λtrace	λmax
Rubber	r =0 r≤1	0.044051 0.005887	55.38754 (0.000)** 6.417619 (0.1608)	48.96992 (0.000)** 6.417619 (0.1608)
Cardamom	r =0 r≤1	0.028238 0.002114	54.93743 (0.000)** 3.779120 (0.0519)	51.15831 (0.000)** 3.77912 (0.0519)
Pepper	r =0 r≤1	0.049671 0.000000	108.5156 (0.000)** 0.039580 (0.8423)	108.5156 (0.0001)** 0.039580 (0.8423)

****Indicates significance at 1% level**
Figures in parentheses are P values

The test results clearly indicate the existence of one cointegration relationship between spot and future prices of all the commodities.

As stated earlier, cointegration by itself cannot indicate where the new information is processed and which market adjusts to the other. The price discovery function of the futures market depends on whether new information in the market is reflected first in the changes in futures prices or changes in spot prices. To examine whether the new information is processed first in the futures market or in the spot market or both, we adopt the methodology adopted by Ribba (2003). This involves imposing restrictions on the speed of adjustment coefficients in α's of the Π matrix of equation (3). If the adjustment coefficient in the equation of future is statistically insignificant and that of spot is significant, we conclude that new information in the market is reflected first in the changes in futures prices than changes in spot prices. In this case futures market performs the price discovery function efficiently. The test results are furnished in Table 3.

Table 3: Direction of Causality

Commodity	Direction of causality	$\chi 2$
Rubber	Spot does not cause Future Future does not cause Spot	0.205271 (.0650499) 38.33359 (0.0000)**
Cardamom	Spot does not cause Future Future does not cause Spot	0.505223 (0.472887) 33.688881(0.0000)**
Pepper	Spot does not cause Future Future does not cause Spot	0.079805 (0.777562) 114.9447 (0.0000)**

****Indicates significance at 1% level**
Figures in parentheses are P values

It is clear from table 3 that while the hypothesis that future does not cause spot has been rejected, the hypothesis that spot does not cause future has been accepted for all the commodities. The test result clearly indicates that futures market performs its price discovery role very efficiently for the selected commodities.

CONCLUSIONS

The study examined the effectiveness of futures market in terms of its functions, namely risk transfer role and price discovery role. Three agricultural commodities are selected for the empirical analysis. The commodities selected are Rubber, Pepper and Cardamom. Daily data of spot and future prices from February 2009 to December 2014 collected from NCDEX website have been used in the analysis. Unit root test confirmed the existence if one unit root in level in all the prices. Thus both prices of all the commodities are difference stationary. Johansen cointegration analysis confirmed that spot and future prices for all the commodities are cointegrated and thus exhibits long run relationship. To obtain further information about the direction of information flow $\chi 2$ test has been performed on the adjustment coefficients of both equations in (3). The test clearly indicates that there is information flow from future market to spot market and not vice versa. Thus we can safely conclude that in the case of the selected commodities futures market is functioning efficiently in India. So measures are required to strengthen further the working of commodity futures market in India as a market based risk management system.

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