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An Empirical Anecdote of Price Discovery in Indian Spot and Future Commodity Markets

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ABSTRACT

Risk management is very critical for the organization to survive and compete in the present day business environment. From the last two decades derivatives are popular as less costly and efficient risk management tools. The increased use of derivatives as risk management vehicle is basically due to their ability to predict future cash flows. Future cash flows can be predicted more accurately in derivatives if we understand the process of price discovery. Price discovery is the process of incorporating information produced and transmitted across spot and future markets in the commodity price. Both spot and future commodity markets react to the similar information but which market first react first is important for us because this market acts as market leader in price discovery. This piece of research tries to analyses the price discovery behavior of four indices i.e. mcx Comdex, mcx metal, mcx agri and mcx energy for the period 1st January 2006 to 31st December 2012. The data is first verified for stationarity by using Augmented Dickey Fuller Test (ADF) and Phillips-Perron (PP). ADF & PP Test unveiled that the data has unit root which means the data is not stationary. The data is converted into stationary time series by taking their first difference. Johansen Co-integration Test reveals a long run co-integration between the spot and future prices of all indices taken for the study. To test the short run Cointegration VECGranger Causality method was used which predict a short run bi-directional relationship between the spot and future prices of all commodities. No lead lag relationship has been found between the spot and future prices of all the indices taken for study.

1. Background

Derivative is an asset class whose value depends upon underlying asset which is known as underlying/base. The underlying/base can be a currency, stock, index or commodity etc. An important role of derivative markets is price discovery and same is witnessed by commodity derivatives. In static sense price discovery is the process by which market try to reach at an equilibrium price. Price discovery is important function of derivative markets which means revealing information about future cash market prices through the futures market. Derivatives markets provide a mechanism by which diverse and scattered opinions of future are collected into one readily discernible number which provides a consensus of knowledgeable thinking. Understanding price discovery behavior helps to identify appropriate hedging opportunities in the volatile derivative market. Price discovery can also be studied with the help of contango and backwardation. These two situations arise in the derivative markets due to difference in the price volatility of a commodity in one of the markets. If the spot prices are more volatile than the future prices it is called as backwardation which means that spot market react to the new information first. Whereas a situation when price volatility is high in future markets and it is the future market which reacts to the new information in the market first is known as contango.

2. Review of literature

Kumar, Gupta and Taneja (2018) empirically examined gold and gold guinea contracts from MCX and revealed a bi-directional causality relationship between their spot and future prices.

Irfan and Hooda (2017) analysed ten agriculture commodities traded on NCDEX and found a uni-directional relationship between their spot and future prices.

Sridhar, Sumathy, Sudha and Ambrose (2016) analysed spot and future prices of sliver and found that price discovery take place in spot market and from here volatility spillover to future market. Hence spot market acts as price leader in price discovery. They empirically rejected bidirectional relationship between spot and future prices of silver and has used ganger causality test.

Isha Chhajed and Sameer Mehta (2013) revealed that price discovery function vary from commodity to commodity and in most of the cases there exist a bi-directional causal relationship between spot and future commodity prices.

Prashanta and Gopala Rao (2013) analysed MCX comdex index by advanced econometric tools and found that future prices shows leadership in price discovery and has strong influence in deciding spot prices as predicted by CCF plot and multiple regression.

Sehgal, Rajput and Deisting (2013)analysed twelve active commodities being traded on MCX and empirically confirmed the role of future markets in price discovery for eight commodities.

Kushankur D and Debasish M (2012) examined price discovery in pepper spot and future markets. The study inferred that incorporation of shock as well as innovations is faster in future markets in comparison to spot markets.

Srinivasan P (2012) examined price discovery in MCXAGRI, MCXENERGY, MCXMETAL and MCXCOMDEX using VECM and observed the dominant role of spot markets in price discovery. The paper also highlight that volatility spillover takes place from spot market to future markets is dominant.

Srinivasan & Ibrahim (2012) used a Bivariate ECM-EGARCH (1,1) model to find out Price Discovery and Asymmetric Volatility Spillovers in spot and future prices of gold being traded on NCDEX. They concluded that volatility spillover from spot to future is strong in comparison to volatility spillover from future to spot markets.

Sarkar A. K and Shailesh Rastogi (2011) studied spot and future prices of gold and silver and came to the conclusion that price discovery takes place in future markets.

N. Kumar & Arora (2011) concluded that future markets leads in price discovery after analyzing spot and future prices of gold being traded at MCX. They have used data from June 2005 to December 2009.

Ivanov & Jose(2011) have done an elaborate study of relative price discovery on 30 Indices and commodity markets and concluded that in majority of Indices price discovery take place in future markets. They have used Gonzalo and Grauper permanent transitory methodology.

VishwanathanIyer and Archana Pillai (2010) also confirmed that price discovery takes place in future market in five commodities taken for studyin NCDEX.

Pantisa Pavabutr and Piyamas Chaihetphon (2009) used nascent gold future contracts from MCX and concluded that future markets leads in price discovery in both mini and standard contracts.

Mahalik, Debashis and Babu (2009) studied four spot and future indices of Multi Commodity Exchange of India. They found that information flows from future to spot markets in case of MCX Agri, MCX Energy and MCX Comdex but no such relation have been noticed in MCX Metal.

Pravakar (2009) showed that the future market is more efficient than spot markets in five commodities i.e chana, petroleum crude gold, copper and soya oil.

Biswat Pratap Chandra (2009) argued that there is a long run co-integration between spot and future markets. The direction of flow of information is from future markets to spot markets thus future markets leads in price discovery.

SalvadiEaswaran and Ramasundaram (2008) shows that market depth and volume are not much affected by volatility of spot and future markets which are not integrated themselves.

Praveen and Sudhakara (2006) have done very interesting study where they have tried to compare the price discovery process between commodity future markets and stock markets. They have used gold futures contracts traded on MCX and Nifty future traded on NSE.

It was empirically concluded that gold future prices are first to respond to the new information and effect the spot prices of gold. A clear lead lag relation is found in commodity markets, whereas spot prices of Nifty are indifferent to one month Nifty future prices but are effected by Nifty future.

Gupta and Belwinder (2006) analysed price discovery in spot and future prices of NSE and found a bilateral causality relationship.

Mukherjee and Mishra (2006) studied Nifty spot index and Nifty future index and found a bi-directional causal relationship among the spot and future prices.

Fu and Qing (2006) found a bidirectional relationship between spot and future markets of china, with sufficient empirical evidences supporting long term equilibrium between two markets. They used Johansen co-integration, VECM and bi-variate EGARCH model to support their argument.

Liu and Zhang (2006) have found limited lead lag relationship between spot and future prices of copper, aluminum, rubber, soybean and wheat in Chinese commodity market. They also noticed that volatility in spot market is greater that future market for some commodities.

Sahi G.S (2006) have found that introduction of future contracts cause volatility in the prices of underlying commodities thus destabilizing effect of future markets on spot markets was noticed.

Zhong, Maosen, Ali F.Darrat and Rafael Otero (2004) found that future markets cause instability in spot markets thus future price index can acts as price discovery vehicle.

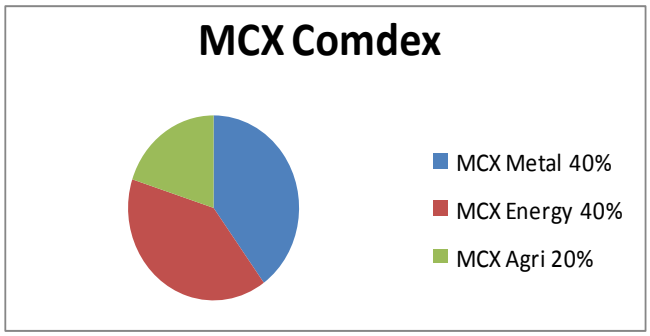
Raju and Karande (2003) discovered that price discovery in both spot and future markets takes place simultaneously but future prices are first to deviate from the equilibrium.

3. Gap Analysis

Many studies have been done on commodity derivatives in the developed world. But in India commodity derivative trading has a short history so comprehensive empirical studies for a vast majority of contracts are missing. The organised derivative trading in India started in 2003 in small number of commodities. The frequent bans on future trading of many commodities was also a discouraging factor to undertake this venture. Although there are some efforts to explore different aspects of derivative markets in India but most of these efforts are concentrated on study of agriculture commodities. This paper tries to bring forth a comprehensive empirical investigation of price discovery in

four important indices of Multi-Commodity Exchange (MCX) i.e MCX Comdex, MCX Agri, MCX Energy and MCX Metal from a period spanning from 2006 to 2012. This piece of research is also an effort to evaluate the results of past studies done on these indices. This piece of research is a comprehensive empirical effort to investigate price discovery in agriculture, metal and energy commodities being traded on Multi-Commodity Exchange.

Figure 1.1 Displays the constituents of MCX Comdex Index and their respective weightage



4. Objectives of study

1. To study the price discovery in spot and future prices in four indices.
2. To study the lead lag relationship in the spot and future prices of the indices.
3. To study the efficiency of spot and future markets in price discovery.

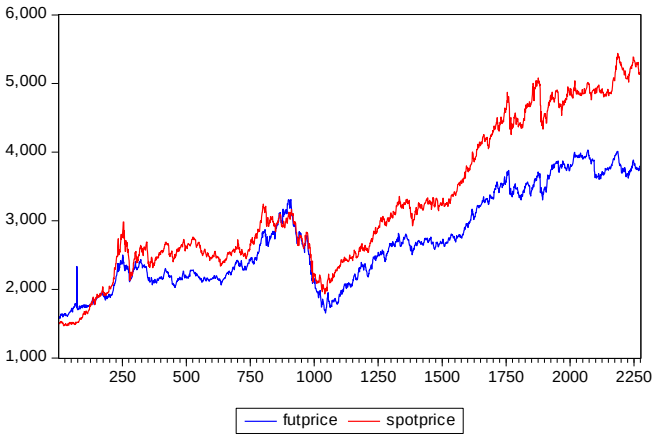
5. Research methodology

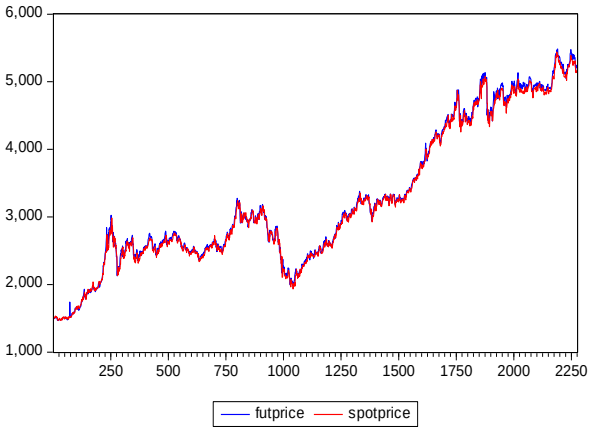
Sample Collection

This piece of research is based on secondary data which is collected for the period 1st January, 2006 to 31st December, 2012. The spot and future prices for MCXCOMDEX, MCXAGRI, MCXENERGY and MCXMETAL are collect from the official website of Multi-Commodity Exchange. The analysis used the daily closing future prices with daily spot prices of the indices for the above period.

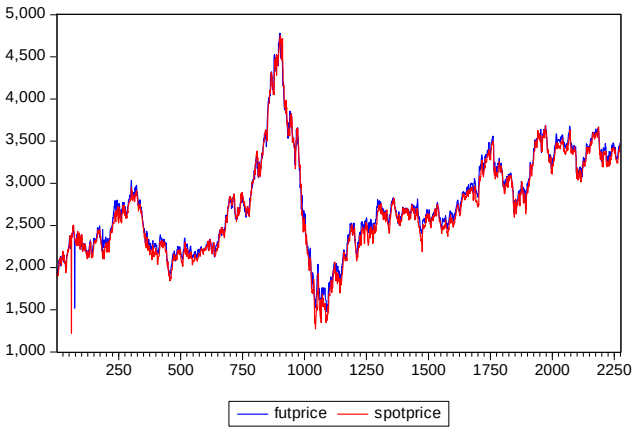
Figure 1.2 Displays the spot and future price raw series

MCX COMDEXMCX METAL

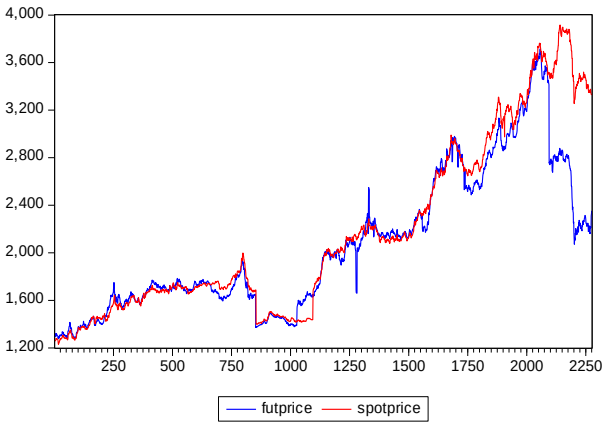




MCX ENERGY



MCX AGRI



Statistical Tools

For investigating into price discovery process E-views 9 software has been used. The data is first verified for stationarity by using Augmented Dickey Fuller Test (ADF) and Phillips-Perron (PP). ADF & PP Test unveiled that the data has unit root which means the data is not stationary. The whole data is converted into stationary time series as time series analysis is not performed on non-stationary data. The time series is converted into stationary time series by taking their first difference. In order to examine long run co-integration between the spot and future prices of indices Johansen Co-integration Test has been employed. This analysis involves selection of

appropriate lag which has been done by using VAR Lag Order AIC criteria. In order to investigate lead lag relationship between the spot and future prices of commodity indices Vector Error Correction Granger Causality Test was employed.

6. Estimation of Results

Raw data and not the data of the variables is used to find the descriptive statistics such as mean, standard deviation, skewness etc. for spot and future prices of four indices. The results are presented in the table below.

Table 1.1 Descriptive statistics for the raw data of spot and future prices of indices.

Indices	Mean	Std. Dev.	Skewness	Kurtosis	J-Bera	Prob.**
MCX COMDEX FUTURE	2709.263	681.1116	0.384914	1.912116	168.4361	0.000000
MCX COMDEX SPOT	3232.361	1064.761	0.493684	2.042915	179.3209	0.000000
MCX METAL FUTURE	3260.779	1079.496	0.499104	2.057709	178.6973	0.000000
MCX METAL SPOT	3232.361	1064.761	0.493684	2.042915	179.3209	0.000000
MCX ENERGY FUTURE	2758.693	573.2764	0.587525	3.281672	138.4645	0.000000
MCX ENERGY SPOT	2714.882	588.1674	0.539757	3.385252	124.5893	0.000000
MCX AGRI FUTURE	2068.947	594.9834	0.768936	2.640496	236.5419	0.000000
MCX AGRI SPOT	2172.882	741.6123	0.791255	2.359096	276.4483	0.000000

Note: *and** indicates 1% and 5% level of significance respectively

Augmented Dickey Fuller Test (ADF) and Phillips-Perron (PP) are used to examine the stationarity in the spot and future prices of indices. Both the tests revealed that the data has a unit root. Then this data is converted to stationary time series by taking their first difference which is presented in two tables below.

Table 1.2 Augmented Dickey Fuller Test (ADF) Results

Indices	ADF Test	t-statistics	Critical Value	P-value**	Co-efficient
MCX COMDEX FUTURE	Level	-1.02954	-2.862610	0.7447	-0.001028
	First Difference	-55.75652	-2.862610	0.0001	-1.155516
MCX COMDEX SPOT	Level	-0.629904	-2.862609	0.8615	-0.000461
	First Difference	-49.45461	-2.862610	0.0001	-1.036816
MCX METAL FUTURE	Level	-0.557592	-2.862610	0.8773	-0.000418
	First Difference	-51.63273	-2.862610	0.0001	-1.079874
MCX METAL SPOT	Level	-0.629904	-2.862609	0.8615	-0.000461
	First Difference	-49.45461	-2.862610	0.0001	-1.036816
MCX ENERGY FUTURE	Level	-1.986331	-2.862610	0.2931	-0.003661
	First Difference	-51.98837	-2.862610	0.0001	-1.086551
MCX ENERGY SPOT	Level	-2.125519	-2.862610	0.2347	-0.004514
	First Difference	-56.51109	-2.862610	0.0001	-1.168565
MCX AGRI FUTURE	Level	-1.457174	-2.862609	0.5553	-0.001442
	First Difference	-46.10550	-2.862610	0.0001	-0.966886
MCX AGRI SPOT	Level	-0.134035	-2.862609	-6.48E-05	0.9439
	First Difference	-45.25286	-2.862610	0.0001	-0.948135

Note: *and** indicates 1% and 5% level of significance respectively

Table 1.3Phillips Perron Test (PP) Results

Indices	PP Test	t-statistics	Critical Value	P-value**	Co-efficient
MCX COMDEX FUTURE	Level	-1.072681	-2.862609	0.7286	-0.001200
	First Difference	-55.67670	-2.862610	0.0001	-1.155516
MCX COMDEX SPOT	Level	-0.595375	-2.862609	0.8692	-0.000461
	First Difference	-49.45795	-2.862610	0.0001	-1.036816
MCX METAL FUTURE	Level	-0.594680	-2.862609	0.8694	-0.000478
	First Difference	-51.53510	-2.862610	0.0001	-1.079874
MCX METAL	Level	-0.595375	-2.862609	0.8692	-0.000461

SPOT	First Difference	-49.45795	-2.862610	0.0001	-1.036816
MCX ENERGY FUTURE	Level	-2.050148	-2.862609	0.2654	-0.004002
	First Difference	-51.96830	-2.862610	0.0001	-1.086551
MCX ENERGY SPOT	Level	-2.188990	-2.862609	0.2105	-0.005341
	First Difference	-56.60207	-2.862610	0.0001	-1.168565
MCX AGRI FUTURE	Level	-1.463770	-2.862609	0.5520	-0.001442
	First Difference	-46.08063	-2.862610	0.0001	-0.966886
MCX AGRI SPOT	Level	-0.352909	-2.862609	0.9145	-6.48E-05
	First Difference	-46.32699	-2.862610	0.0001	-0.948135

Note: *and** indicates 1% and 5% level of significance respectively

After converting the data into stationary time series for all the four mcx indices Johansen Co-integration Test is carried to examine the long-run relationship between the spot and future prices of indices. Both the Max-Eigen value statistics and Trace statistics shows that the spot and future prices in all the four mcx indices are co-integrated as shown in the table1.4 below.

Table: 1.4 Johansen Cointegration Test Results

Indices	**Trace Statistics**			**Max-Eigen statistics**		
	λ trace	**Critical value**	**Prob.****	**λ max**	**Critical value**	**Prob.****
MCX COMDEX	951.1320	15.49471	0.0001	615.3751	14.26460	0.0001
MCX METAL	287.5743	15.49471	0.0001	259.0086	14.26460	0.0001
MCX ENERGY	472.4956	14.26460	0.0001	350.4396	14.26460	0.0001
MCX AGRI	660.0822	15.49471	0.0001	435.7131	14.26460	0.0001

Note: *and** indicates 1% and 5% level of significance respectively

VEC Granger Causality Test is used to study the short run causality relationship between spot and future prices of four indices. The results of the test reveal that there is a bi-directional casual relationship between the spot and future prices of all the indices as mentioned in the table 1.5.The result of granger causality reveals that, no lead lag relationship exists between the two prices. Both the markets are equally efficient in price adjustment due to new innovation or information etc.

Table: 1.5 VEC Granger Causality Test/Block Exogeneity Wald Test Results

Indices	**Null Hypothesis**	**Chi-sq**	***P*-value****	**Lags**	**Direction**	**Relationship**
MCX COMDEX	Fp does not granger cause Sp	529.64	0.0000	4	Bi-directional	F ⟷ S
	Sp does not granger cause Fp	66.56	0.0000	4		
MCX METAL	Fp does not granger cause Sp	27.38	0.0006	8	Bi-directional	F ⟷ S
	Sp does not granger cause Fp	214.99	0.0000	8		
MCX ENERGY	Fp does not granger cause Sp	1156.2	0.0000	13	Bi-directional	F ⟷ S
	Sp does not granger cause Fp	26.944	0.0127	13		
MCX AGRI	Fp does not granger cause Sp	63.42	0.0000	5	Bi-directional	F ⟷ S
	Sp does not granger cause Fp	236.56	0.0000	5		

Note: *and** indicates 1% and 5% level of significance respectively

7. Findings of the study

1. A long run co-integration exists between the spot and future prices of MCX Comdex, MCX Agri, MCX Energy and MCX Metal.
2. A Bi-directional Causality relationship has been found between the spot and future prices of all indices taken for the study.
3. No lead lag relationship has been found spot and future prices of all the indices taken for study.
4. From the analysis it is found that both the spot and future markets react to the new information at the same time which gets adjusted in the spot and future prices simultaneously.

8. Implications of the study

This study had made an empirical effort to investigate the price discovery in four important indexes of MCX which is biggest commodity exchange of India in terms of value and volume of contacts traded. Derivatives are less costly risk management tool due which they are gaining importance in the global financial system. Risk management is very critical in present dynamic business environment for the survival and growth of multinational organizations. Through this study we have found how spot and future markets react to the new information and which get quickly adjusted into their equilibrium price.

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