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A STUDY OF LINKAGES BETWEEN AGRICULTURAL COMMODITY INDICES IN THE INDIAN MARKET

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ABSTRACT

The study facilitates in understanding of the commodity market and the agricultural indices. The commodity market is deeply evaluated as all the exchanges and their agricultural indices are analyzed in the study. Further, the volatility effect of MCX Agri Index and NCDEX Dhannya Index are evaluated since MCX having major market share in the commodity market as compared to NCDEX. The volatility is studied in order to understand if there is any further price discovery of commodities and to understand if the Indian agricultural commodity market is still volatility. As the effect of one index on the other is being understood the investor can be aware of the volatility change in the agricultural market. Volatile market gives a chance to the investor to earn in the market from new price discovery of the commodity. On examination of the indices, it is learnt that there are only two commodity exchanges providing agricultural indices i.e. MCX and NCDEX and the composition of their agricultural commodity indices are further analyzed. Past studies have shown linkages between future and spot market of individual commodities and other commodity indices; hence, to examine the volatility effect or the linkage between the agricultural commodity indices for the period 2007 to 2015, tools and techniques used are correlation test, ADF t- test, Garch (1, 1) and Granger Causality Test in E - views. The study shows that there is linkage between both the agricultural commodity indices since volatility of one index affects the other.

KEYWORDS

MCX Agri Index, Dhanya Index, ADF, GARCH etc.

INTRODUCTION

In the study, the Indian commodity market is studied in order to identify the commodity exchanges, which provide platform for trading of agricultural commodities. The agricultural commodity indices are further analyzed based upon the composition i.e. Indices which have only agricultural commodity composition and not energy and metal. This is done so there is uniformity in both the indices while analyzing. Though the compositions of the indices are different in the respective weight ages the base is the same, as only agricultural indices are selected. The volatility effect is further analyzed so that the relationship between both the indices is understood i.e. up to what extend the volatility of the agricultural indices effect each other.

The study facilitates in understanding of the commodity market and the agricultural indices. The commodity market is deeply evaluated as all the exchanges and their agricultural indices are analyzed in the study. Further, the volatility effect of MCX Agri Index and NCDEX Dhannya Index are evaluated since MCX having major market share in the commodity market as compared to NCDEX. The volatility is studied in order to understand if there is any further price discovery of commodities and to understand if the Indian agricultural commodity market is still volatility. As the effect of one index on the other is being understood, the investor can be aware of the volatility change in the agricultural market. Volatile market gives a chance to the investor to earn in the market from new price discovery of the commodity. Till now only metal and energy have been looked upon as volatile commodities, hence here in this study we look upon the agricultural commodities indices and try to understand if they are volatile or not.

LITERATURE REVIEW

Sanjay Sehgal, Wasim Ahmad and Florent Deisting (2013) in their paper An Empirical Examination of the Process of Information Transmission in India's Agriculture Futures Markets examined the process of information transmission in India's agriculture commodity futures market by investigating the price discovery and direction of volatility spillovers between futures and spot prices of nine agricultural commodities viz., Barley, Cardamom, Castor seed, Chana (Chickpea), Chili, Mentha oil, Pepper, Soybean and Refined Soya, traded on Multi-Commodity Exchange (MCX) and National Commodity & Derivatives Exchange (NCDEX). The study uses the daily data from January 01, 2009 to May 31, 2013. The empirical results confirm the price discovery between futures and spot prices, indicating strong information transmission. The volatility spillover results indicate that in the short-run, there is strong volatility spillover from spot to futures market whereas in the long run, it is exactly opposite.

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Isha Chhajed and Mr.Sameer Mehta (2013) in their paper Market Behavior and Price Discovery in Indian Agriculture Commodity Market examined the market behavior and price discovery in Indian Agriculture Commodity Markets. The commodity derivatives market in India has witnessed a phenomenal growth since the functioning of future market came under scrutiny during 2008-2009 due to price rise and the role of futures market in stabilizing spot prices was widely studied. The study considered average monthly spot and future prices of nine agriculture commodities viz. wheat, chana, soybean oil, jute, mentha oil, rubber, potato, crude palm oil and cardamom trading on MCX and NCDEX during 2009-2010. Granger causality test have been used to test the price discovery i.e., the effect of future market on spot market and vice-versa. The market behavior was studied with the help of backwardation and contango. The result of the study says that the price discovery mechanism is quite different for different commodities but it suggests that causality can be used in forecasting spot and futures prices. Most of the commodities showed bi-directional causality between spot and future prices. The contango and backwardation helps in identifying the hedging opportunities in the market.

Sanjay Sehgal, Namita Rajput and Florent- Deisting (2013) in their paper Price Discovery and Volatility Spillover: Evidence from Indian Commodity Markets examined the price discovery and volatility spillover relationship for Indian commodity markets. Here they covered twelve actively traded commodities including agriculture, metal and energy and four commodity indices. Price discovery was confirmed for eight commodities and three indices with a greater role for futures markets in the price discovery process. The tools and techniques used in this paper are Granger Causality, VECM and EGARCH. However, the study shows that the market does not seem to be competitive. Volatility spillover is confirmed for only three commodities and none of the indices. This implies the Indian Commodity Market is yet to evolve an efficient risk transfer system for most commodities. The findings have implications for policy makers, hedgers and investors. The research contributes to alternative investment literature for emerging markets such as India.

Prof. Sanjay Sehgal, Dr. Namita Rajput, Mr Rajeev Kumar Dua (2012) In the context of emerging Indian commodity futures markets, this paper empirically examines the effect of futures trading activity on spot price volatility for seven agricultural commodities (guar seeds, turmeric, soya bean, black pepper, barley, Maize and Castor Seed).To clearly understand the destabilization effect, the relationship of the unexpected liquidity of futures market is done with Unexpected volatility of spot market returns which is estimated by taking the residuals of the GARCH model. We find that unexpected futures trading volume is Granger causing spot price volatility and are significant for five out of seven agricultural commodities. We find reversed effect for one commodity i.e. Pepper the effect of spot volatility on futures trading and for Barley, no causality is revealed from either future to spot or Vice-Versa. Besides being of interest to the participants, this study is likely to be useful in addressing the concerns of policy makers in India on alleged destabilizing effect of futures markets on spot prices as for emerging futures markets. Financial autonomy and adequate powers should be given to Forward Market Commission to penalise any insider trading and price manipulations, this will minimize price distortions. The Government support shall lead to market growth and overall economic development.

Brajesh Kumar and Ajay Pandey (2011) in their study International Linkages of the Indian Commodity Futures Markets examined the cross-market linkages of Indian commodity futures for nine commodities with futures markets outside India. These commodities range from highly tradable commodities to less tradable agricultural commodities. They analyzed the cross-market linkages in terms of return and volatility spillovers. The nine commodities consist of two agricultural commodities: Soybean, and Corn, three metals: Aluminum, Copper and Zinc, two precious metals: Gold and Silver, and two energy commodities: Crude oil and Natural gas. Return spillover is investigated through Johansen's cointegration test, error correction model, Granger causality test and variance decomposition techniques. The authors applied Bivariate GARCH model (BEKK) to invest- tigate volatility spillover between India and other World markets. In case of commodities, it is found that world markets have bigger (unidirectional) impact on Indian markets. In bivariate model, it is found bi-directional return spillover between MCX and LME markets. However, effect of LME on MCX is stronger than the ef- fect of MCX on LME. Results of return and volatility spillovers indicate that the Indian commodity futures markets function as a satellite market and assimilate information from the world market.

Mantu Kumar Mahalik, Debashis Acharya and M. Suresh Babu (2009) in their paper Price Discovery and Volatility Spillovers in Futures and Spot Commodity Markets: Some Empirical Evidence from India examined the Indian commodity futures markets and even though it registered 373% growth during 2005-06, despite this growth rate, there is skepticism about the effect of commodity futures on its underlying assets in India. The study examines price discovery and volatility spillovers in Indian spot-futures commodity markets by using cointegration, VECM and the bivariate EGARCH model. The study has used four futures and spot indices of Multi-Commodity Exchange (MCX), that employes daily data spanning over 12th June 2005 to 31st December 2008. Besides the bivariate GARCH model indicates that although the innovations in one market can predict the volatility in another market, the volatility spillovers from future to the spot market are dominant in the case of LENERGY and LCOMDEX index while LAGRISP acts as a source of volatility towards the agri futures market.

James S. Doran and Ehud I. Ronn (2008) in their paper Computing the Market Price of Volatility Risk in the Energy Commodity Markets and in their paper they demonstrate the need for a negative market price of volatility risk to recover the

difference between Black-Scholes (1973)/Black (1976) implied volatility and realized term volatility. Initially, using quasi-Monte Carlo simulation, they demonstrated numerically that a negative market price of volatility risk is the key risk premium in explaining the disparity between risk-neutral and statistical volatility in both equity and commodity energy markets. Next, using futures and options data from natural gas, heating oil and crude oil contracts over a ten-year period, they estimated the volatility risk premium and demonstrate that the premium is negative and significant for all three commodities. There appear distinct seasonality patterns for natural gas and heating oil, where winter/withdrawal months have higher volatility risk premiums. Computing such a negative market price of volatility risk highlights the importance of volatility risk in understanding priced volatility in these financial markets.

Sushismita Bose (2008) in her study "Commodity Futures Market in India - A Study of Trends in the Notional Multi-Commodity Indices" examined The main purpose of the present study would be to look into some characteristics of the Indian commodity futures market in order to judge whether prices indicate efficient functioning of the market or otherwise, particularly as this market is less developed compared to the financial derivatives markets, being constrained by its chequered history with many policy reversals. Using the available notional price indices for the commodity market, we find that multi-commodity indices, which have higher exposure to metals and energy products, with clear and efficient price dissemination in national and international markets, behave like the equity indices in terms of efficiency and flow of information. Both the contemporaneous futures and spot prices contribute to price discovery and the futures market can provide information for current spot prices and thus help to reduce volatility in the spot prices of the relevant commodities and provide for effective hedging of price risk. Agricultural indices on the other hand do not exhibit such features very clearly. Our results also help to build a case for opening up of parts of the Indian agricultural futures market.

Kumar and Sunil (2004) examine the price discovery for five commodities in six Indian commodities exchanges. In this study daily futures and comparable ready prices have been used in the study and the ratio of standard deviations of spot and future rates have been taken for testing of ability of futures markets to incorporate information well. Besides, the study analyzes the efficiency of spot and future markets by employing the Johansen cointegration technique. They find the inability of the futures market to fully incorporate information and confirmed inefficiency of the future market. The authors conclude Indian agricultural commodities future markets are not yet mature and efficient.

OBJECTIVES

- To study the Indian Commodity Market.
- To analyze the agricultural commodity indices in Indian Commodity Market.
- To evaluate the co-relation between "Mcx – Agri" Index and NCDEX "Dhannya" Index
- To evaluate the volatility effect of MCX Agri and NCDEX "Dhannya"

METHODOLOGY

The sample used in the study consists of two indices i.e. MXC Agri Index and NCDEX Dhannya Index. The period of study is from 2007 – 2015 as data is available for NCDEX index from 2007 onwards and the same is taken for MCX Agri. Daily closing prices of both the indices are taken in order to evaluate the volatility effect of both the indices. Tools and techniques used are correlation, ADF t – Test, Garch (1,1) and Granger Causality Test in E- Views.

Before examining the linkage among both the indices the augmented Dickey-Fuller (ADF) unit-root test is performed to examine the stationary of the commodity market indices. The Dickey-Fuller test verifies the heterogeneously distributed errors by including lagged sequences of first differences of the variable in the data sets.

The null hypothesis of the Augmented Dickey-Fuller t-test is $\mathbf{H_0 = \theta = 0}$ (i.e. the data needs to be differenced to make it stationary) versus the alternative hypothesis of $\mathbf{H_1 = \theta < 0}$ (i.e. the data is stationary and doesn't need to be differenced).

In the time series models unit root is a characteristic of processes that evolve through time that can cause problems in statistical inference if it is not adequately dealt with. The testing procedure for the ADF test is the same as for the Dickey–Fuller test;

$$\Delta y_t = \alpha + \beta t + \Upsilon y_{t-1} + {}^{\delta}{}_1 \Delta y_{t-1} + \ldots + {}^{\delta}{}_{p-1} \Delta y_{t-p+1} + \varepsilon_t,$$

where 'α' is a constant, 'β' the coefficient on a time trend and 'p' the lag order of the autoregressive process.

For analyzing the transmission of volatility effects between both the indices, Generalised Autoregressive Conditionally Heteroskcedasticity model (GARCH) has been estimated. GARCH model allows the conditional variance to be dependent upon previous own lags apart from the past innovation. To model the volatility between MCX Agri Index and Dhannya Index, different

orders of GARCH can be evaluated. Since GARCH (1, 1) models are well fitted to the data series like index returns, GARCH (1, 1) models have been used in the analysis. If the coefficient of the same is significant, this confirms the presence of volatility. In other word, the residuals of MCX Agri Index and NCDEX Dhannya Index have been used in the volatility equation of agricultural commodity market.

The GARCH (1, 1) equation can be specified as follows:

$h_{t\ (MCX\ Agri)} = C + \beta_1\varepsilon^2_{t-1} + \alpha_1 h_{t-1} + \Omega_1(\text{squrresid}_{NCDEXDHANNYA})$

$h_{t\ (NCDEXDHANNYA)} = C + \beta_1\varepsilon^2_{t-1} + \alpha_1 h_{t-1} + \Omega_1(\text{squrresid}_{MCX\ Agri})$

Where $C > 0$, $\beta_1 \geq 0$, $\alpha_1 \geq 0$. In the equations, h_t is the conditional variance of MCX Agri, which is a function of mean C. News about volatility from the previous period, is measured as the lag of the squared residual from the mean equation (ε^2_{t-1}), last period's forecast variance (h_{t-1}) and the squared residual of Mcx agri and NCDEX Dhannya in the above equations.

The Granger causality test is the statistical hypothesis test for determining whether one time series is useful in forecasting the other time series. The Granger-causality test is based on the standard F statistic, which is calculated for each equation using the constrained and unconstrained form of each equation.

When the null hypothesis $\mathbf{H_0: \alpha_0 = \alpha_1 = \alpha_m = 0}$ is retained, it suggests that y(2,t) does not Granger-cause y(1,t). According to Granger causality, if a signal X_1 Granger-causes a signal X_2, then past values of X_1 should contain information that helps predict X_2.

DATA ANALYSIS

Correlation Analysis between "Mcx – Agri Index" and NCDEX "Dhannya Index"

Table-1: Co-relation Results between MCX Agri Index and NCDEX Dhannya Index

NCDEX Dhannya Index	Mcx Agri Index	
1	0.61918192	NCDEX Dhannaya Index
	1	Mcx Agri Index

Sources: Authors Compilation

On performing the co relationship test between both the indices i.e. evaluating the indices based upon the co- relation between them, we find out that there is positive co-integration between both the indices i.e. MCX Agri Index and NCDEX Dhannya. Hence, we can state that if there is increase in one index there will be increase in the other as the co relation between both the indices is up to 0.619. As the correlation co efficient is above 0.5, we state that both the variables are positively co related. Since the value of "r" is between 0 and 1 the two variables tend to increase or decrease together.

Positive correlation between MCX Agri Index and NCDEX Dhannya Index means if there is an increase in the MCX Agri Index, there will be an increase in the NCDEX Dhannya Index based upon value of correlation coefficient between both the indices. Similarly, if there is a decrease in any of the one index there will be proportionate decrease in the other index.

Here we see that there lies a positive co relationship between both the indices since the correlation co efficient is between 0 and 1 and above 0.5, hence we summarize that having co efficient value at 0.619 there exists positive co-relation between both the indices, i.e. MCX Agri Index and NCDEX Dhannya Index.

Evaluating the volatility effect of MCX Agri and NCDEX "Dhanya"

Unit Root Test of Variables

The presence of Unit Root Test of both the data series i.e. MCX Agri Index and NCDEX Dhannya Index has been verified by using Augmented Dickey-Fuller (ADF) t - test before carrying out GARCH and evaluating the volatility.

Hypothesis for Augmented Dickey-Fuller t-test

The null hypothesis: $\mathbf{H_0 = \theta = 0}$ (i.e. the data needs to be differenced to make it stationary) Alternative hypothesis of $\mathbf{H_1 = \theta < 0}$ (i.e. the data is stationary and doesn't need to be differenced).

At 95% confidence level i.e. 0.05 significance level, we reject Null Hypothesis if p value is less than 0.05 and do not reject the null hypothesis if the p value is more than 0.05.

Table-2: Unit Root Test results of MCX Agri Index and NCDEX Dhannya Index

Index	Null Hypothesis	ADF test (t) statistics	Probability
MCX Agri Index	MCX Agri Index has a unit root	-32.68534	0.0000
NCDEX Index	NCDEX Index has a unit root	-30.08250	0.0000

Sources: Authors Compilation

As seen from the above table, the probability value for MCX Agri Index and NCDEX Dhannya is less than 0.05 at 0.05 significance level; hence, we reject the null hypothesis, which states that there is unit root. Since the probability of both the indices is 0.0000 which is less than 0.05 we reject the null hypothesis and accept the alternate hypothesis which states that both the data series of the indices i.e. of MCX Agri Index and NCDEX Dhannya Index do not have unit root and the data is stationary and doesn't need to be differenced.

Since the data is stationary, we can further utilize both the data series of the indices for Garch and Granger Causality Tests so that the volatility can be determined between both the indices.

GARCH EQUATION

GARCH Equation for MCX Agri Index

GARCH = C(3) + C(4)*RESID(-1)^2 + C(5)*GARCH(-1) + C(6)*NCDEXINX

Table-3: The Result of the GARCH Equation for MCX Agri Index

Coefficients		Probability
C	1.351066	0.0000
A	0.109165	0.0000
B	0.815801	0.0000
NCDEXINX	-0.860120	0.0000

Sources: Authors Compilation

Since coefficient of RESID i.e. alpha is 0.10916 which measures the sensitivity is above 0.1, we can state that MCX Agri Index is sensitive to market events or even other market factors and the Index is said to be volatile i.e. volatility in MCX Agri Index would affect NCDEX Dhannya Index.

The Garch persistence parameter i.e. the Beta which measures the effect of volatility is 0.8158 is ranging between .80 and 0.90 limit, which means that the effects of α would last for a longer period of time .i.e. fluctuations or volatility would last for a longer period on the NCDEX DHANNYA Index. Since high, α which is associated with low β, would produce volatility of volatility, hence we draw the conclusion that MCX Agri Index is capable of affecting the NCDEX Dhannya Index.

On adding the coefficients to the equation, we derive the value 1.4159, which states that the volatility from the GARCH Model is relatively more for a longer period. Hence, there is more volatility in MCX Agri Index.

Garch Equation for NCDEX Dhannya Index

GARCH = C(3) + C(4)*RESID(-1)^2 + C(5)*GARCH(-1) + C(6)*MCXAGRI

Table-4: The Result of the GARCH Equation for NCDEX DHANNYA Index

Coefficients		Probability
C	0.022909	0.0000
A	0.068413	0.0000
B	0.893173	0.0000
MCXAGRI	-0.003500	0.0000

Sources: Authors Compilation

Since coefficient of RESID i.e. alpha is 0.06841 which measures the sensitivity is below 0.1, we can state that NCDEX Dhannya Index is not sensitive to market events or even other market factors and the Index is said to be less volatile i.e. i.e. volatility in NCDEX Dhannya Index would not affect MCX Agri Index.

The Garch persistence parameter i.e. the Beta which measures the effect of volatility is 0.8958 is ranging between .80 and 0.90 limit, which means that the effects of α would last for a longer period of time .i.e. less fluctuations or zero volatility would last for a longer period on MCX Agri Index. Since low, α which is associated with low β, would produce less or zero volatility of volatility, hence we draw the conclusion that NCDEX Dhannya Index is not capable of affecting the MCX Agri Index.

On adding the coefficients to the equation, we derive the value 0.9809, which states that the volatility from the GARCH Model is relatively less for a longer period. Hence, there is less volatility in NCDEX Dhannya Index.

PAIRWISE GRANGER CAUSALITY TESTS

Null hypothesis $\mathbf{H_0: \alpha_0 = \alpha_1 = \alpha_m = 0}$ (i.e. x_1 variable does not Granger Cause x_2 variable)

Table-5: Granger Causality Test Results for MCX Agri Index and NCDEX Dhannya Index

Index	Null Hypothesis	Lags	F-Statistic	Prob.	Remarks
NCDEX	NCDEX does not Granger Cause MCX	2	0.01665	0. 9835	Accept Null Hypothesis
MCX	MCX does not Granger Cause NCDEX	2	8.98409	0. 0001	Reject Null Hypothesis

Sources: Authors Compilation

Accept the Null hypothesis if P-value for the variable is more than 0.05 and reject the null and accept the alternate hypothesis if the p value is less than 0.05 at 0.05 Level of Significance.

From the above table we can determine that NCDEX Dhannya does not cause any effect on MCX Agri since probability is more than 0.9835, hence we accept the null hypothesis, which states that NCDEX Dhannya Index does not Granger Cause MCX Agri. But since probability value is less than 0.05 for MCX Agri Index i.e. the probability value for MCX Agri Index is 0.0001 at 0.05 level of significance; we reject the Null Hypothesis which states that MCX Agri Index does not Granger Cause NCDEX Dhannya Index. From this we can state that MCX Agri Index does have effect or can cause NCDEX Dhannya Index i.e. change in MCX Agri Index will cause a similar or significant change in the NCDEX Dhannya Index.

Since MCX Agri Index Granger Causes NCDEX Dhannya Index, then past values of MCX Agri Index should contain information that can help in predicting the future values of NCDEX Dhannya Index.

CONCLUSION

Since the indices are highly positively correlated, change in the MCX Agri Index will have the same change on NCDEX Dhannya Index and vice- versa. As there is correlation between both the indices the volatility test has been further performed in order to understand the effect of one index on the other. The study shows that there is volatility effect of MCX Agri Index on NCDEX Dhannya Index in the end since the results interpreted show a high volatility effect of MCX Agri Index on the other factors and in this study, it is NCDEX Dhannya Index. However, NCDEX Dhannya Index has zero or less volatility and does not affect MCX Agri Index. Hence, sensitive news will cause the MCX Agri Index to fluctuate in the commodity market, which will affect NCDEX Dhannya Index, and the volatility effect will be present for a long period in the market. Similarly, the Granger Causality test shows the result that NCDEX Dhannya Index does not cause any affect on MCX Agri Index but MCX Agri Index does cause an effect on NCDEX Dhannya. Hence, we can conclude that the volatility of MCX Agri Index has direct an effect on NCDEX Dhannya Index. Fluctuations or change in the MCX Agri Index will cause NCDEX Dhannya Index to fluctuate for a long period.

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