
An Empirical Study of Relationship Between Spot Price and Future Price of Copper in MCX

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The key research objective of the study was to analyse the nature of relationship between future and spot prices of Copper in Indian Commodity Market (MCX). The data were taken from MCX Year Books, with data from April 2004 to December 2010. MCX has stopped publishing Year Books, last being Year Book 2011. While latest (raw) data could have been taken from the site of MCX itself for the period from 2004 to 2014, it was thought to examine the data given in the Year Book only, which is smoothened by MCX itself. While the exact spot price given for months respectively in the Year Books are taken, to get the month wise future price of copper, same has been taken by taking the average of opening and closing future price of every month given in the Year Books. The various models used in the analysis are Correlation and Regression analysis only. Non-stationary data were converted to Stationary data wherever it was required for better interpretation. Regression analysis was made on stationary and non-stationary data i.e., prices of spot and future of Copper. While it was found that there was direct correlation and more close relation between Non-stationary spot and future prices, the relationship was not so close when the data changed to stationary.

Key Words: Metals, Industry Metals, Copper, Spot Price, Future Price, MCX

INTRODUCTION

World Commodity Market:

As per the Commodity Markets Outlook (January 2014 Edition from World Bank), with the exception of energy, all the key commodity price indices declined significantly in 2013. Fertilizer prices led the decline, down 17.4 percent from 2012, followed by precious metals (down almost 17%), agriculture (-7.2%), and metals (-5.5%). Crude oil prices (World Bank Average), which have been remarkably stable during the past three years averaged \$104/barrel (bbl) during 2013, marginally lower than \$105/barrel average of 2012. Most non-energy commodity prices, notably grains, followed a downward path during 2013.

The report says further that in the baseline scenario, which assumes no macroeconomic shocks or supply disruptions, oil prices are expected to average \$103/bbl in 2014, just 1% lower than the 2013 (refer table above). Natural gas prices in the US are expected to increase due to stronger demand from energy intensive industries that are moving to the US to take advantage of the “energy dividend”. Metal prices have declined by almost 2% in 2013-14, but is expected to increase by close to 1% in 2014-15.

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Indian Commodity Market:

Commodity exchanges in India are found to be in a two-tier structure i.e., Regional and Country-Wide. Regional exchanges are permitted to have only a limited number of contracts whose membership is local. Countywide national exchanges are multi-commodity electronic exchanges with a demutualized ownership pattern. Currently, there are three such exchanges, viz., MCX (Multi Commodity Exchange), NMCE (National Multi

Commodity Exchange) and NCDEX (National Commodities and Derivatives Exchange).

MCX has come up as the largest exchange in the country. MCX started its operations on November 10, 2003 and today it holds a market share of over 80 per cent of the Indian commodity futures market and has more than 2000 registered members operating through over 100,000 trader work stations across India.

Table showing Average Daily Turnover (in Rs.) and market share of MCX (taken from Annual Report):

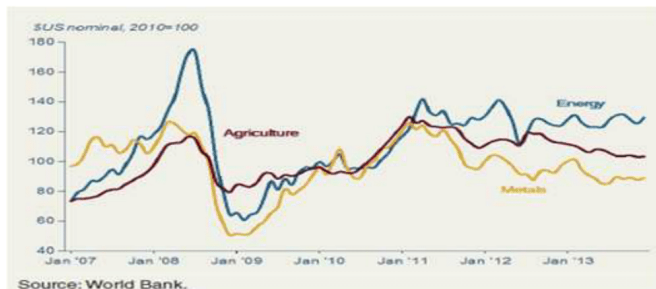


Table showing Key Nominal price indices:
Nominal Price Indices, actual and forecasts (2010=100)

	ACTUAL					FORECAST		CHANGE (%)		
	2009	2010	2011	2012	2013	2014	2015	2012/13	2013/14	2014/15
Energy	80	100	129	128	127	127	124	-0.1	-0.1	-2.6
Non-Energy	83	100	120	110	102	99	99	-7.2	-2.6	-0.2
Metals	68	100	113	96	91	89	90	-5.5	-1.7	1.1
Agriculture	89	100	122	114	106	104	103	-7.2	-2.5	-0.6
Food	93	100	123	124	116	111	110	-7.1	-3.7	-1.4
Grains	99	100	138	141	128	116	117	-9.3	-9.8	0.8
Fats and oils	90	100	121	126	116	116	113	-8.1	0.5	-3.2
Other food	90	100	111	107	104	101	100	-3.0	-3.1	-0.8
Beverages	86	100	116	93	83	82	82	-10.1	-2.0	0.4
Raw Materials	83	100	122	101	95	96	97	-5.9	0.9	1.1
Fertilizers	105	100	143	138	114	100	99	-17.4	-11.7	-1.4
Precious metals	78	100	136	138	115	100	98	-16.9	-13.1	-1.8
Memorandum Items										
Crude oil (\$/bbl)	62	79	104	105	104	103	100	-0.9	-0.6	-3.5
Gold (\$/toz)	973	1225	1,569	1,670	1,412	1,220	1,200	-15.4	-13.6	-1.6

Source: World Bank.

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10, 2003 and today it holds a market share of over 80 per cent of the Indian commodity futures market and has more than 2000 registered members operating through over 100,000 trader work stations across India.

Table showing Average Daily Turnover (in Rs.) and market share of MCX (taken from Annual Report):

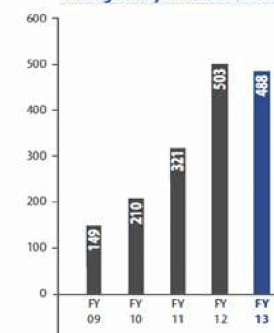
Copper:

While the overall MCX Commodity Index (future) which was 3996.76 on the opening day of the year 2014 went down to 3686.40 on 30th Sept 2014, a decline by almost 7.8%, the MCX Metal Index (spot) which was 4834.17 and 4521.67 respectively during the said period showed a decline by 6.5%. The copper (spot) price which was Rs.463.50 per Kg. on the 1st day of 2014 declined to Rs.413.90 per Kg. on 30th Sept 2014, a decline by close to 11%. So a general interpretation can be drawn that there has been decline in overall commodity prices in the last nine months.

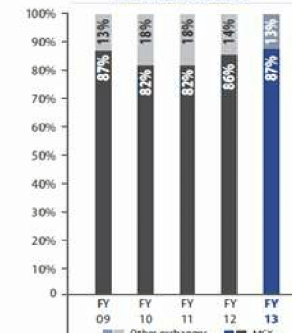
The five years growth chart of Copper from Kitco website is given below for information:

OPERATIONAL

Average Daily Turnover (in ₹billion)

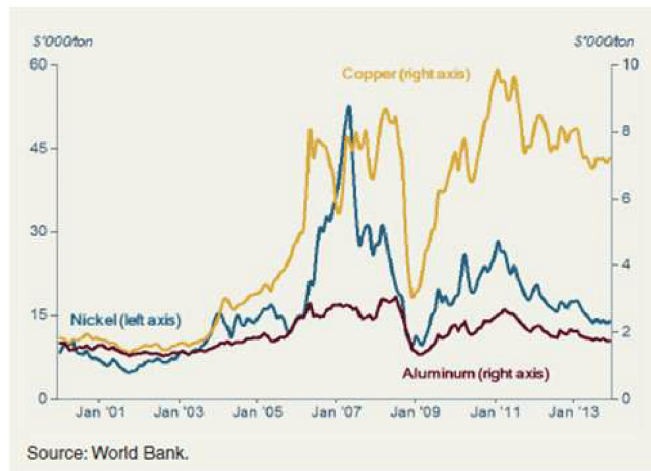


MCX Market Share





The metal prices of Copper vis-à-vis Aluminum and Nickel are given below as per the world bank report.



REVIEW OF LITERATURE

Before striking very straight on the prices such as spot and future prices, it is quite imperative that there should be a good understanding of the market as a whole. Li Xidan and Zhang Bing (2008) in their research article "Price linkages between Chinese and World Copper Future Market" emphasized that there existed a time varying relationships between the Chinese Copper market & its London counterparts. There is a long run relationship between Shanghai Future Market (SHFE) and London Metals exchanges (LME) copper futures prices. The influence of LME on SHFE is greater than that of SHFE on LME.

Gravelle John, Global Mining Leader, PwC, in its report titled "Metal mired in global uncertainty (Gold, Silver and Copper Price Report 2014)" said that few commodities in the mining sector have escaped the downturn caused by global economic uncertainty and volatile markets. Gold, silver and copper are among the closely watched metals. They have also been some of the hardest hit in 2013.

On the factors affecting Spot and Future prices, Frankel Jeffrey A. and Rose Andrew K. (2009) in their article "Determinants of Agricultural and Mineral Commodity Prices" say that although two macroeconomic fundamentals -- global output and inflation -- both have positive effects on real commodity prices, the fundamentals that seem to have the most consistent and strongest effects are microeconomic variables: volatility, inventories, and the spot-forward spread. There is also evidence of a bandwagon effect.

Gospodinov Nikolay & Ng Serena (2011), stressed on the role of individual and aggregate convenience yields in explaining the commodity prices and can be seen as informational variable about future economic conditions as conveyed by the future markets in contrast to the general thinking that commodity prices are thought to have inflationary consequences. While the convenience yields of cocoa, orange juice and copper have positive effect

on one-period ahead of inflation, soyabeans, oats and silver have negative effect, the coefficients on other convenience yields are not statistically significant.

On the nature of Spot and Future prices and their relationships, Hernandez Manuel & Torrero Maxinno (2010), in their discussion paper on "Examining the Dynamic relationship between spot and future prices of agricultural commodities" of International Ford Policy Research Institute, tested empirically the nature of flow of information between spot and future prices. They mentioned that changes in future prices affects more spot prices than the vice-versa.

Winkoop Henri van in his thesis paper (2012) titled "Short-run and long-run determinants of the price of silver" stated that to obtain long-term equilibrium, the consumer price index has the biggest impact on the silver price of silver. The relationship of oil with both industrial use and inflation probably explains the positive co-integration with silver. Both silver and gold seems to share comparable properties, although the market for gold is less volatile and has a stronger relation with consumer price index.

In India, Kumar Brajesh and Pandey Ajay (2008) investigated the cross market linkages of Indian commodity futures with futures markets outside India. They found that world markets have bigger (unidirectional) impact on Indian markets. However, effect of London Metal Exchange (LME) on India's Multi Commodity Exchange (MCX) is stronger than the effect of MCX on LME. Results of return and volatility spill overs indicate that the Indian commodity futures markets function as a satellite market and assimilate information from the world market.

Further after going through one working paper of Ghosh (2009), on "Issues & concerns of commodity derivative market in India: An agenda for research" available in the website of Takshashila Academia of Economic Research (TAER) Limited (earlier known as MCX Academia of Economic Research), set up by Multi Commodity Exchange of India- MCX, it is

understood that there has been not so good development in our country in the establishment of proper relationship between spot and futures market to understand the various issues concerning the commodities derivative market. As per his own wordings in the article, he has emphasized the need for doing research in the aforesaid area.

Behera Chinmaya in his article (2012) titled "Price Discovery and Market Efficiency in Indian Commodity Market" found that gold market is not efficient while silver, copper, crude oil and natural gas markets are efficient.

Singhal Krishna said in the article (2014) titled "Lead and Lag relationship between Spot and Future price of Crude oil in India" that the price discovery is much faster in future market than in the spot market.

OBJECTIVES

The key research objective proposed is:

To analyze the nature of relationship between future and spot prices in India for Copper.

MAJOR HYPOTHESES

The various approaches towards null and alternative hypotheses can be understood by looking at the following:

- For checking whether the data of Spot and Future price of Copper are non-stationary, the following are the hypotheses:

H_0 (Null Hypotheses) = Data is Stationary.

H_1 (Alternate Hypotheses) = Data is Non-Stationary.

- For checking on Regression Analysis, the following are the hypotheses:

(i) H_0 (Null Hypotheses) = Coefficient would be zero.

H_1 (Alternate Hypotheses) = Coefficient

would not be zero.

(ii) H_0 (Null Hypotheses) = Intercept would be zero.

H_1 (Alternate Hypotheses) = Intercept would not be zero

SOURCES OF DATA

The data are collected from secondary sources. Data for last 8 years from 2004 to 2010 have been taken.

Secondary data have been gathered from reports, surveys, published material from library and internet resources like web sites of commodity exchanges, more specifically from Commodity Insight Books from MCX web site.

RESEARCH METHODOLOGY

The research methodology defines the process and methods, the researcher shall undertake to accomplish the objectives. The research methodology chosen are appropriate as there has been a detailed study undertaken through review of literature and the null hypotheses and alternative hypotheses have been different depending on the tools used.

MCX has stopped publishing the Annual Insight Book, last being the Insight Book 2011 available in the web site of the company. The latest data (raw) could be taken out from the web site of the company and then the same data could have been smoothened by processing the same through statistical tool, before applying the models given below. But the whole idea is to whatever the data given in the Insight Book, let us use the same data (as it is already smoothened by MCX itself) and study the result thereafter even though the data looks slightly older.

A separate study shall be undertaken later extracting the latest raw data from the MCX site, further the data shall be smoothened through some statistical tool and then the models as given below shall be applied again to see the result whether remains same or changes.

While Spot Price of Copper (monthly) is given straight in the Yearly Insight Book of MCX, the Future Price of same is calculated at our end by taking the average of opening and closing price given in the aforesaid Book.

The following models have been used: Correlation and Regression analysis.

ANALYSIS OF DATA

Checking whether data (Copper Future) is non-Stationary

Refer Appendix A and B, since the graph is projecting the future price being gradually up, so the data may be considered as non-Stationary. But we are using other statistical test i.e., Ljung-Box (LB) statistic to critically examine whether that data is non-stationary.

So to check more accurately whether data is non-stationary, the Ljung-Box (LB) Statistics is used and we have used Corrologram and the same is extracted from Eviews software and given in Appendix C.

Since there were 79 items, Corrologram has considered 32 lags (33-40% generally). As can be seen that spikes have exceeded the two parallel lines from Lag no.1 to 9 which corroborates the fact that data in the series is non-stationary.

Further we have considered the hypotheses as follows:

H_0 (Null Hypotheses) = Data is Stationary.

H_1 (Alternate Hypotheses) = Data is Non-Stationary.

But the Probability of the Q-statistic (last 32 lag) is having zero probability, being less than 5%, we will conclude that we can reject the null hypotheses and accept alternative hypotheses.

Thus the data is non-stationary.

Similarly we can also check for Copper Spot Prices as to whether the data is non-stationary as given in

Appendix D & E. So based on the above representations for all the Copper data, for future and spot prices, it is proved that all the data are non-stationary.

Converting Non-stationary data into Stationary

Since to apply regression and other analysis, the data series preferably need to be stationary. So to get the stationary data, we need to further decide how many differences to be taken as to arrive at the right quality data for applying aforesaid model. So to arrive exactly how many differences to be undertaken, we have randomly taken the 1st difference, 2nd difference and 3rd difference of original data. It is found that

the Corrologram in the case of 2nd differenced data of Copper Future shows that the probability in the case of 1st lag is more than 5% (that is 43%) we can accept this series better stationary than even 1st and 3rd differenced data of Copper future, where the probability is found to be not more than 5% in any lag. Similarly for Copper Spot, as we notice that the probability is more than 5% in case of only 2nd differenced data and thus we can not reject null hypotheses and thus accept that 2nd differenced data of Copper spot is better stationary than 1st differenced and 3rd differenced data.

Regression Analysis of Copper Future and Copper Spot Data

Regression Analysis with Non-Stationary data:

From the summary output and diagram given (Refer Appendix F and G) and further looking at the non-stationary data of Copper Future and Copper Spot, the following are the major findings;

- Multiple R which represents Correlation is very close to 1 i.e., 0.995104791. This means that there is close relation between Copper Future and Copper Spot data but not to forget that the data series are non-stationary.
- Further the inference can also be drawn that a significant portion of change in the Y variable (Copper Future) is explained by the role played by X variable (Copper Spot).

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- Mathematically the equation can be explained as $Y = 0.996485166 * X + 2.293001372$, where 0.996485166 is the coefficient of b and 2.293001372 is the intercept. (* is the multiplication sign)
- Probability value of intercept is 46.63%, which is more than 5%. So the null hypotheses which said that Intercept would be zero, cannot be rejected and we do not accept the alternative hypotheses, which said that it would be not equal to zero.
- Similarly Probability value of Coefficient of b is less than 0%, which is less than 5%. So the null hypotheses which said that Coefficient would be zero, is rejected and we accept the alternative hypotheses, which said that it would be not equal to zero.
- The probability of having Intercept between - 3.9442135 to 8.530216241 is with 95% confidence level. Also the probability of Coefficient of b between 0.97387615 and 1.019094183 is with 95% confidence level.

Similarly from the summary output and diagram given (Appendix H) and further looking at the non-stationary data of Copper Spot (Y) and Copper Future (X), the following are the major findings;

- Multiple R which represents Correlation is very close to 1 i.e., 0.995104791. This means that there is close relation between Copper Spot and Copper Future data but not to forget that the data series are non-stationary.
- Further the inference can also be drawn that a significant portion of change in the Y variable (Copper Spot) is explained by the role played by X variable (Copper Future).
- Mathematically the equation can be explained as $Y = 0.993726327 * X + 0.299074926$, where 0.993726327 is the coefficient of b and 0.299074926 is the intercept. (* is the multiplication sign)
- Probability value of intercept is 92.43%, which is more than 5%. So the null hypotheses which said that Intercept would be zero, cannot be rejected and we do not accept the alternative hypotheses, which said that it would be not equal to zero.
- Similarly Probability value of Coefficient of b is less than 0%, which is less than 5%. So the null hypotheses which said that Coefficient would be zero, is rejected and we accept the alternative hypotheses, which said that it would be not equal to zero.
- The probability of having Intercept between - 5.9510567 to 6.549206549 is with 95% confidence level. Also the probability of Coefficient of b between 0.971179905 and 1.016272749 is with 95% confidence level.

Regression Analysis with Stationary data:

From the summary output and further looking at the stationary data of Copper Future (Y) and Copper Spot (X) (Refer Appendix I and J), the following are the major findings;

- Multiple R which represents Correlation is more than 0.5 but not very close to 1 i.e., 0.699257781. This means that there is significant but not close relation between Copper Future and Copper Spot data but not to forget that the data series are stationary.
- Further the inference can also be drawn that a significant portion of change in the Y variable (Copper Future) is explained by the role played by X variable (Copper Spot).
- Unlike in the case of non-stationary data where there appears a close relationship, this regression analysis (using stationary data) points out this fact that there are also other variables having impact on Y (Copper Future) other than X (Copper Spot)
- Mathematically the equation can be explained as $Y = 0.444353022 * X + 0.282808047$, where 0.444353022 is the coefficient of b and 0.282808047 is the intercept. (* is the multiplication sign)
- Probability value of intercept is 84.24%, which is

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- more than 5%. So the null hypotheses which said that Intercept would be zero, cannot be rejected and we do not accept the alternative hypotheses, which said that it would be not equal to zero.
- Similarly Probability value of Coefficient of b is less than 0%, which is less than 5%. So the null hypotheses which said that Coefficient would be zero, is rejected and we accept the alternative hypotheses, which said that it would be not equal to zero.
- The probability of having Intercept between - 2.54262949 to 3.108245586 is with 95% confidence level. Also the probability of Coefficient of b between 0.33913028 and 0.549575764 is with 95% confidence level.
- that Intercept would be zero, cannot be rejected and we do not accept the alternative hypotheses, which said that it would be not equal to zero.
- Similarly Probability value of Coefficient of b is less than 0%, which is less than 5%. So the null hypotheses which said that Coefficient would be zero, is rejected and we accept the alternative hypotheses, which said that it would be not equal to zero.
- The probability of having Intercept between - 4.54852868 to 4.346258097 is with 95% confidence level. Also the probability of Coefficient of b between 0.839817477 and 1.360961726 is with 95% confidence level.

From the summary output and further looking at the stationary data of Copper Spot (Y) and Copper Future (X) (Refer Appendix K & L), the following are the major findings;

- Multiple R which represents Correlation is more than 0.5 but not very close to 1 i.e., 0.699257781. This means that there is significant but not close relation between Copper Spot and Copper Future data but not to forget that the data series are stationary.
- Further the inference can also be drawn that a significant portion of change in the Y variable (Copper Spot) is explained by the role played by X variable (Copper Future).
- Unlike in the case of non-stationary data where there appears a close relationship, this regression analysis (using stationary data) points out this fact that there are also other variables having impact on Y (Copper Spot) other than X (Copper Future)
- Mathematically the equation can be explained as $Y = 1.100389601 * X - 0.10113529$, where 1.100389601 is the coefficient of b and - 0.10113529 is the intercept. (* is the multiplication sign)
- Probability value of intercept is 96.39%, which is more than 5%. So the null hypotheses which said

SUMMARY

Copper Spot and Future prices (data) taken from MCX Annual Insights Book were found to be non-stationary. The Regression Analysis showed that the non-stationary data of Copper Spot and Copper Future had close relationship between them where as stationary data of both showed that there was significant but not so close relationship. Further it was noticed there are other factors affecting the relationship between Copper Spot and Copper Future (Stationary data).

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Appendix A

Original Data of Copper Future and Copper Spot

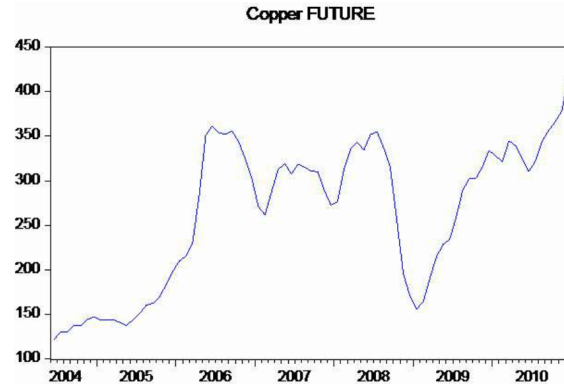
Months	Copper Future Price/Kg (Rs.)	Copper Spot Price/Kg (Rs.)
2004M06	122.025	126
2004M07	130.35	126.48
2004M08	130.475	127.09
2004M09	138	134.36
2004M10	137.3	139.41
2004M11	144.25	142.94
2004M12	147.7	141.8
2005M01	143.775	138.28
2005M02	143.95	140.11
2005M03	144.2	144.26
2005M04	141.05	143.7
2005M05	137.775	135.66
2005M06	144.15	150.13
2005M07	151.225	155.47
2005M08	160.675	163.66
2005M09	162.7	167.28
2005M10	170.05	184.43
2005M11	183.65	198.03
2005M12	198.15	204.19
2006M01	210.15	207.15
2006M02	215.375	218.87
2006M03	229.7	225.05
2006M04	282.4	284.15
2006M05	350.85	361.81
2006M06	361.625	337.15
2006M07	353.7	360.16
2006M08	352.225	360.01
2006M09	355.7	351.78
2006M10	344.05	341.78
2006M11	324.825	313.39
2006M12	302.875	298.94
2007M01	270.9	255.33
2007M02	261.75	253.1
2007M03	287.8	282.28
2007M04	312.675	325.47
2007M05	319.4	314.06
2007M06	307.625	304.17
2007M07	318.775	319.77
2007M08	315.3	302.11

Months	Copper Future Price/Kg (Rs.)	Copper Spot Price/Kg (Rs.)
2007M09	311.15	306.55
2007M10	310.1	314.47
2007M11	289.175	272.67
2007M12	272.75	265.21
2008M01	276.575	277.73
2008M02	312.75	311.64
2008M03	335.85	338.21
2008M04	343.15	345.2
2008M05	334.65	347.74
2008M06	351.95	347.4
2008M07	354.675	353.54
2008M08	337	323.73
2008M09	314.825	316.15
2008M10	255.225	234.15
2008M11	195.775	183.84
2008M12	170.9	150.71
2009M01	156.325	160.27
2009M02	164.05	164.42
2009M03	190.3	193.6
2009M04	214.525	225.3
2009M05	228.7	224.96
2009M06	234.075	240.68
2009M07	259.4	253.47
2009M08	289.425	299.65
2009M09	302.55	301.79
2009M10	302.875	297.1
2009M11	315.75	311.67
2009M12	334.15	328.57
2010M01	327.7	339.68
2010M02	321.5	317.67
2010M03	344.75	340.79
2010M04	339.375	347.68
2010M05	324.675	315.47
2010M06	310.1	301.36
2010M07	321.675	316.28
2010M08	343.75	340.64
2010M09	356.075	358.52
2010M10	365.875	369.81
2010M11	378.275	381.4
2010M12	413.775	413.25

An Empirical Study of Relationship Between Spot Price and Future Price of Copper in MCX

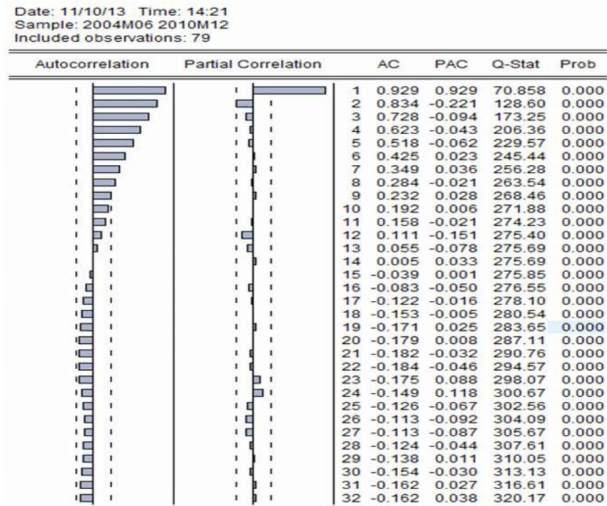
Appendix B

The Graphical Picture of the Copper Future is taken and same is given below



Appendix C

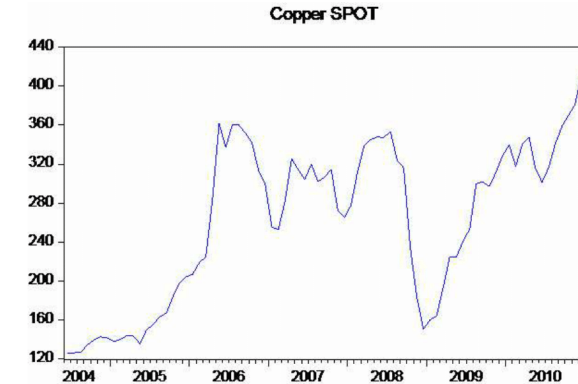
Correlogram of Copper Future



An Empirical Study of Relationship Between Spot Price and Future Price of Copper in MCX

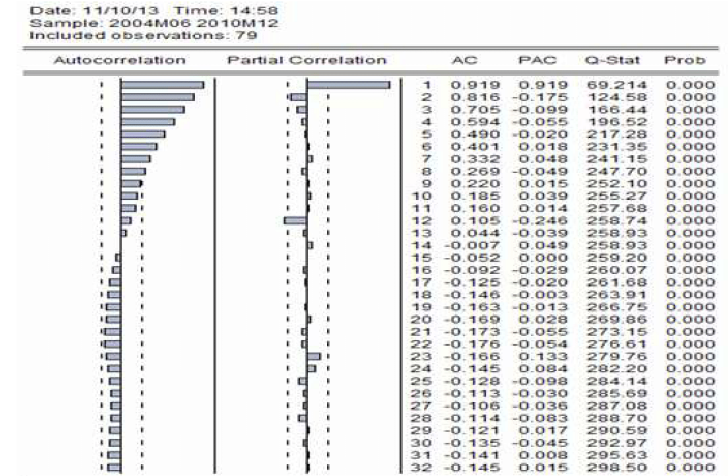
Appendix D

Graphical Picture of Copper Spot



Appendix E

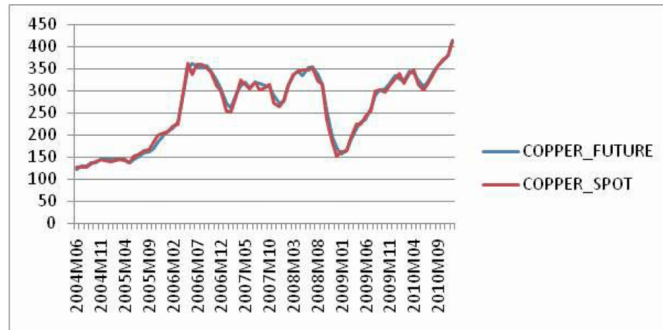
Correlogram of Copper Spot



An Empirical Study of Relationship Between Spot Price and Future Price of Copper in MCX

Appendix B

Graphical representation of Copper Future and Copper Spot (Original Data)



Appendix G

Regression Analysis (When Copper Future is Y variable and Copper Spot is X variable)

SUMMARY OUTPUT								
Regression Statistics								
Multiple R	0.995104791							
R Square	0.990233544							
Adjusted R Square	0.990105038							
Standard Error	8.048755364							
Observations	78							
ANOVA								
	df	SS	MS	F	Significance F			
Regression	1	499196.6795	499196.7	7705.738	3.73411E-78			
Residual	76	4923.467181	64.78246					
Total	77	504120.1467						
	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	2.293001372	3.131646657	0.732203	0.466297	-3.9442135	8.530216241	-3.944213498	8.530216241
X Variable	0.996485166	0.011351774	87.78233	3.73E-78	0.97387615	1.019094183	0.97387615	1.019094183

(Note: Copper Future is Y and Copper Spot is X variable)

An Empirical Study of Relationship Between Spot Price and Future Price of Copper in MCX

Appendix H

Regression Analysis if Copper Spot is Y and Copper Future is X variable

SUMMARY OUTPUT								
Regression Statistics								
Multiple R	0.995104791							
R Square	0.990233544							
Adjusted R Square	0.990105038							
Standard Error	8.037605868							
Observations	78							
ANOVA								
	df	SS	MS	F	Significance F			
Regression	1	497814.6182	497814.6	7705.738	3.73411E-78			
Residual	76	4909.836215	64.60311					
Total	77	502724.4545						
	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	0.299074926	3.138132037	0.095303	0.924325	-5.9510567	6.549206549	-5.951056687	6.549206549
X Variable	0.993726327	0.011320345	87.78233	3.73E-78	0.971179905	1.016277749	0.971179905	1.016277749

Appendix I

Stationary Data of Copper Future and Copper Spot

Months	DDCOPPER_FUTURE	DDCOPPER_SPOT
2004M06	NA	NA
2004M07	NA	NA
2004M08	-8.200000	0.130000
2004M09	7.400000	6.660000
2004M10	-8.225000	-2.220000
2004M11	7.650000	-1.520000
2004M12	-3.500000	-4.670000
2005M01	-7.375000	-2.380000
2005M02	4.100000	5.350000
2005M03	0.075000	2.320000
2005M04	-3.400000	-4.710000
2005M05	-0.125000	-7.480000
2005M06	9.650000	22.51000
2005M07	0.700000	-9.130000
2005M08	2.375000	2.850000
2005M09	-7.425000	-4.570000

Months	DDCOPPER_FUTURE	DDCOPPER_SPOT
2005M10	5.325000	13.53000
2005M11	6.250000	-3.550000
2005M12	0.900000	-7.440000
2006M01	-2.500000	-3.200000
2006M02	-6.775000	8.760000
2006M03	9.100000	-5.540000
2006M04	38.37500	52.92000
2006M05	15.75000	18.56000
2006M06	-57.67500	-102.3200
2006M07	-18.70000	47.67000
2006M08	6.450000	-23.16000
2006M09	4.950000	-8.080000
2006M10	-15.12500	-1.770000
2006M11	-7.575000	-18.39000
2006M12	-2.725000	13.94000
2007M01	-10.02500	-29.16000

An Empirical Study of Relationship Between Spot Price and Future Price of Copper in MCX

Months	DDCOPPER_FUTURE	DDCOPPER_SPOT
2007M02	22.82500	41.38000
2007M03	35.20000	31.41000
2007M04	-1.175000	14.01000
2007M05	-18.15000	-54.60000
2007M06	-18.50000	1.520000
2007M07	22.92500	25.49000
2007M08	-14.62500	-33.26000
2007M09	-0.675000	22.10000
2007M10	3.100000	3.480000
2007M11	-19.87500	-49.72000
2007M12	4.500000	34.34000
2008M01	20.25000	19.98000
2008M02	32.35000	21.39000
2008M03	-13.07500	-7.340000
2008M04	-15.80000	-19.58000
2008M05	-15.80000	-4.450000
2008M06	25.80000	-2.880000
2008M07	-14.57500	6.480000
2008M08	-20.40000	-35.95000
2008M09	-4.500000	22.23000
2008M10	-37.42500	-74.42000
2008M11	0.150000	31.69000
2008M12	34.57500	17.18000
2009M01	10.30000	42.69000

Months	DDCOPPER_FUTURE	DDCOPPER_SPOT
2009M02	22.30000	-5.410000
2009M03	18.52500	25.03000
2009M04	-2.025000	2.520000
2009M05	-10.05000	-32.04000
2009M06	-8.800000	16.06000
2009M07	19.95000	-2.930000
2009M08	4.700000	33.39000
2009M09	-16.90000	-44.04000
2009M10	-12.80000	-6.830000
2009M11	12.55000	19.26000
2009M12	5.525000	2.330000
2010M01	-24.85000	-5.790000
2010M02	0.250000	-33.12000
2010M03	29.45000	45.13000
2010M04	-28.62500	-16.23000
2010M05	-9.325000	-39.10000
2010M06	0.125000	18.10000
2010M07	26.15000	29.03000
2010M08	10.50000	9.440000
2010M09	-9.750000	-6.480000
2010M10	-2.525000	-6.590000
2010M11	2.600000	0.300000
2010M12	23.10000	20.26000

An Empirical Study of Relationship Between Spot Price and Future Price of Copper in MCX

Appendix J

Regression Analysis of Copper Future and Copper Spot data (Stationary)

SUMMARY OUTPUT								
Regression Statistics								
Multiple R	0.699257781							
R Square	0.488961445							
Adjusted R Square	0.482055518							
Standard Error	12.36043641							
Observations	76							
ANOVA								
	df	SS	MS	F	Significance F			
Regression	1	10817.33497	10817.33	70.80316	2.12922E-12			
Residual	74	11305.74874	152.7804					
Total	75	22123.08371						
	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	0.282808047	1.418005452	0.199441	0.842465	-2.54262949	3.108245586	-2.542629491	3.108245586
X Variable	0.444353022	0.052808253	8.414462	2.13E-12	0.33913028	0.549575764	0.33913028	0.549575764

(Note that Copper Future is Y variable and Copper Spot is X variable)

Appendix K

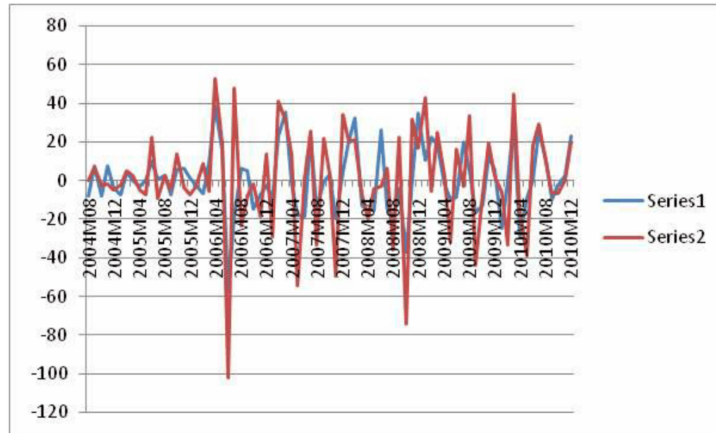
Regression Analysis when Copper Spot is Y and Copper Future is X variable

SUMMARY OUTPUT								
Regression Statistics								
Multiple R	0.699257781							
R Square	0.488961445							
Adjusted R Square	0.482055518							
Standard Error	19.45104661							
Observations	76							
ANOVA								
	df	SS	MS	F	Significance F			
Regression	1	26787.89685	26787.9	70.80316	2.12922E-12			
Residual	74	27997.39787	378.3432					
Total	75	54785.29472						
	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	-0.10113529	2.232018222	-0.04531	0.963981	-4.54852868	4.346258097	-4.54852868	4.346258097
X variable	1.100389601	0.130773619	8.414462	2.13E-12	0.839817477	1.360961726	0.839817477	1.360961726

An Empirical Study of Relationship Between Spot Price and Future Price of Copper in MCX

Appendix L

Diagram of Copper Future and Copper Spot data (Stationary)



(Series1 is Copper Future and Series2 is Copper Spot data)

BRIEF PROFILE OF THE AUTHORS

Ferojuddin M A Khan, is a Professor and has more than 20 years of work experience in Teaching and Corporate, which includes more than 11 years of Industry experience in the core sectors of economy i.e., Power (NTPC), Heavy Engineering (Bharat Yantra Nigam) and Financing (Kuber group of companies), besides having 9 years of teaching. Having the right blend of theory and practical, he is famous in the teaching fraternity as a faculty who can almost integrate any theory with lot of practical examples. He has conducted MDP for public sector companies such as NTPC, IRCON, GAIL in the area of Tax Planning, Cost reduction Strategies. Some of his noteworthy publications include Supplementary chapter on “Financial Information System” published by Oxford University Press, Case study on “Salary Taxation” fetched him certificate of merit from ISB Hyderabad, Case study on “Individual Values Vs. Organizational Practices” got published in International Journal, got best of five award from NIRC (ICWAI) in their

“Article writing Competition”. He is a quality focused person as he has undergone training on TQM, Business Process Re-engineering, Creativity, Kaigen besides he himself is a ISO 9000 certified auditor and Site-Team Evaluator for ACBSP accreditation.

L.Ramani, PhD holds doctorate in Finance from Vardhaman Mahaveer Open University Kota Rajasthan. He has done his PGDBM from Institute of Management Technology Ghaziabad. He has around 8 years of corporate experience mostly in financial services sector. He has worked for Can Bank Financial Services , Escorts Finance , S.K. Agarwal & Co (Member Delhi Stock Exchange). He has 16 years of academic experience and has been associated with leading B Schools of NCR. He has conducted many MDPs in organizations like JSPL , NTPC, Maruti .He has presented & chaired sessions in the international conferences. He is into developing cases and guiding doctoral students as well.