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A STUDY ON PRICE DISCOVERY IN THE INDIAN WHEAT MARKET

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ABSTRACT

Empirical literature is generally disputed about the impact of agricultural commodity derivative trading on spot markets. The purpose of this study was to empirically investigate role of derivative trading in price discovery of wheat across spot and future market. It investigates price discovery of assets in long run between future and spot market. The Johansen cointegration test (1990) determines the existence of long run equilibrium between future and spot market. The results show that the long run equilibrium relationship exists in Wheat. The results revealed that future markets played a dominant role in giving price signals to spot market. To deepen the markets the government needs to encourage participation of hedgers in the future market by promoting better infrastructure facilities like low storage costs, warehouse receipts and electronic spot exchange.

Keywords: *Empirical Literature, Agricultural Commodity, Spot Market, Electronic Spot Exchange.*

Introduction

Wheat traded in the mandi is susceptible to price fluctuations. Adverse price changes in the future, the producers and traders dealing in Wheat are exposed to risk. Derivative markets have been set up to provide a hedge against adverse price risk and investment opportunity for speculators to assume risk for possible returns. However, for agricultural commodities which have dispersed spot markets throughout the country, electronic derivative markets are also a linking tool and acts as a price barometer. Hence, the role of agricultural derivative market is not only risk management and price stabilization but also price discovery. These markets are meant to give price signals, provide a level playing field and hedging facilities to the farmers in India. However, over decades future trading has been accused of encouraging speculative trading and destabilizing spot markets. As Wheat forms part of the basket of commodities for calculating the Consumer Price Index (CPI) & Wholesale Price Index (WPI) government has exercised rigorous controls over these markets.

After Agriculture Policy Statement of the year 2000, the government shifted its stand from protectionist to liberalization and privatization in agriculture. The period after 2003, saw a magnanimous upsurge in trade volumes at agricultural derivative markets. However, in 2007-08 there was a ban on many essential commodities and the stated reason given for the ban was rising inflation due to futures trading. It has been argued that the government had put a ban due to political pressure (Srinivasan, 2008) and the Sen Committee Report, 2008 was inconclusive about the effect of futures trading on unexpected spurt in prices of agricultural commodities. The committee gave policy recommendations for developing electronic spot markets for better linkages between mandis, improvement in infrastructure facilities, transport and warehousing receipt system and encouraging participation of farmers to take benefit of the futures market. The report also highlighted that although the volume of trading had grown phenomenally in the future market it was greatly dominated by speculators and it had failed to provide instrument of risk management (Sen, 2008).

Research studies are generally disputed about the effect of futures trading on spot prices. Some research findings have documented that trading on futures market increases market depth for the

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commodity, leads to rapid dissemination of information and better price discovery[1] (Fligewski, 1981, Bessembinder and Seguin, 1992). The design of future market is such that, the electronic system provides rapid dissemination of floor information to traders and market makers help improve market liquidity (Schrieber and Schwartz, 1986). Without electronic derivative markets, price determination for agricultural commodities would be dependent upon scattered mandis all over the country. Future markets improve the process of price discovery of commodities. The Price Discovery process starts with the arrival of new information that generates trades and price movements as traders absorb the news while market reaches new equilibrium. The process is barred by impediments like noise in the information content of assets, returns on the assets over a short period are not serially independent, increased variance of short period returns and biased beta of short period data. The derivative markets are expected to reduce the information distortions, because of low transaction cost involved in future trading which pushes the traders to search for better information. Thereby, the future markets are considered more efficient[2] than the spot markets. They give signals about future cash price and are important for production and consumption decision made by the producers, manufacturers and investors (Yang and Leatham, 1999). The price risk is spread amongst a large number of investors and transferred from those hedging spot positions to professional speculators who could bear it. Thereby, reducing the risk premium attached to spot market transactions (Fligewski, 1981). However, for dispersion of information among markets, it is necessary that the spot and future markets are integrated. Market integration is a situation where prices of commodities in different markets move together that is they exhibit co-movements and the price of one market has a smooth reflection on prices in the other integrated markets (Roy, 2008). Different studies, (Hammoudeh, Li and Jeon 2002, Roy 2008 and Worthington and Higgs 2010) have investigated the integration using Johansen Cointegration Lambda and Trace Test. The Johansen cointegration test examines long term equilibrium relationship between two series. Series which are cointegrated in the long run are then examined for short run adjustment process using Vector Error Correction Model (VECM). A large body of literature is available dealing with the Price Discovery among financial assets. Even in Indian context, several studies have dealt with the subject. However, there is very limited work on the Price Discovery in agricultural commodities. In Indian context, empirical work on the price discovery in agricultural commodities is almost negligible. In this study, the objective is to fill this gap in the literature.

The study is organized into five sections, including the present one. Section 2 describes the data, its sources and descriptive statistics, Section 3 deals with Cointegration between spot and future market in the long run. The last section discusses summary and conclusions.

Data

- **Data Source**

The data consists of daily closing spot prices and futures prices for Wheat. The future price series has been constructed using daily closing future prices of middle month contracts for all commodities. Both the spot and future price series has been compiled from National Commodity & Derivative Exchange Limited (NCDEX) for the data period from 1st January' 2003 to 31st December' 2013.As the Government of India allowed re-introduction of commodity futures in 2002, the trading picked up and data was available only after the year 2002.

Product Profile of Wheat

It is one of the most important cereal grains consumed in the world. It is used for making breads, bakery products and other numerous edible products. Apart from that it is also an important source of animal feed. It requires cooler weather during earlier plantation and needs warmer atmosphere to dry up. It is cultivated as the Rabi crop in the month of October and has the harvest season from April to May. India is the third largest producer of wheat in the world and produces 75-80 million tons every year. The delivery centres for future contract are located in Delhi, Kanpur and Kota. It has a contract launch for every month. Also the delivery unit for trade is 10 metric tons.

- **Descriptive Statistics**

Descriptive statistics of the future and spot return series are reported in **Exhibit 2.1**. The average prices of future returns are higher than spot returns. The pattern exhibits a market situation

[1] According to Yang and Leatham, 1999, "In a static sense, Price Discovery implies the existence of equilibrium prices. In a dynamic sense, the price discovery process describes how information is produced and transmitted across the markets."

[2] Efficient market implies price change happens only due to new unanticipated information.

known as the Contango, whereby for almost all the commodities the market traders are net long and the future prices would fall over the life of the contract.

An analysis of return volatility as shown by standard deviation reveals that for Wheat the future markets are more volatile than the spot market. The return series exhibit asymmetric distribution with negative skewness and longer left tail and mostly concentrated on the right.

The statistical Kurtosis which measures thickness of the tails reveals that all the distributions have a K higher than three indicating thicker tails and leptokurtic distribution. The return series exhibits the pattern of small changes that would happen less frequently as there is clustering around the mean and a more likely large variation with fat tails.

Exhibit 1: Descriptive Statistics

Return series	Mean	Std. dev.	Skewness	Kurtosis
Wheat future returns	0.000414	0.010958	-1.50971	21.90146
Wheat spot returns	0.000338	0.010776	-1.22503	17.67057

Long Run Equilibrium between Spot and Future Market

To run the Johansen Cointegration test, is necessary that the first form difference is integrated of order 1 or higher. The order of integration of the spot price (ln P_{st}) and future price (ln P_{ft}) series is examined using Augmented Dickey Fuller (ADF) test[1]. It is observed that for Wheat, both spot and future price series are non-stationary at the level form, whereas it is stationary at first form difference, i.e. future series (ln P_{ft}/P_{ft-1}) and spot series (ln P_{st}/P_{st-1}). Hence, it can be concluded that the series are all integrated of order 1, viz. I(1) processes and Johansen test for long run equilibrium relationship can be applied. The result of the stationarity test is given in **Exhibit 3.1**.

Exhibit 2: ADF Test Results for Spot and Future Series in Level Form and First Form Difference

	Level form		First form difference	
	t-statistic	p-value	t-statistic	p-value
Wheat future	-1.03258	0.7435	-39.5627	0
Wheat spot	-1.81971	0.3711	-14.2009	0

Null Hypothesis: Variable has a unit root

Earlier researches have estimated market integration based on the Engle-Granger (1987) technique of bivariate cointegration. It involved two or more series, which were non stationary, but a linear combination of them was stationary. The more recent techniques are Johansen (1988) and Johansen & Juselius (1990, 1992) to determine the cointegrating relationships. If y_t is considered to be (n×1) vector of non-stationary I(1) variable, then the Vector Auto Regression (VAR) of $y_t$upto k lags can be specified as:

$$y_t = M + \Sigma_i^k \Pi_i y_{t-1} + e_t, \text{ (t=1, 2 ....T)} \qquad (3.1)$$

Where each of π_i is an (n×n) matrix of parameters, e_t is an identically and independently distributed n-dimensional vector of residuals and M is an (n×1) vector of constants.

The above equation (1.1) can be expressed in first difference notation and formulate the error correction representation of y_t as:

$$\Delta y_t = \Gamma_1 \Delta y_{t-1} + \cdots + \Gamma_{k-1} \Delta y_{t-k+1} + \Pi y_{t-1} + u_t \qquad (3.2)$$

Where, $\Gamma_i = -(I - \Pi - \cdots - \Pi_i); i = 1,2, \cdots k-1, \Pi = -(1 - \Pi_1 - \cdots \Pi_k)$

Γ_i 'S are (n×) coefficient matrix for, Δy_{t-1},i=1,2,…k-1

$\Pi$is an (n×n) coefficient matrix for the variables in y_{t-1},

$u_t$is an (n×1) column vector of disturbance terms.

The above equation gives information about both the short and long run adjustments to changes in y_t through Γ_i and Π respectively. The information of the long run relationship is gathered from the cointegration analysis, which basically involves examining the impact matrixΠ.

[1] ADF testis applied on the following regression model;
$\Delta Yt = \beta 1 + \beta 2t + \delta Yt-1 + \sum_{i=1}^{m} \alpha i \Delta Yt-i + \varepsilon t$, where εt is a pure white noise error term.
It is a unit root test for the time series with the null hypothesis δ=0.

Johansen (1988) derived two likelihood ratio test statistics to test for the number of cointegrating vectors. The null hypothesis of r cointegrating vectors against alternative of more than r cointegrating vectors is tested by using the lambda-trace statistics which is given by:

$$\lambda_{trace} = -T\sum_{i=r+1}^{n} \ln(1-\hat{\lambda}_i) \quad (3.3)$$

On the other hand, the null hypothesis of r cointegrating vectors against the alternative of (r+1) cointegrating vectors is tested by using the lambda-max. Statistics, which is computed as:

$$\lambda_{max} = -T\sum_{i=r+1}^{n} \ln(1-\hat{\lambda}_{r+1}) \quad (3.4)$$

Whereλ_i's are the estimated Eigen values (characteristic roots) and T is the number of usable information.

The lambda-trace test and maximum eigenvalue test has been applied on two non-stationary variables spot price (ln P_{st}) and future price (ln P_{ft})of eight agricultural commodities using the bivariate framework. The results of Johansen trace test and maximum eigenvalue are reported in **Exhibit 3**. Out of the eight commodities only one commodity, namely Kapas accept the null hypothesis that spot and futures market are not cointegrated since both the statistics λ_{trace} and λ_{max} don't exceed the critical value with a 5% level of significance. The absence of any long run relationship reveals lack of integration of the spot market with the derivatives market. Wheat commodity indicates one cointegrating equation implying a single path of convergence towards equilibrium.

Exhibit 3: Johansen Cointegration Test

Panel A: Cointegration Rank (Trace) Test;with 1st hypothesis H_0: No. of Cointegrating equations = 0 against H_1: No. of Cointegrating equations is more than 0 and 2nd hypothesis H_0: No. of Cointegrating equations at most 1 against H_1: No. of Cointegrating equations is more than 1

Commodity	Hypothesized no. of CE(s)	λ_{trace}	Critical value (5%)	Prob. value	Decision
Wheat	None	35.95096	15.49471	0	Indicates one cointegrating equation
	At most one	2.682034	3.841466	0.1015	

Summary and Conclusion

There is very limited research work on the role of future markets in price discovery of agricultural commodities. Empirical literature deals with price discovery in two parts: long term equilibrium between future and spot market. Long term equilibrium relationship between the two markets is examined by Johansen cointegration test (1988). Data employed consists of daily returns of future and spot market for eight commodities where the derivative of these agricultural commodities is traded on NCDEX. The study period is from January 2003 to December 2013.

Results show that for Wheat future and spot market is cointegrated with one cointegrating vectors. Long term equilibrium for Wheat spot and future market is in contrast to the earlier empirical work in this commodity, which shows no cointegrating relation, Roy (2008). The study contributes to the existing literature on price discovery in agricultural commodities, especially for an emerging market like India.

Policy makers and government agencies can use the results of this study to analyze the role of future market. Future market can perform the function of Price discovery for agricultural commodities only if future and spot markets are cointegrated in the long run.

To deepen the markets the government needs to encourage participation of hedgers in the future market. The hedging activity can be promoted with better infrastructure facilities like low storage costs, warehouse receipts and electronic spot exchange for better information symmetry. The farmers can be encouraged to participate in the derivative trading by introduction of commodity options. Commodity options provide direct benefit farmers.

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