



Testing of Market Efficiency and Price Discovery in Indian Commodity Derivatives Market

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Abstract

This paper explores to test the presence of market efficiency and price discovery system in Indian commodity derivatives market. The study uses the time series techniques to test the market efficiency, long run equilibrium and short term dynamics and price discovery. the Johansen co integration test (1988) for long run relationship between spot and futures price, Vector Error Correction (VECM) Model for finding the short term dynamics in commodity prices, The Granger Causality (1969) for investigate causality between spot and futures prices, Augmented Dickey Fuller (ADF) test (Dickey and Fuller, 1979) and Philips-Parron test to check the stationarity in the prices of commodities. In the study ten commodities are selected, four agricultural commodities viz: Mentha oil, Guar Seed, Cotton and Cardamom, four non agricultural commodities (metals) viz: Gold, Copper, Zink and Silver and the remaining two commodities from energy commodities, Crude oil and Natural gas. The remark of study is long run market efficiency proved in only three commodities mentha oil, cotton and natural gas. The co integration reveals long term efficiency in achieving the equilibrium between the spot and futures prices.

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The causality reveals in few non agriculture commodities achieving price discovery, those commodities has international market linkage,

Key Words: *Commodity Futures Price, Spot Prices, Derivatives Market, Causality, Market Efficiency, Price Discovery,*

JEL Classification: C01, C12, C22, C58, C87, G13, G14

INTRODUCTION

The prices of commodities and securities generally determined by market forces like collective interaction of demand and supply. The speed, frequency and magnitude of price changes can increase the volatility in commodities and asset prices in general. Thus, the commodities are subject matter of our social fabrication; therefore, in any economic system commodity is an essential part to trade and exchange between and among the different set of people as producers and consumers. The commodity market is a central place in exchange process of commodities between traders, formers, manufacturers and business people.

The price risk is a key factor for commodities trading as many participants want to stabilise price either of the way, buy or sale. To stabilise the price risk in advance people or participants in market create the agreements or contracts to buy and sale the commodity on a future date with a settlement schedule at a pre determined price irrespective of price level in spot at the time of delivery of the commodity. Hence the commodity derivatives market efficiency in holds the price convergence by generation of symmetric information flow between the spot and futures market.

REVIEW OF LITERATURE

There is plethora of studies in the field since the existence of trading took place on commodities at India and the world. The important studies are reviewed and presented in a chronological order and examined the role of price discovery, market efficiency, hedging, and regulation system and future prospects to assess the performance of Indian commodity derivatives market specifically.

Shroff (1950) referred the Government of India draft bill on Introduction of Forward trading in India and recommended the introduction of forward trading helps in hedging, price stabilization, reducing the speculation. The study further advised to establish the trading rules and regulations, approved and managed by Government.

Kamara (1982) analyzed the impact of introduction of commodity futures by comparing the spot market volatility before and after introduction of commodity futures and found no significant change.

Kabra Committee Report³ (1993) advised to strengthen the Forward Market Commission (FMC) and Forward Contract Act, 1952 by means of improving infrastructure, telecommunication, functioning of the exchanges, adequate norms, automation of trading in exchanges, regulation to designing and trading of futures contracts, and establishing strong vigilance committee.

Silvapulle and Moosa (1999) examined the relationship between the spot and futures prices of WTI crude oil using a sample of daily data. Linear causality testing revealed that futures prices lead spot prices, but nonlinear causality testing revealed a bi-directional effect. This result suggests that both spot and futures markets react simultaneously to new information.

The National Agricultural Policy⁴, (2000) recommended to liberalize the agriculture and allied sector, enhance the infrastructure and information technology, the commodity exchanges has to launch futures contract on liquid commodities in the market.

Singh (2000) analyzed Efficiency of Indian Commodity Futures, advised optimizing the futures markets to discover the prices and minimize risk. According to him exchanges should be self regulated to curb speculation. The Government should minimize the intervention in pricing mechanism and should initiate private participation.

Sahadevan (2002) surveyed the recognized exchanges and their organizational, trading and the regulatory set up for futures trading in commodities and revealed that many of the commodity futures exchanges fail to provide an efficient hedge against the risk emerging from volatile prices of many farm products in which they carry out futures trading.

Chen and Firth (2004) analyzed the relationship between return and trading volume of four commodity futures in China, by using Correlation and Granger causality test. They found no correlation between return and volume, but signify the causality from trading volume and return, vice versa. They, however, found a correlation between absolute return and trading volume.

Bir (2004) investigated hedging performance of agricultural commodity futures market in terms of price discovery and risk management. The factors responsible for inefficient hedging in commodities were found as low volume, low participation, inadequate warehouse facility and deficient information system of commodity exchanges.

³Kabra Committee report (September, 1994) on forward markets, Ministry of Consumer Affairs, Food & Public Distribution, Government of India

⁴The National Agricultural Policy July 28,2000 Government of India

Wang and Ke (2005) analyzed the efficiency of the futures market for agricultural commodities in China found that long term equilibrium exists between futures and cash prices for Soybean. On the other hand, the comparison of wheat and soya bean futures reveals short term efficiency of Soybean futures market.

Zapata (2005) analyzed the unidirectional Granger causality from futures prices for world sugar on the New York Exchange and world spot price of sugar and found the futures market helps in price discovery in spot, and the flow of information is from futures to spot market but not vice versa.

Rouwenhorst and Gorton (2004&2005) analyzed the long term characteristics of investment in collateralized commodity futures contracts by creating a commodity futures weighted index covering period of July 1959 to December 2004. The results showed that there was higher historical index and spot market return during the sample period. Further the study was found that the commodity futures risk premium was higher than debt market return and equal to equity market return.

Ahuja (2006) analyzed the Commodity Derivatives market in India. And found that the commodity futures market in India has recorded spectacular growth to reach a one trillion mark in 2006. However, several challenges have to be overcome for further stability and persistent growth and development of the market.

Yang (2006) investigate the lead-lag relationship between trading activity and cash price volatility for major agricultural commodities the study concludes that Granger causality and generalized forecast error variance decomposition proved the unexpected and unidirectional flow in futures trading volume compelled to up in cash price volatility and also found the weak causal relatedness between open interest and cash price volatility exists

Liu and Zhang⁵ (2006) analyzed the Price discovery of Spot and Futures price in Chinese Copper, Aluminum, Rubber, Soybean and Wheat markets and found that lead lags relationship between spot and futures market is quite limited.

Abhijit Sen (2007) the committee revealed that there is no significant proof for price acceleration of agricultural commodity prices in post futures period, the period of study being very short to discriminate enough between the futures trading and the cyclical adjustments.

Lokare (2007) revealed significant co integration between futures and spot prices of selected commodities and had shown the slower operational efficiency. On the other hand, there was inefficient exploitation of available information to capture in the prices of futures contract.

⁵Liu and Zhang (2006) Price Discovery and Volatility spillovers: Evidence from Chinese Spot-Futures Markets, this paper is sponsored by Nature Science Funds of China (70573044&10371025)

Karande (2007) studied the castor seed futures traded in with Mumbai and Ahmadabad and evaluated three features of commodity futures market in India, viz basis risk, price discovery and spot price volatility. The result found that the price discovery was achieved and beneficial in spot price volatility market. On the other hand

Ram and Ashis (2007) concluded that agricultural commodity derivatives provide an efficient protection against the price volatility risk in terms of commodity prices, commodity exchanges offer a broad based platform for trading of agricultural and non agricultural commodities over time and space so the commodity exchanges need to be developed at national level.

IIM Bangalore⁶ (2008) Study found post futures period volatility increased, in spite of negative results of futures market, suggested to integrate the geographical separated markets, remove the incompetence is arising among the futures prices and futures spot prices, which was due to immature nature of the market, there are many obstruction in nature of the institutional and policy level constraints.

Kedarnath and Mukharjee (2008) investigated the impact of futures trading on Agricultural commodity market and found there is no significant change in spot prices post futures period in essential commodities, but a comparative advantage found through causality analysis proves bidirectional exists between futures and spot market through flow of information.

Bose (2008) found that information flow between the market helps in price determination. In spite of lesser degree of association in spot and futures indices, the agriculture commodity indices shows weak performance in price dissemination for predicting the futures prices than non agriculture commodity futures indices.

Nath and Lingareddy (2008) concluded that futures trading in the selected commodities escort to increase volatile in case of Urad, in case of Gram and Wheat prices moderately rise in post futures period not proved statistically significant.

Bhawna et al. (2009) they found the removal ban on commodities achieved the spectacular growth, achieved its objective as price risk management and price discovery and high untapped potential market growth in agriculture commodities.

IIT Bombay⁷ (2009) conducted a research study on behalf of Forward Market Commission (FMC) of India and found that seventy percent of population depends on agriculture commodities, and there is a need to liberalize the to manage the price risk through commodity futures.

⁶IIM B (2008) A study on Impact of Futures Trading on Agriculture Commodities, FMC Commissioned to Indian Institute of Management, Bangalore (IIMB)

⁷IIT Bombay (2009) Study on function and powers of FMC in regulation of Commodity Exchanges in India, on behalf of Forward market Commission of India

Sabnavis&Gurbandani (2010) analyzed global commodity markets. These markets have proved to be efficient price discovery mechanism in India and worldwide. Further Gurbandani (2010) found that both spot and future prices for selected agricultural commodities are efficient in weak form. Future prices are independent and past prices have no role in the contribution of future price prediction.

Basu and Gavin (2010) concluded that the investors are searching for the alternatives like high risky mortgage debt and financial derivatives market to mitigate the risk. The study also found that there is negative correlation between Equity market to Commodity futures return and it gives scope of bringing the arbitrage to exit hedging profits.

Shanmugam and Dey (2011). Have shown that the commodity market have performed better for all the stakeholders. There is an urgent need for new instruments in the commodity markets. In addition, the regulator has to develop stringent policies that can allow financial intermediaries like institutional investors, banks and mutual funds to benefit at gross root level.

Swati and Shukla (2011) concluded there is a need to convergence of all types of market like equity, commodity, forex and debt, should be developed and regulated properly to provide a wide-ranging risk management solutions to Indian stakeholders.

Gupta and Ravi (2012) investigated the relationship in price discovery proved that futures market are more responsive in dissemination information and price discovery to correct spot market.

Barua and Mahanta (2012) investigated the high inflationary pressure due to commodity derivatives. Few futures contracts like red gram, black gram, chickpeas, wheat, rice, potato, refined soybean oil and rubber have been canceled, but analysis proved that the ban on these commodity futures contract didn't bring price stability.

Popli and Singh (2012) revealed that commodity futures market was volatile in USA, U.K. and India. The comparison between US, U.K and Indian futures markets reveals the policy makers have to follow the clue from U.S and U.K regulation to promote and encourage investments in commodity derivatives market.

TarunSoni (2013) Nonlinearity in the Indian commodity markets: evidence from a battery of tests. the presence of nonlinearity in returns is considered as evidence against the efficiency of Indian commodity markets theory which characterizes data as random walk or more strictly a martingale

Kaur and Anjum (2013) carried out the study on agricultural commodity futures in India and found that in spite of development of commodity futures market, farmers and could not gain leverage from the market, as there is no integration between spot and futures market. They further found that due to lack of infrastructure and warehousing, regional exchanges could not penetrate to rural India

OBJECTIVES OF THE STUDY

The main objective of the study is to test the Market Efficiency, Price Discovery process in Indian commodity derivative market

HYPOTHESES OF THE STUDY

To ascertain the objective of the study the following hypotheses are undertaken and tested:

1. The Johansen co integration test for long term efficiency Price Discovery Mechanism

Ho: There is no co-integration vector (none, i.e. $r=0$) between spot and futures prices of select commodities

Ha: There is at least one co integration vector (at most 1, i.e. $r=1$) between select commodity spot and futures prices.

2. The Vector Error Correction Model (VECM) Efficiency in Short Term Price Discovery Mechanism

Ho: Theselect Spot Price and Futures price series convergent to Zero or positive

Ha: The select Spot Price and Futures price series divergent to Zero or positive

3. The Granger Causality test for the market efficiency and price discovery

Ho:The Select Commodity Spot Prices series do not granger cause Select Commodity Futures Prices series.

Ha: The Select Commodity Spot Prices series granger cause Select Commodity Futures Prices series.

4. The ADF and PP Test for stationarity in elect commodity Spot and Futures Prices series

Ho: The Spot and Futures prices are non-stationary at first difference I (1) level

Ha: The Spot and Futures prices are stationary at first difference I (1) level

DATA SOURCES AND METHODOLOGY OF THE STUDY

The study is analytical, empirical and conclusive in nature and it used secondary data collected through FMC annual reports and website of the Ministry of Consumer Affairs Further, the data pertaining to 10 active futures contracts are

select as sample out of 80 active futures contracts traded in MCX, each selected commodity are regularly traded, liquidity and settlement during in 2012 to 2013 taken as sample from agricultural and non agricultural category are Mentha oil, Guar Seed, Cotton and Cardamom and non agricultural commodities are Gold, Copper, Zink and Silver and other two are energy commodities, Crude oil and Natural gas.

LIMITATION OF THE STUDY

The accuracy of the results formed from the findings is subject to the validity and quality of the data collected from the secondary source, websites and annual reports, the period of data collected through selected 10 commodity futures contracts, which are actively traded in MCX during the period of 2012-2013.

METHODOLOGY OF THE STUDY

To test the market efficiency and long run equilibrium, tools Johansen co integration test (1988) have been applied. The Vector Error Correction (VECM) Model used to know the short term dynamic adjustments between the variables for the long run equilibrium. The Granger Causality (1969) used test the market efficiency to infer cause and affect relationship between two or more time series, the essentially to check stationarity of time series the Augmented Dickey Fuller (ADF) test (Dickey and Fuller, 1979) and Philips-Parron test have been applied.

Johansen Co integration Test

The price linkage between futures market and spot market is examined using co integration analysis that has reveals the extent to which two markets has moved together towards long run equilibrium.

$$Y_t = \alpha + A_1 Y_{t-1} + A_p Y_{t-p} + \epsilon_t$$

Where Y_t is a vector ($n \times 1$) integrated of first order denoted by $I(1)$, ϵ_t is an error term (vector ($n \times 1$) of innovations) and $A_1 \dots A_p$ are variables. The test comprises of two methods: the Maximum Eigen Value test and the Trace test which have been put to use.

Vector Error Correction Model (VECM)

The co integration test criterion between futures and spot market, if validated the residuals shows the deviation from the equilibrium and this equilibrium error in the long run tends to zero. Vector error correction model (VECM) used to capture the deviations from the long run equilibrium. In the case of VECM, a linear deterministic trend model is run only for the co-integrated price series, the model is represented by putting to an Ordinary Least Square in each equation.

$$\Delta S_t = a_{s,0} + \sum_{i=1}^{p-1} a_{s,i} S_{t-i} + \sum_{i=1}^{p-1} b_{s,i} F_{t-i} + \alpha z_{t-1} + \epsilon_{s,t}$$

Where, ΔS_t is the change spot price, measured by RHS (i.e.) $a_{s,i}$ $b_{s,i}$ being coefficients of spot price denote (S_t) and futures price (F_t) is and Z_t is the co

integration vector. The coefficient (α) of the error correction term (Z_{t-1}) indicates the speed at which the series returns to equilibrium. If it is less than zero, the series converge to long run equilibrium and if it is positive and zero, the series diverges from equilibrium. If the estimated error correction coefficient in futures prices is negative (positive), it indicates that decrease (increase) in the previous period's equilibrium error leads to a decrease (increase) in the current period spot price. Similarly, if the spot price coefficient is positive (negative), it implies that increase (decrease) in previous period equilibrium error leads to an increase (decrease) in current period spot price. Both the error correction coefficient suggests that sustainable long run equilibrium is achieved by bridging the gap between futures and spot prices. In efficient market, spot price rise to meet the futures price while futures price revert to spot price, and *vice versa*.

Granger Causality Test

Granger (1969) was developed a time series model in order to determine the causality between two economic time series variables, he intellect that one economic variable cause of another economic variable, if X can be usable in predicted value of accuracy of y with its past values.

Clarification of the model : the information set Ω_t with the form $(a_t, \dots, a_{t-j}, b_t, \dots, b_{t-k})$ it may conclude that a_t is granger causal for b_t , w rt, Ω_t if the variance of the optimal linear predictor of b_{t+k} based on Ω_t has small variance than the optimal predictor of b_{t+k} based on logged value of b_t for any h, thus a granger cause b if and only if $\sigma_1^2(b_t: b_{t-k}, a_{t-j}) < \sigma_1^2(b_t: b_{t-k})$ with j and k = 1,2,3...n and σ^2 representing the variance of forecast error. Granger Causality is based on the simple logic that effect cannot precede cause.

It is important to note that the statement “x Granger causes y” does not imply that y is the effect or the result of x. Granger causality measures precedence and information content but does not by itself indicate causality in the more common use of the term.

The different types of situation in which causality test may applied, in a simple granger-causality test there are two variable and their lags, in multi causality more than two variables and final causality also tested in a VAR frame work in this multivariate model extended.

$$S_t = \alpha_0 + \sum_{i=1}^m \beta_i (S)_{t-1} + \sum_{j=1}^n \gamma_j (F)_{t-1} + \varepsilon_t$$

$$F_t = \phi_0 + \sum_{i=1}^m \psi_i (F)_{t-1} + \sum_{j=1}^n \varphi_j (S)_{t-1} + e_t$$

Where S_t and F_t are two variable at time 't', I and j the number of lags, β_0 is deterministic, ε_t is error term, γ and β are coefficients on lagged S_t and F_t value respectively.

Where S_t and F_t are two variable at time 't', I and j the number of lags, ϕ is deterministic, e_t is error term, ϕ and ψ are coefficients on lagged S_t and F_t value respectively.

null hypothesis is $\psi_i=0$ for all I 's and j 's and $\psi_j=0$ for all j 's versus the alternative hypothesis that $\psi_i \neq 0$ and $\psi_j \neq 0$ for at least some I 's and j 's. if the coefficients ψ_i are statistically significant but ψ_j 's are not, then F_t causes S_t , but if both ψ_i and ψ_j are significant, than causality bidirectional.

ANALYSIS OF STATIONARITY

In economic time series variable analysis is vital to test the time series parameters before undertaking any econometric estimation and relationship. The unit root test examines the stationarity, which help us to understand series that has a trend, as well volatility and economic relation between time series data. In order to determine the order of integration of each spot and futures commodity price series, first the researcher tested whether select commodities, spot and futures prices are stationarity or not?. The Augmented Dickey Fuller (ADF) test performed one level from each commodity price series. The test on such series are tested for stationarity at 5% significant level at the first difference $I(1)$ of commodity and futures price series as the null hypothesis states the existence of unit root in the series. The optimal lag length of each difference series is tested by Akaike Information Criterion (AIC). The analysis is presented through table 1 very clearly to understand the things that are discussed above.

Table no 1
Analysis of stationarity test (Unit Root)

Commodity price series	Unit Root Results				Based SIC
	ADF (T stat)	Test 5%Critical value	PP TEST (T stat)	Test 5%Critical value	Lag value
MENTHAOIL F	-7.739125	-2.890327	-7.520867	-2.890327	12
MENTHAOIL S	-10.75077	-2.890327	-10.72190	-2.890327	12
GOLD F	-13.67881	-2.875538	-13.67951	-2.875538	14
GOLD S	-9.266480	-2.875608	-15.02194	-2.875538	14
GUAR SEED F	-5.598554	-2.963972	-5.622800	-2.963972	7
GUAR SEED S	-6.379255	-2.963972	-6.313730	-2.963972	7
NATURAL GAS F	-7.387539	-2.900137	-7.487058	-2.900137	11
NATURAL GAS S	-8.920667	-2.900137	-7.487058	-2.900137	11
COPPER F	-16.01529	-2.875680	-15.90431	-2.875680	14
COPPER S	-17.29847	-2.875680	-17.45196	-2.875680	14
SILVER F	-14.76874	-2.875680	-14.78821	-2.875680	14
SILVER S	-15.37618	-2.875680	-15.33073	-2.875680	14

COTTON F	-10.95543	-2.882590	-10.92273	-2.882590	13
COTTON S	-11.59789	-2.882590	-11.65557	-2.882590	13
NICKEL F	-10.25006	-2.890037	-10.24974	-2.890037	12
NICKEL S	-8.184274	-2.890327	-9.655737	-2.890037	12
CRUDEOIL F	-13.10294	-2.880336	-13.08367	-2.880336	13
CRUDEOIL S	-15.22291	-2.880336	-13.08367	-2.880336	13
CARDAMOM F	-8.102876	-2.899115	-8.026652	-2.899115	11
CARDAMOM S	-8.420359	-2.899115	-8.026652	-2.899115	11

Results and Discussion

Table 1 depicts that the ADF and Phillip Parron unit root test analyzed the stationarity in the select commodity price series, which are essentially pre-requisite to implement the time series econometric tools. The ten select commodities, mentha oil, gold, guar seed, natural gas, copper, silver, cotton, nickel, crude oil and cardamom's spot and futures price series were non stationary at the level tested, but registered the stationarity, that can be observed from the analysis. Test statistics shows the result at 5% significance at first difference I (1) of prices considerably. Hence, the stationarity tests conducted on select commodities spot and futures price series sets show that the stability is found at first difference and acquiescent for cointegration analysis.

JOHANSEN'S COINTEGRATION TEST BETWEEN SELECT COMMODITY PRICES

Johansen cointegration analysis elucidates the price association between futures and spot prices of commodities in long run equilibrium. Stationarity test proves that if two or more time series are themselves non stationary, but the linear combination of them is stationary, then the series is said to be co-integrated. As each commodity spot and futures prices are integrated of the same order, cointegration technique is used to determine the existence of stable long run relationship between the prices of commodity pairs. The cointegration analysis make known to two markets have moved together towards long run equilibrium and it allows for divergence of respect markets as long run equilibrium in the short run. The co-integrating vector identifies the existence of long run equilibrium while error correction dynamics describes the price discovery process that helps market to achieve equilibrium. In addition, it is theoretically claims that if futures and spot indices co-integrated it implies presence of causality at least in one direction. If some level series are integrated over the same order it does not mean that both level series are integrated. Cointegration implies linear combination of both series cancelling the stochastic trend, thereby producing stationary series. Therefore, Johansen cointegration test carried out to determine the existence of long run relationship between the select commodities, mentha oil, gold, guar seed, natural

gas, copper, silver, cotton, nickel, crude oil and cardamom spot and futures prices of the commodities pairs (See table 2 for details).

Table 2

Johansen's Cointegration test analysis

commodity	Cointegration equation	Trace test		Prob.**	Max. Eigen value		Prob.**	Lags
		statistics	Critical value 0.05		statistics	Critical value		
MENTHAOI L S&F	None*	16.11901	15.49471	0.0402	12.73353	14.26460	0.0860	12
	Almost 1	3.385476	3.841466	0.0658	3.385476	3.841466	0.0658	
GOLD S&F	None	4.161466	15.49471	0.8901	4.161452	14.26460	0.8419	14
	Almost 1	1.37E-05	3.841466	0.9991	1.37E-05	3.841466	0.9991	
GUAR SEED S&F	None	7.767384	15.49471	0.4906	6.184874	14.26460	0.5896	7
	Almost 1	1.582510	3.841466	0.2084	1.582510	3.841466	0.2084	
NATURAL GAS S&F	None *	18.69752	15.49471	0.0159	15.87530	14.26460	0.0276	11
	Almost 1	2.822224	3.841466	0.0930	2.822224	3.841466	0.0930	
COPPER S&F	None	8.638310	15.49471	0.3999	5.957276	14.26460	0.6187	14
	Almost 1	2.681034	3.841466	0.1015	2.681034	3.841466	0.1015	
SILVER S&F	None	7.963708	15.49471	0.4693	6.282028	14.26460	0.5773	14
	Almost 1	1.681680	3.841466	0.1947	1.681680	3.841466	0.1947	
COTTON S&F	None*	19.63988	15.49471	0.0112	13.97509	14.26460	0.0555	13
	Almost 1	5.664794	3.841466	0.0173	5.664794	3.841466	0.0173	
NICKEL S&F	None	14.32775	15.49471	0.0744	14.00493	14.26460	0.0549	12
	Almost 1	0.322811	3.841466	0.5699	0.322811	3.841466	0.5699	
CRUDEOIL S&F	None	4.912760	15.49471	0.8180	2.955505	14.26460	0.9497	13
	Almost 1	1.957255	3.841466	0.1618	1.957255	3.841466	0.1618	
CARDAMO M S&F	None	11.22320	15.49471	0.1982	8.524442	14.26460	0.3279	11
	Almost 1	2.698762	3.841466	0.1004	2.698762	3.841466	0.1004	

Lags interval (in first differences): 1 to 4

Lags are selected based on Schwarz Information Criterion (SIC)

Trace test indicates 1 cointegrating equation(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

Results and Discussions

The Johansen co-integration test analysis presented through table 2 shows that the t-statistics and critical value analysis Trace statistics and Maximal Eigen Value statistics are used to interpret whether null hypothesis of $r=0$ is rejected at 5% significance level or not?⁸ The select ten commodities pairs of spot and futures prices of mentha oil, gold, guar seed, natural gas, copper, silver, cotton, nickel, crude oil and cardamom spot and futures prices were tested with trace and Maximal Eigen value test and compared with the t-statistics. The test analysis shows that mentha oil, natural gas and cotton test statistics were higher than t-statistics, hence, the outcome is rejection of the null hypothesis, which means that there exists more than one co-integrating equation that exists between spot and futures markets. Whereas, in the case of gold, guar seed, copper, silver, nickel, crude oil and cardamom null hypothesis was not rejected, as the trace and Maximal Eigen values statistics were lower than t- critical value. It states that there is no co-integration vector between spot and futures prices of these commodities by at least one. The connotation of co-integration is that the commodity prices in two different markets react disproportionately to the pricing information in short run but the convergence will happen in long run. From this analysis it can be asserted that long run market efficiency proved in only three commodities, mentha oil, cotton and natural gas, but, in precious metal and industrial commodities there was no evidence over market efficiency. It states that the spot and futures markets are not achieving equilibrium in fact response to the new information flow in the market not be reaching at the end. Thus there is a scope of information asymmetry, due to such scenario the futures market still creeping as weak form of market efficiency.

EFFICIENCY IN PRICE DISCOVERY MECHANISM IN SHORT TERM

Once test for cointegration between futures and spot market is performed in long run equilibrium, accordingly the granger representation theorem, if two variable futures and spot are co-integrated, then the relationship between two can be expressed as Error Correction Model ECM (Gujarathi, 2005), hence, the Vector Error Correction Model (VECM) employed to probe price discovery process in spot and futures market of select commodities mentha oil, gold, guar seed, natural gas, copper, silver, cotton, nickel, crude oil and cardamom. The coefficient of error correction term indicates that the speed at which series prices to equilibrium, if it is less than Zero, the series convergence to long run equilibrium and if positive and zero the series diverges from equilibrium. It has estimated error correction coefficient in futures price is negative or positive, it indicates that decrease (increase) in the previous period's equilibrium error leads to a decrease (increase) in the current period spot price vice-versa. Both error correction coefficients suggests that sustainable long run equilibrium is achieved by filling the gap between futures

⁸ Rejection of null hypothesis implies that there exists at least one cointegration vector, which confirms a long run equilibrium relationship between two series as select commodity spot and Futures prices.

and spot prices persuades itself. In efficient market, spot price to meet the futures price while futures price revert to spot price and vice-versa.

The Johansen co integration test reveals the long run equilibrium between spot and futures prices of three commodities they are: mentha oil, natural gas and cotton, justifying the use of use of Vector Error Correction Model (VECM) for showing the short term dynamics and differences (See table 3 for details).

Table no 3

Vector error correction model test the short term dynamics to achieve long run equilibrium

commodity	Coefficient value	Standard error	T statistics	Inference
MENTHAOIL F	-0.155373	(0.14115)	[-1.10074]	Spot market corrects faster towards equilibrium. Futures leads spot
MENTHAOIL S	0.204235	(0.08373)	[2.43926]	
NATURALGAS F	0.223069	(0.12305)	[1.81284]	Futures market marginally corrects towards equilibrium. Futures leads spot
NATURAL GAS S	0.205775	(0.06466)	[3.18234]	
COTTON F	-0.019321	(0.05286)	[-0.36550]	Spot market corrects faster towards equilibrium. Futures leads spot
COTTON S	0.114475	(0.03691)	[3.10142]	

Note:* T test bench mark above 1.80

Lags are selected based on Schwarz Information Criterion (SIC)

Results and Discussion

Table 3 marked for VECM. The results indicates the estimated error correction coefficient negative at -0.15 for futures price and for spot price it is 0.20 for mentha oil; it gives -0.019 futures and 0.11 spot for cotton, whereas, in the case of natural gas coefficients are found at 0.22 for futures and 0.20 for spot. This analysis states that how quickly the depend variable such as spot and futures prices absorb and adjust themselves for previous period disequilibrium errors. On the other hand, the coefficients measured the ability of prices to incorporate economic shocks in prices, in this analysis; futures and spot markets absorbed 15% and 8% in case of mentha oil, 1.9% and 11% for cotton, and 22% and 20% for natural gas respectively. This trend has been led to bring the equilibrium. It can be asserted that the information flow is more in futures market as evident by magnitude of the coefficients of mentha oil and cotton -0.15 and -0.019 respectively, whereas natural gas magnitude of coefficients at 22%. It stands for the meaning as spot market

information highly influences the futures market exploring its intrinsic price under discovery mechanism.

CAUSALITY BETWEEN SELECT SPOT AND FUTURES COMMODITY PRICES - ANALYSIS OF AN INDIAN FUTURES MARKET.

Granger (1969) is a time series data based approach, that infers cause and effect relationship between two time series economic variable known as Granger causality. In Granger intellect a simple logic that effect significantly cannot precede cause, once co-integration established it is imperative to find the causality to assess direction of relation between the variable, if two or more variable are possibly establishing the long run relationship and one variable may cause another variable in prediction as well as causation. The present study analysing commodity spot market prices converses themselves as futures market prices and vice-versa. Besides, it also dwells on the Granger cause of futures market commodity prices and spot market commodity prices in analytical way (See table 4 for details).

Table 4

Ganger causality test analysis of selected commodities

Null hypothesis: commodity wise	F-Statistics	Probabi lity value	Direction of causality	lags
MENTHAOIL S does not Granger Cause MENTHAOIL F	1.21468	0.2922	No causal direction	12
MENTHAOIL F does not Granger Cause MENTHAOIL S	1.09003	0.3831		
GOLD S does not Granger Cause GOLD F	1.86916	0.0332	Bidirectiona l causality	14
GOLD F does not Granger Cause GOLD S	11.6566	2.E-18		
GUAR SEED S does not Granger Cause GUAR_SEED F	1.49965	0.2706	No causal direction	7
GUAR SEED F does not Granger Cause GUAR_SEED S	0.95803	0.5072		
COPPER S does not Granger Cause COPPER F	0.56406	0.8897	Unidirection al Futures granger cause spot	14
COPPER F does not Granger Cause COPPER S	35.1221	1.E-41		
SILVER S does not Granger Cause SILVER F	0.86279	0.6002	Unidirection al Futures	14
SILVER F does not Granger Cause	10.6221	9.E-17		

SILVER S			granger cause spot	
COTTON S does not Granger Cause COTTON F	0.80653	0.6519	No causal directional	13
COTTON F does not Granger Cause COTTON S	1.35606	0.1947		
NICKEL S does not Granger Cause NICKEL F	1.11683	0.3618	Unidirection al Futures granger cause spot	12
NICKEL F does not Granger Cause NICKEL S	6.43058	2.E-07		
CRUDEOIL S does not Granger Cause CRUDEOIL F	0.64815	0.8086	Unidirection al Futures granger cause spot	13
CRUDEOIL F does not Granger Cause CRUDEOIL S	47.7715	4.E-40		
CARDAMOM S does not Granger Cause CARDAMOM F	2.06332	0.0433	Unidirection al Spot granger cause Futures	11
CARDAMOM F does not Granger Cause CARDAMOM S	1.10995	0.3754		

Significance at 5%, Lags are selected based on Schwarz Information Criterion (SIC)

Analysis and Discussion

Table 4 provides result of causality analysis tests. It is evident from the table that the spot prices does not granger cause futures and futures does not granger cause spot. Hence, the rejection of null hypothesis infers that spot prices granger cause futures prices and vice-versa. There are ten commodities, mentha oil, gold, guar seed, natural gas, copper, silver, cotton, nickel, crude oil and cardamom were selected and tested under the causality and direction of the prices. The commodities, mentha oil, guar seed and cotton show that there is no causality between spot and futures prices, it can be concluded that spot and futures prices are independent. The gold spot and futures prices shows the bidirectional causality, it can be concluded that in gold commodity spot and futures prices leads concurrently and price discovery happened in both sides i.e, spot and futures market, hence, they achieved the long run equilibrium of market efficiency. On the other hand, commodities, copper, silver, nickel, crude oil and cardamom shows the unidirectional causality between spot and futures prices, the information flow happened form futures to spot market and futures prices leads spot prices in case of copper, silver, nickel and crude oil in price discovery mechanism, whereas cardamom results registered unidirectional, thus spot prices led futures prices, hence, it can concluded that spot market works as price discovery mechanism. At

the end it can be inference that except three commodities, mentha oil, guar seed and cotton, remaining seven sample commodities, gold, copper, silver, nickel, crude oil, and cardamom moved through the causality in either of the direction of causality and price discovery mechanism, hence, we can assert that the market efficiency of Indian commodity futures markets is to take-off in the days to come.

FINDINGS AND CONCLUSION OF THE STUDY

1. It is found that the select ten agricultural, Mentha oil, Guar Seed, Cotton, and Cardamom, and non agricultural commodities, Gold, Copper, Zink, Silver, Crude oil and Natural gas performance found by price discovery, long term market efficiency, short term dynamics, causality between spot and futures of commodities.
2. The stationarity found through the ADF and Phillip Parron unit root tested ten selected commodities mentha oil, gold, guar seed, natural gas, copper, silver, cotton, nickel, crude oil and cardamom spot and futures price series, it makes possible to every time series econometric tools to investigate the existences of long run relation between the selected commodities price series.
3. The Johansen's co integration analysis of select ten commodities pairs of spot and futures prices of mentha oil, gold, guar seed, natural gas, copper, silver, cotton, nickel, crude oil and cardamom spot and futures prices. The test analysis shown that mentha oil, natural gas and cotton exists more than one co integrating equation exists between spot and futures market. Whereas gold, guar seed, copper, silver, nickel, crude oil and cardamom not found evidence that there is co-integration vector between spot and futures prices of these commodities by at least one. The connotation of co integration is that the commodity prices in two different markets react disproportionately to the pricing information in short run but the convergence will happen in long run, from this analysis it can be concludes that long run market efficiency proved in only three commodities mentha oil, cotton and natural gas, but in precious metal and industrial commodities shows there is no evidence in market efficiency, it means spot and future market is not achieving equilibrium in fact response to the new information flow in the market not be reaching at the end, so still there is a scope of information asymmetry, hence it can say that futures market still weak form of market efficiency in few commodities even though highly liquid contracts such as gold, silver, copper, crude oil, nickel, cardamom and guar seed.
4. The Vector Error Correction Model (VECM) found that the estimated error correction coefficient negative at -0.15 for futures price and 0.20 for spot price of mentha oil, for -0.019 futures and 0.11 for spot prices of cotton, where as natural gas coefficients are 0.22 for futures and 0.20 for spot prices. This analysis shows how quickly the depend variable such as spot and futures prices absorb and adjust themselves for previous period disequilibrium errors. The other hand the coefficients measures the ability of prices to incorporate economic shocks in prices, in this analysis futures and spot market absorb 15% and 8% in case of mentha oil, 1.9% and 11% for cotton,

and 22% and 20% for natural gas respectively to bring about the equilibrium. The information flow is more in futures market as evident by magnitude of the coefficients of mentha oil and cotton -0.15 and -0.019 respectively, whereas natural gas magnitude of coefficient 22% means spot market information more influence in futures market to adjust price discovery.

5. It is found that causality tests of select commodities mentha oil, guar seed and cotton shows that there is no causality between spot and futures prices and as well as futures and spot prices, it can be concluded that spot and futures prices behavior follows independently. The gold spot and futures prices shown the bidirectional causality, it is concluded that in gold commodity spot and futures prices leads concurrently and price discovery happened in both sides spot and futures market and achieved the long run equilibrium of market efficiency. On the other hand commodities copper, silver, nickel, crude oil and cardamom shows the unidirectional causality between spot and futures prices, the information flow happened form futures to spot market and futures prices leads spot prices in case of copper, silver, nickel and crude oil in price discovery mechanism, whereas cardamom results follows unidirectional and spot prices leads futures prices, hence it can conclude that spot market leads price discovery mechanism, at the end it is refer that except three commodities mentha oil and guar seed and cotton remaining seven sample commodities gold, copper, silver, nickel, crude oil, and cardamom shown the causality either of the direction of causality and price discovery mechanism. It further infers there is scope of market efficiency Indian commodity futures market.

THE MANAGERIAL IMPLICATION

The research findings reveal long term efficiency in achieving the equilibrium between the spot and futures prices. The both markets react disproportionately to the pricing information in short run, so still there is a scope of information asymmetry cause futures market still weak form of market efficiency, which gives scope of high speculation in trading and difficult in achieving the price discovery and risk management. The regulators has to control the high speculative trading and build the confidence among the market participants. The causality reveals in few non agriculture commodities achieving price discovery, those commodities has international market linkage, on the other hand few agricultural commodities has unidirectional helps in achieving the price discovery in spot and futures market. The market integration has to be improving between spot and futures market by establishing the effective communication, transparency and easy trading and settlement facilities.

The market integration has to be improving between spot and futures market by establishing the more number of commodity spot and futures exchanges at tier two cities and integrate with national exchanges. The massive awareness programs have to conduct to clarify the complexity of derivatives trading and

information dissemination. Hence there is need to focus exploring the data though open source

The Commodity Derivatives Market taken under regime of Securities Exchange Board of India (SEBI), the dynamism of commodity derivatives quite different to financial markets it's a new challenge to regulate and develop the harmony between financial and commodity markets, we hope it regulate and make new heights of the commodity derivatives market too.

SCOPE FOR FURTHER RESEARCH

The present study is the market efficiency and price discovery process with limited select commodities, there are more scope for examine other commodity contracts. Further lot of scope to investigate and research into macro economic factors that influence the market performance and study for price discovery, hedging practices by the industry, need for introduction of new instruments in the market, the trading and settlement issues related to risk management, further the integration of commodity market with financial markets etc.

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