RISK MANAGEMENT BY PAIR TRADE: AN EMPIRICAL EXAMINATION OF MCXINDIA

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ABSTRACT
Commodity market is the easiest yet most controversial instrument in the whole world to create wealth for the investors. It is tempting as well as good instrument to invest yet most risky in its segments. However, this instrument is the most unpredictable instrument of the world. People are having different opinions, some says it is just speculation while some says- in long term, profit is sure shot if invested in proper commodity instruments. To make aware time-by-time exchanges are shredding strategies where investor can protect their investment. In this sense Hedging – pair trade- arbitrage may help investor to either protect their capital of gain small but sure shot profit. This paper will focus on how investor can earn through pair trade strategy in which loss is minimum as well as profit is also minimum. Pair trade require little research before entering in to particle position. To check the effectiveness of pair trade. Out of most liquid commodity instrument of MCXINDIA will be considered. There will be pair from same segment. On the day of expiry, one commodity will be bought and one will be shorted. In addition, on that month's expiry, bought will be sold and sold will be bought. Which one will be bought or sold from the pair will be decided through the 100-day moving average of the commodity. The research may help investor to gain through pair trade strategy with minimum risk

Key words: pair trade strategy, MCXINDIA, effectiveness, Commodity instruments, buy and sell, risk management.

Risk management by Pair trade: an empirical examination of MCXINDIA
Commodity holding returns correspond to a simple investment strategy. At time t an investor buys a futures contract guaranteeing delivery of the underlying commodity in one period and sells the commodity in the spot market at expiry. Many institutional investors, looking for ways to expand their diversification opportunities, have been increasing their positions in a commodity futures index and using it as a performance benchmark. There are estimates of more than a tenfold increase in institutional commodity holdings from 2004 to 2022. Commodity price risk is a fundamental and pervasive risk in manufacturing companies, making price risk management an important issue in practice. Commodity derivatives have been widely recognized as a closely related risk management tool since the earliest textbook on corporate risk management (Mehr and Hedges, 1963).

What is a "Commodity"?
Commodity, by definition, is a good which is produced by many producers/companies/firms without any qualitative difference and the producer cannot be identified by examining the goods. A ton of steel /gold produced anywhere. A ton of copper/rubber produced anywhere
Commodities are emerging as a new asset class. Commodities exhibit negative correlation with most other asset classes – equity, bond, real estate etc. Why negative correlation among assets is better for portfolio? With negative

correlated assets, portfolios risk is lesser. In fact, now mutual funds in India have started investing in commodities. Tata Multi-Asset Opportunities Fund invests in has commodities along with other asset classes such as equity and bonds. Commodity investments also provide an effective hedge against inflation. When inflation rises, commodity prices also increase. Traditionally Gold and Silver has been considered as inflation hedge. Now other commodities such as crude oil, copper etc. are considered as inflation hedge.

Reasons to study commodity trend analysis

Human beings have traded commodities since time immemorial. Commodities and derivatives contracts on commodities are traded in exchanges. Commodity prices are increasingly becoming volatile. Higher the volatility higher is the risk. Important for consumers/producers to understand what factors are contributing to volatility and how commodity price risk can be mitigated?

History of the Multi Commodity Exchange

The Multi Commodity Exchange was founded in 2003 by Financial Technologies (India) Ltd., with the aim of becoming India's primary commodity exchange. Not only has it succeeded in this aim – at recent estimates commanding 80% of India's futures market – but it has also become one of the world's most successful exchanges. Recent figures show that it is challenging for the position of the world's primary precious metals exchange, being #1 in the world for silver, and #2 for gold. It is also highly rated for industrial metal commodities and energy commodities, being #2 in the world for copper and natural gas, and #3 for aluminium, zinc, and crude oil.

List of Regional Commodity Exchanges in India		
Sr. no	**Exchange**	**Commodities**
1	The Ahmedabad Commodity Exchange., Ahmedabad	Castor seed
2	The Bombay Commodity Exchange Ltd, Mumbai	Castor seed, Castor Oil (International), RBD Palmolein, Sunflower Oil & Groundnut oil
3	Rajkot Seeds Oil & Bullion Merchants Assn., Rajkot	Castor seed
4	The East India Cotton Assn. Ltd., Mumbai	Cotton
5	The South India Cotton Association, Coimbatore	Cotton
6	Bhatinda Om & Oil Exchange Ltd., Bhatinda	Gur

Commodity classification:

MCXINDIA (Multi Commodity Exchange) offers commodity instruments for trading and hedging perspective in below segments

Precious metals	Base metals	Energy	Agri commodity
Gold	Aluminium	Crude oil	Cotton
Silver	Lead	Natural Gas	**Rubber**
	Zinc		Mentha Oil
	Nickel		
	Copper		

The study is to identified the trends of these different segmented commodity. Commodity trading on MCXINDIA started from 2004. The study is in the area of the rates of these commodities from 2004 to 2022, this study may help the investors to define the trend of the commodity.

❖ **Some commodities were de listed for some time and then again introduced by MCX India for trading, while some commodity was removed from trading permanently.**

❖ **For example, Nickel right now is discontinued from trading. Rubber is also not available for trading.**

Theoretical background of the Commodity groups. / pair in commodity
Pairs trading is a trading strategy that involves buying one asset and shorting another. The aim of pairs trading is to bet that, if the prices of 2 assets diverge, they will converge eventually.
A pairs trading strategy is one of the most popular strategies when it comes to finding trading opportunities between the two stocks that are co-integrated.

History of pairs trading
Pairs trading was first introduced in the mid-1980s by a group of technical analyst researchers that were employed by Morgan Stanley. The pairs trading strategy uses statistical and technical analysis to seek out potential market-neutral profits.

Logic behind pairs trading?
In the case of a pairs trading strategy, the two stocks or the financial instruments need to be trending at a similar mean price and remain close to each other. But, on certain occasions, one of the instruments may go through a short period of deviation from another in terms of price.

In this short period, the trader can take the opportunity to go long on one of the financial instruments while shorting the other. The positions are based on the current market price of both the stocks and their standard deviation.

Correlation
Correlation is quantified by the correlation coefficient ρ, which ranges from -1 to +1. The correlation coefficient indicates the degree of correlation between the two variables. The value of +1 means there exists a perfect positive correlation between the two variables, -1 means there is a perfect negative correlation and 0 means there is no correlation. A perfect positive correlation is when one variable moves in either an upward or downward direction and the other variable also moves in the same direction with the same magnitude. Whereas a perfect negative correlation is when one variable moves in the upward direction and the other variable moves in the downward (i.e. opposite) direction with the same magnitude.

The correlation coefficient for the two variables is given by:

Correlation(X,Y) = ρ = COV(X,Y) / SD(X).SD(Y)
where,
cov (X, Y) = the covariance between X & Y
SD (X) and SD(Y) = the standard deviation of the respective variables

If the correlation is high, say 0.8, traders may choose that pair for pairs trading. This high number represents a strong relationship between the two stocks. So if A goes up, the chances of B going up are also quite high. Based on this assumption a market neutral strategy is played where A is bought and B is sold; bought and sold decisions are made based on their individual patterns.

Just looking at correlation might give you spurious results. For instance, if your pairs trading strategy is based on the spread between the prices of the two stocks, it is possible that the prices of the two stocks keep on increasing without ever mean-reverting.

Spread = log(a) – nlog(b)

where 'a' and 'b' = prices of stocks A and B respectively
For each stock of A bought, you have sold n number of stocks of B. Now, both 'a' and 'b' increase in such a way that the value of the spread decreases. This will result in a loss since stock A is increasing at a rate lower than stock B and you are short on stock B. Thus, one should be careful of using only correlation for determining the pairs of the stocks while performing the pairs trading strategy.

Cointegration

The most common test for Pairs Trading is the cointegration test. Cointegration is a statistical property of two or more time-series variables which indicates if a linear combination of the variables is stationary.
Let us understand the statement above. The two time series variables, in this case, are the log of prices of stocks A and B. Linear combination of these variables can be a linear equation defining the spread:

Spread = log(a) – nlog(b)
where 'a' and 'b' are prices of stocks A and B respectively.
For each stock of A bought, you have sold n stocks of B.If A and B are cointegrated, the equation above is stationary. A stationary process has very valuable features which are required to model pairs trading strategies. For instance, in this case, if the equation above is stationary, that suggests that the mean and variance of this equation remain constant over time.So if we start with 'n', which is called the hedge ratio, so that spread = 0, the property of stationary implies that the expected value of spread will remain as 0. Any deviation from this expected value is a case for statistical abnormality, hence a case for pairs trading.

Evidence of Profitability
In an important research paper written by Yale Business School economists Even G. Gatev, William Goetzmann, and K. Geert Rouwenhorst, the authors attempted to prove that pairs trading is profitable. Using a large set of data from 1967 to 1997, the trio found that over any six-month trading period, the pairs trade averaged a +12% return.[1] To distinguish profitable results from plain luck, their test included conservative estimates of transaction costs and randomly selected pairs.More recent research has also shown that pairs trading can still be a profitable venture, although the advent of algorithmic and high-frequency trading (HFT) has left this business largely to the professionals these days

The Bottom Line
The broad market is full of ups and downs that force out weak players and confound even the smartest prognosticators. Fortunately, using market-neutral strategies like the pairs trade, investors and traders can find profits in all market conditions. The beauty of the pairs trade is its simplicity. The long/short relationship of two correlated securities acts as a ballast for a portfolio caught in the choppy waters of the overall market. Good luck with your hunt for profit in pairs trading, and here's to your success in the markets.

LITERATURE REVIEWS
Review of literature
Jose, S. K. (2016). A study of mean reversion in Indian commodities market. This study considers both spot and futures price series of nine commodities for a time period from 2004 to 2013. Since the study needs both spot and futures data with similar dates, commodities where chosen based on the availability of both spot and future data series. Nationalized commodity exchanges like the Multi Commodity Exchange (MCX) and National Commodities and Derivatives Exchange (NCDEX) are the data sources. Present study tries to explore various developments in the Indian commodity market.
Bhagwat, S., & Maravi, A. S.(2016).A Study of Commodity Market V/S Multi Commodity Exchange of India Limited (MCX). The present study is conducted commodity market in India with special reference to Multi Commodity Exchange (MCX). The study is based on secondary data, which has been collected from commodity market and their publications, books related topics, magazines, reputed journals, research paper, new paper, and internet sources like commodity market bulletins, information from commodity exchanges,annual reports of Forward Markets Commission (FMC), and other publications.
Wang et al. (2011), Beckmann and Czudaj (2013) and Van Hoang et al. (2016) have examined the long and short-run inflation hedging potential of gold by using a nonlinear approach. The findings of Wang et al. (2011) suggested that gold returns cannot be used as a hedge against inflation in both US and Japan during low momentum regimes.
Ahmad, S., & Jamshed, M. (2014).Nurturing Agriculture friendly Commodity Derivatives Marketing in India. The market acts as a barometer to identify the status of reforms and to set a standard of achievements. In a broader perspective, the commodity derivatives market should not be limited only to facilitate price discovery and price

risk management but also play a much larger role against the social institutional backdrop of a liberalized economic regime.

Agarwal, N., &Kaur, G. (2010).Agricultural Commodity future trading and its implications. The paper focuses on the conceptual perspective of commodity future trading and its implication on the commodity market. The objectives of the paper are to study the growth of the commodity market in India and study the price volatility, efficiency and arbitrage opportunity of agricultural future commodity market

Sahadevan, 2004; Raizada and Sahi, 2006; Lokare, 2007; Bose, 2008; Kumar and Pandey, 2008; Sahoo and Kumar, 2009; Iyer and Pillai, 2010; Ali and Gupta, 2011; Sehgal, Rajput and Dua, 2012. The existence of cointegrating relationships in the Indian commodities futures market has been supported by majority of studies. However, results supporting the existence of integrating vectors are rare as very few studies in Indian context have tested the efficiency and unbiasedness by imposing restrictions on the co integrating vectors.

Sahadevan (2004) performed tests on futures and spot prices for six agricultural commodities traded at different regional exchanges between January 1999 to August 2001 and obtained results rejecting βo= 0, β1=1. Raizada and Sahi (2006), however, tested futures and spot prices for wheat contract traded at NCDEX between July 2004 to July 2006 and obtained results rejecting βo= 0, β1=1. Further, several studies have examined whether spot and futures prices are cointegrated, using Johansen's cointegration approach and found significant cointegration in spot and futures prices of various commodities contracts traded on Indian commodity exchanges

RESEARCH METHODOLOGY
Research Gap.
GAP: I
Most of the study in Indian commodity market has been done on trading behaviour. Very few studies focused upon commodity segment in risk management area. Therefore, this is the research opportunity for the researcher. Investors, who are trading in commodity segment, may get an advantage how to manage risk in commodity market. Most of the study took place in China, Japan and USA. Very little study took place in Indian.

Wang et al. (2011), Beckmann and Czudaj (2013) and Van Hoang et al. (2016) have examined the long and short-run inflation hedging potential of gold by using a nonlinear approach. The findings of Wang et al. (2011) suggested that gold returns could not be used as a hedge against inflation in both US and Japan during low momentum regimes. In the case of high momentum regimes, gold has shown its inflation hedging potential only in the US while it has not been able to fully hedge inflation in Japan during shortrun. Beckmann and Czudaj (2013) found that gold is a partial hedge against inflation in the long-run in the US and the UK rather than in the Euro area and Japan.

GAP: II
Studying different literatures reviled that some studies has conducted in the agricultural commodity that is (NCDEX). However, very less study has been done in the area of metals, energy and agriculture commodity (MCXINDIA).

Sahadevan (2004) performed tests on futures and spot prices for six agricultural commodities traded at different regional exchanges between January 1999 to August 2001 and obtained results rejecting βo= 0, β1=1. Raizada and Sahi (2006), however, tested futures and spot prices for wheat contract traded at NCDEX between July 2004 to July 2006 and obtained results rejecting βo= 0, β1=1.

Objective of study
The study has following objectives:
1.   To check the effectiveness of commodity pair strategy
2.   To check which pair is more effective
3.   To check the trend analysis of commodity instruments.

Selection of pair from the above list

MCX INDIA commodity instrument pairs / Groups	
Gold	Silver
Lead	Zinc
Crude oil	Natural gas
Aluminium	Copper
Mentha oil	Cotton

Rates of different commodity on MCX India from inception of their trading (2004)

Commodity trend analysis summary

MCX INSTRUMENTS	GOLD	SILVER	CRUDE	NATURAL GAS	LEAD	ZINC	ALUMINIUM	COPPER	COTTON	MENTHA OIL
STARTING DATE	Jan-04	Jan-04	Mar-05	Aug-06	Mar-06	Mar-06	Nov-05	Jun-04	Oct-11	Apr-05
profit in 2004										
profit in 2005	1.11	0						13.38		
profit in 2006	39.62	61.4	16.87	-			19.80	93.17		17.27
profit in 2007	3.91	4.226	0.96	-4.15	80.00	20.48	-7.63	-4.82		-5.45
profit in 2008	31.87	14.65	38.65	28.00	-17.59	-39.39	1.83	-0.34		3.08
profit in 2009	8.27	11.41	27.31	-46.61	-5.62	2.50	-27.03	-12.88		-4.29
profit in 2010	37.18	34.99	18.86	-2.44	16.07	19.51	23.46	35.80		59.65
profit in 2011	30.86	72.81	24.47	-4.50	14.87	4.08	13.00	19.48		55.92
profit in 2012	23.72	3.389	10.16	-18.32	0.89	2.94	-4.42	2.88	-4.77	29.21
profit in 2013	-2.49	-16.5	15.84	42.95	12.39	7.62	0.00	1.17	15.96	-33.70
profit in 2014	-4.35	-14.7	-3.78	16.59	0.00	17.70	6.48	-3.92	-4.60	-31.63
profit in 2015	-5.62	-12.3	43.43	-35.77	-10.24	-8.27	-7.83	-14.87	-15.53	21.52
profit in 2016	12.44	14.21	-5.15	8.38	11.40	18.03	3.77	-7.61	18.30	-1.87
profit in 2017	-1.49	-2.23	12.13	8.29	19.69	32.64	18.18	25.00	7.37	31.61
profit in 2018	5.32	-4.08	31.94	7.14	0.66	4.19	9.23	6.83	6.92	27.77
profit in 2019	14.94	8.52	-8.94	-16.67	-2.61	-3.02	-2.82	-0.46	-3.18	-7.73
profit in 2020	35.32	30.74	-29.70	-8.00	-0.67	-5.70	4.35	10.78	-14.21	-23.05
profit in 2021	-0.71	20.87	78.19	74.53	20.27	33.52	38.89	48.65	47.41	-9.86
profit in 2022	7.39	-7.72	50.65	87.90	2.25	27.16	16.50	0.14	56.95	4.79
% average profit from inception	13.18	12.20	10.61	8.58	8.86	5.81	6.22	11.80	10.05	7.84

For above historical analysis following pair strategies can be created

Particulars	Crude	Natural gas	Gold	Silver	Lead	Zinc	Cotton	Mentha oil	Aluminium	Copper

Average profit from inception (from 2004)	10.61%	8.58%	13.18%	12.20%	8.86%	5.81%	10.05%	7.84%	6.22%	11.80%
Pair	BUY	SELL	BUY	SELL	BUY	SELL	BUY	SELL	SELL	BUY

Lot size of the instruments with margin:

Particulars	Crude	Natural gas	Gold mini	Silver mini	Lead	Zinc	Cotton	Mentha oil	Aluminium	Copper
Lot size	100 Barrel	1250 MMBTU	100 grams	5 KGS	5 MT	5 MT	25 BALES	360 KGS 2 drums	5 MT	2.5 MT
Margin	215173	173496	47647	33593	81531	164909	134011	49076	91511	152797
P or l	100 per 1 rs	1250 per 1 rs	10 rs per 1 rs	5 rs per 1 rs	5000 rs for 1 rs	5000 rs for 1 rs	25 rs for 1 rs	180 rs per 1 rs	5000 rs for 1 rs	2500 rs for 1 rs

Total margin required to trade in pair trade strategy: 11,43,744

Net profit or loss of pair strategy for six-month position (consolidated)

Month	Profit / Loss
Net Profit / Loss for The Month of January 2022	-142290
Net Profit / Loss for The Month of February 2022	-177960
Net Profit / Loss for The Month of March 2022	-110235
Net Profit / Loss for The Month of April 2022	110505
Net Profit / Loss for The Month of May 2022	513732
Net Profit / Loss for The Month of June 2022	481273
Net Profit / Loss for The Month of July 2022	-413147
Net Profit / Loss for The Month of Aug 2022	141994
Net Profit / Loss for The Month of Sep 2022	69399
Net Profit / Loss for The Month of Oct 2022	232868
Net Profit / Loss for The Month of Nov 2022	-230161
Net Profit / Loss for The Month of Dec 2022	76267
return of six-month position	**552245**
investment made	**11,43,744**
Yearly profit	**591499**
percentage yearly return	**51.71603086**

Instrument Wise Effectiveness of Pair Trading Strategy

Instruments	Profit / loss	Effectiveness/ un effectiveness
Cotton – Mentha Oil	563080	Pair trade is effective
Gold - Silver	296090	Pair trade is effective
Aluminium – Copper	26625	Pair trade is effective
Lead- Zinc	-108750	Pair Trading is Ineffective

Crude Oil – Natural Gas	-224800	Pair Trading is Ineffective

FINDINGS OF TREND ANALYSIS

1. It was found from the study that average return in all commodity segment was 9.52%
2. It was found from the study that from 2004 to 2022, highest return in commodity segment was given by Gold (13.18%).
3. It was found from the study that from 2004 to 2022, lowest return was given by zinc (5.81%).
4. It was found from the study that the average return in precious metals was 12.69 %.
5. It was found from the study that average return in base metals was 8.1725 %.
6. It was found from the study that average return in energy sector was 9.6%
7. It was found from the study that average return in agriculture sector was 8.95%

SUGGESTIONS FOR TREND ANALYSIS

1. It is suggested from the study that – in precious metal, investors can create long position in gold and can create short position in silver.
2. It is suggested from the study that in base metal sector investors can create long position in Aluminium and create short position in Copper.
3. It is suggested from the study that in base metal sector investors can create long position in Zinc and create short position in Lead.
4. It is suggested from the study that in energy sector investors can create long position in natural gas and create short position in crude oil.
5. It is suggested from the study that in agriculture sector investors can create long position in Cotton and create short position in Mentha Oil.

Instruments	Profit / loss	Effectiveness/ un effectiveness
Cotton – Mentha Oil	563080	Pair trade is effective
Gold - Silver	296090	Pair trade is effective
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Lead- Zinc	-108750	Pair Trading is Ineffective
Crude Oil – Natural Gas	-224800	Pair Trading is Ineffective

FINDINGS OF PAIR TRADE ANALYSIS

1. It was found from the study that, trading with pair of Lead- Zinc for a year (January 2022 to December 222) there was a loss of 1,08,750 INR hence Pair Trading is Ineffective

2. It was found from the study that, trading with pair of Gold Mini- Silver Mini for a year (January 2022 to December 222) there was a profit of 2,96,090 INR hence Pair trade is effective

3. It was found from the study that, trading with pair of Cotton – Mentha Oil for a year (January 2022 to December 222) there was a profit of 5,63,080 INR. Hence Pair trade is effective

4. It was found from the study that, trading with pair of Aluminium – Copper for a year (January 2022 to December 222) there was a profit of 26,625 hence Pair trade is effective.

5. It was found from the study that, trading with pair of Crude Oil – Natural Gas for a year (January 2022 to December 222) there was a loss of 2,24,800 INR Hence Pair Trading is Ineffective

SUGGESTION BASED ON PAIR TRADE / GROUP TRADE STRATEGY

1. It is suggested from the pair trade study that – in precious metal, investors can create pair strategy by buying gold and selling silver.

2.	It is suggested from the pair trade study that – in agricultural commodity, investors can create pair strategy by buying cotton and selling Mentha oil

3.	It is suggested from the pair trade study that – in energy, investors can create pair trade strategy by buying natural gas and selling crude oil

4.	It is suggested from the pair trade study that – in base metals, investors can create pair trade strategy by buying Zinc and selling Lead.

5.	It is suggested from the pair trade study that – in base metals, investors can create pair trade strategy by buying Aluminium and selling Copper.

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