RELATIONSHIP BETWEEN THE GOLD AND SILVER MARKETS IN INDIA.

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Abstract

A derivative is a financial security with a value that is reliant upon or derived from an underlying asset or group of assets. The derivative itself is a contract between two or more parties based upon the asset or assets. Its price is determined by fluctuations in the underlying asset. The most common underlying assets include stocks, bonds, commodities, currencies, interest rates and market indexes. This study shows the "Performance Analysis of Indian gold and silver Commodity derivative Market" and this analysis made through the study of cointegration in gold and silver commodity market, then the long-term relationship between gold and silver market and price discovery in gold and silver commodity derivative market. The study is made using data taken from MCX website for the last five years and these spot and future prices considered here. The study suggests that There is no long-term relationship between future prices and spot prices of Gold and Silver so there is no cointegration or association between them in long run. In this case for an investor this Gold and Silver are good investment avenues in the long run. Both Gold and Silver has no relationship in the long run so by investing in these commodities the investor can diversify the risk and it's a diversified portfolio.

Key Words: MCX ,Gold and Silver , Cointegration , Granger Causality , Unit root

Introduction

A derivative is a financial security with a value that is reliant upon or derived

from an underlying asset or group of assets. The derivative itself is a contract between two or more parties based upon the asset or assets. Its price is determined by fluctuations in the underlying asset. The most common underlying assets include stocks, bonds, commodities, currencies, interest rates and market indexes.

A commodity market is a market that trades in primary economic sector rather than manufactured products. Soft commodities are agricultural products such as wheat, coffee, cocoa, fruit and sugar. Hard commodities are mined, such as gold and oil. Investors access about 50 major commodity markets worldwide with purely financial transactions increasingly outnumbering physical trades in which goods are delivered. Futures contracts are the oldest way of investing in commodities. Futures are secured by physical assets. Commodity markets can include physical trading and derivatives trading using spot prices, forwards, futures, and options on futures. Farmers have used a simple form of derivative trading in the commodity market for centuries for price risk management.

There are some studies shows long term relationship between commodity gold and silver in the commodity derivative market and some other studies shows no long term relationships between commodity gold and silver price of one commodity lead to the price of other commodity and the future market prices leads to the spot market prices and the future spot price of the commodity leads to the future price so there is efficiency in the commodity derivatives market the future spot price is predicted by the future contract price for example the future price of a commodity after 3 months is 30000 and the spot price of the commodity may become 30000 in the future if it happen there is price discovery . Here there is lot of studies in commodity market but recent period especially after 2013 the studies are less in commodity market

(Gupta, 2011) Made study on the topic efficiency in commodity features markets in India. The purpose of this paper to analyse the efficiency of agricultural commodity markets by assessing the relationships between futures prices and spot market prices of major agricultural commodities in India .The efficiency of the futures market for 12 agricultural commodities, traded at one of the largest commodity exchanges of India, i.e. National Commodity & Derivatives Exchange Ltd, has been explored by using Johansen's cointegration analysis and Granger causality tests. Results show that cointegration exists significantly in futures and spot prices for all the selected agricultural commodities except for wheat and rice. **(Ke, 2005)** Analysed the efficiency of the Chinese wheat and soybean futures markets and assess the conditions in agricultural commodity futures and cash markets in China. Formal statistical tests are conducted through Johansen's

cointegration approach using three different cash prices along with different futures forecasting horizons ranging from one week to six months. Results suggest a long-term equilibrium relationship between the futures price and cash price for soybeans, and a weak short-term efficiency of the soybean futures market. **(Easwaran, 2008)** Commodity futures and derivatives have a crucial role to play in the price risk management process, especially in agriculture. The present study is an investigation into the futures markets in agricultural commodities in India. The statistical analysis of data on price discovery in a sample of four agricultural commodities traded in futures exchanges have indicated that price discovery does not occur in agricultural commodity futures market. The econometric analysis of the relationship between price return, volume, market depth and volatility has shown that the market volume and depth are not significantly influenced by the return and volatility of futures as well as spot markets. **(Sehgal, 2012)** Made study on price discovery relationship for ten agricultural commodities has been examined. Price discovery is confirmed for all commodities except Turmeric. Price discovery results are encouraging given the nascent character of commodity market in India. However the market does not seem to be competitive. The findings have implications for policy makers, hedgers and investors and will help in deeply understanding the role of futures.

Scope of the paper

This study shows the "Performance Analysis of Indian gold and silver Commodity derivative Market" and this analysis made through the study of cointegration in gold and silver commodity market, then the long-term relationship between gold and silver market and price discovery in gold and silver commodity derivative market. The study is made using data taken from MCX website for the last five years and this spot and future price considered here.

Objectives

The objectives of this study are as follows:

1. To study the long-term relationship between spot prices of gold and silver.
2. To study the long-term relationship between future prices of gold and silver.
3. To study the efficiency of futures market in price discovery in gold and silver market

Methodology

The data for this study is taken from the MCX website for the last five years and this include the future and spot prices quoted in MCX Gold and Silver market

and this is studied here and the analysis is made using the econometric tests like Johancen's cointegration, Granger causality test and ADF test and PP unit root test. So, the tests is made using above mentioned tests.

In statistics and econometrics, an **Augmented Dickey–Fuller test (ADF)** tests the null hypothesis that a unit root is present in a time series sample. The alternative hypothesis is different depending on which version of the test is used, but is usually stationarity or trend-stationarity. It is an augmented version of the Dickey–Fuller test for a larger and more complicated set of time series models. The augmented Dickey–Fuller (ADF) statistic, used in the test, is a negative number. The more negative it is, the stronger the rejections of the hypothesis that there is a unit root at some level of confidence.

In statistics, the **Phillips–Perron test** (named after Peter C. B. Phillips and Pierre Perron) is a unit root test. That is, it is used in time series analysis to test the null hypothesis that a time series is integrated of order 1.

In statistics, the **Johansen test**, named after Søren Johansen, is a procedure for testing cointegration of several, say k, I(1) time series. For the presence of I(2) variables see Ch. 9 of his 1995 textbook. This test permits more than one cointegrating relationship so is more generally applicable than the Engle–Granger test which is based on the Dickey–Fuller (or the augmented) test for unit roots in the residuals from a single (estimated) cointegrating relationship.

$$\lambda_{Trace}(r) = -T \sum_{i=r+1}^{g} in(1 - \hat{\lambda}_i)$$

$$\lambda_{Max}(r, r+1) = -T \ln(1 - \hat{\lambda}_{r+1})$$

There are two types of Johansen test, either with trace or with eigenvalue, and the inferences might be a little bit different. The null hypothesis for the trace test is that the number of cointegration vectors is $r=r^*<k$, vs. the alternative that $r=k$. Testing proceeds sequentially for $r^*=1, 2$, etc. and the first non-rejection of the null is taken as an estimate of r. The null hypothesis for the "maximum eigenvalue" test is as for the trace test but the alternative is $r=r^*+1$ and, again, testing proceeds sequentially for $r^*=1, 2$, etc., with the first non-rejection used as an estimator for r.

The **Granger causality test** is a statistical hypothesis test for determining whether one time series is useful in forecasting another, first proposed in 1969. Ordinarily, regressions reflect "mere" correlations, but Clive Granger argued that

causality in economics could be tested for by measuring the ability to predict the future values of a time series using prior values of another time series.

Long term Relationship with Spot Gold and Silver and Future Gold and Silver

The testing of the long term relationships with the spot gold and silver prices and future gold and silver prices is normally made using Johansen cointegration model and this is used here, before making Johansen cointegration need to consider lot of other factors that are the descriptive statistics to analyze the basic behavior of the data and unit root test to identify whether the data is stationary and after that we need to fix the lag length criteria to identify the lag structure after these all steps applied Johansen cointegration

Descriptive statistics is used to know the basic behavior of the data. It gives information about mean, median, standard deviation, Skewness, Kurtosis etc and it helps to know whether the data is normal or not. If the data is not normal, we want to smoothen the data. In order to smoothen the data, the data series are to be converted into Log. If the value of skewness and kurtosis are if the value of skewness and Kurtosis are 0 and 3 respectively, the observed distribution is said to be normal but if the skewness coefficient is in excess of one, it is considered as fairly extreme and the low or high kurtosis value indicates extreme platykurtic or extreme leptokurtic

Table 1

Descriptive Statistics

Commodity	Mean	Median	Std. Dev.	Skewness	Kurtosis	Jarque-Bera
Future Gold	28478.63	28659.00	1764.493	0.100215	3.213127	4.433126
Future Silver	40511.54	39850.11	4171.672	0.817480	3.931686	183.4012
Spot Gold	28544.72	28808.00	1754.617	-0.18159	2.093345	49.40556
spot silver	40174.59	39483.00	4080.687	0.728726	3.571116	126.9072

In the case of commodity gold future price the value of skewness is near to zero and the value of kurtosis is near to 3 so it is concluded that the data of commodity gold future is near to normal distribution. The value of Jarque Bera

statistics also shows near to normal distribution. For the value of commodity future silver the value of skewness and Jarque Bera is near to normal distribution and the value kurtosis indicates leptokurtic. So it is assumed the data of commodity future silver is near to normal distribution.

In the case of commodity spot gold prices the value of skewness and Jarque Bera is near to normal distribution and the value of kurtosis indicates platykurtic. So it is assumed the data of commodity spot gold is near to normal distribution. When the commodity spot silver prices is considered the value of kurtosis and the Jarque Bera is near to normal distribution and skewness is also near to normal distribution so the commodity silver spot price is assumed to be normal.

Unit Root Test

The **unit root test** is used to ensure that the variables are stationary. The null hypothesis is generally states the presence of a unit root and alternative hypothesis there is no unit root. The unit root test is performed with the help of Augmented Dicky Fuller Test (ADF) and Philips-Perron test (PP). These two tests show the T statistics and probability value at level and first difference. Then it is decided to reject the null hypothesis when the t statistics is significant at 1%, 5% and 10% levels. Here we use ADF Test and PP test for identifying whether the data is stationary or not. This can be identified using T statistics and the probability value. The null hypothesis is set like that the data has a unit root and if the probability value is more than 0.05 in that case we accept the null hypothesis that means the data has a unit root the data is not stationary. If the probability value is less than 0.05 in that case the null hypothesis is rejected and the data has said to be there is no unit root so the data is said to be stationary normally there is acceptance of null hypothesis in level and we reject it in first difference, if it accepts in level and reject it in first difference so in that case the data is stationary. In the case of T statistics the T statistics is more than the level of significance in level and in first difference the T statistics is less than the level of significance here we reject the null hypothesis, so if all these thongs satisfied we say the data is stationary the following table shows about the normality of data.

Table 4.2

Unit Root Test

	ADF Test				PP Test			
	Level		First Difference		Level		First Difference	
	Probability value	T statistics	Probability value	T statistics	Probability value	T statistics	Probability value	T statistics
Future Gold	0.0585	-2.79979	0.0000	**-26.14****	0.0726	3.84265	0.0001	**-55.17****
Future Silver	0.0848	-2.64211	0.0000	**-29.57****	0.0699	-2.72575	0.0000	**-29.82****
Spot Gold	0.2264	-2.14697	0.0000	**-36.74****	0.1081	-2.53186	0.0000	**-36.99****
Spot Silver	0.1372	-2.41710	0.0000	**-36.94****	0.0781	-2.67817	0.0000	**-37.02****

** The null hypothesis is rejected at 1 % significance level

We can see that in the above table there is T statistics and the probability value both in the **Augmented Dickey Fuller Test (ADF)** and **Philips-Perron test (PP).**

In the case of **future gold prices** in ADF test we can see that the probability value 0.0848 and T statistics -2.79979 at level so in here at level we can see that the probability value is more that 0.05 so here we failed to reject the null hypothesis and we say that there is unit root in the data so the data is not stationary. In the case of first difference we can see that the probability value is only 0.0000 and it is below the normal so we reject the null hypothesis there is a unit root so we can say that the data is stationary. In the case of future gold prices in PP test we can see that the probability value 0.0726 and T statistics -3.84265 at level so in here at level we can see that the probability value is more that 0.05 so here we failed to reject the null hypothesis and we say that there is unit root in the data so the data is not stationary. In the case of first difference we can see that the probability value is only 0.0000 and it is below the normal so we reject the null hypothesis there is a unit root so we can say that the data is stationary. So we can conclude that both in ADF and PP test the data is show unit root or non-stationary in level but in first difference it shows no unit root so the data is stationary.

In the case of **future silver prices** in ADF test we can see that the probability value 0.0585 and T statistics -2.64211 at level so in here at level we can see that the probability value is more that 0.05 so here we failed to reject the null hypothesis and we say that there is unit root in the data so the data is not stationary. In the case of first difference we can see that the probability value is only 0.0000 and it is below the normal so we reject the null hypothesis there is a unit root so we can say that the data is stationary. In the case of future gold prices in PP test we can see that the probability value 0.0699 and T statistics -2.72745 at level so in here at level we can see that the probability value is more than 0.05 so here we failed to reject the null hypothesis and we say that there is unit root in the data so the data is not stationary. In the case of first difference we can see that the probability value is only 0.0000 and it is below the normal so we reject the null hypothesis there is a unit root so we can say that the data is stationary. So we can conclude that both in ADF and PP test the data is show unit root or non-stationary in level but in first difference it shows no unit root so the data is stationary.

In the case of **spot gold prices** in ADF test we can see that the probability value 0.2264 and T statistics -2.14697 at level so in here at level we can see that the probability value is more that 0.05 so here we failed to reject the null hypothesis and we say that there is unit root in the data so the data is not stationary. In the case of first difference we can see that the probability value is only 0.0000 and it is below the normal so we reject the null hypothesis there is a unit root so we can say that the data is stationary. In the case of future gold prices in PP test we can see that the probability value 0.1081 and T statistics -2.53186 at level so in here at level we can see that the probability value is more than 0.05 so here we failed to reject the null hypothesis and we say that there is unit root in the data so the data is not stationary. In the case of first difference we can see that the probability value is only 0.0000 and it is below the normal so we reject the null hypothesis there is a unit root so we can say that the data is stationary. So we can conclude that both in ADF and PP test the data is show unit root or non-stationary in level but in first difference it shows no unit root so the data is stationary.

In the case of **spot silver prices** in ADF test we can see that the probability value 0.1372 and T statistics -2.41790 at level so in here at level we can see that the probability value is more that 0.05 so here we failed to reject the null hypothesis and we say that there is unit root in the data so the data is not stationary. In the case of first difference we can see that the probability value is only 0.0000 and it is below the normal so we reject the null hypothesis there is a unit root so we can say that the data is stationary. In the case of future gold prices in PP test we can see that the

probability value 0.0781 and T statistics -2.67817 at level so in here at level we can see that the probability value is more than 0.05 so here we failed to reject the null hypothesis and we say that there is unit root in the data so the data is not stationary. In the case of first difference we can see that the probability value is only 0.0000 and it is below the normal so we reject the null hypothesis there is a unit root so we can say that the data is stationary. So we can conclude that both in ADF and PP test the data is show unit root or non-stationary in level but in first d**4.2.4**

Johansen Cointegration

In statistics, the Johansen test, named after Søren Johansen, is a procedure for testing cointegration of several, say k, I(1) time series. For the presence of I(2) variables see Ch. 9 of his 1995 textbook. This test permits more than one cointegrating relationship so is more generally applicable than the Engle–Granger test which is based on the Dickey–Fuller (or the augmented) test for unit roots in the residuals from a single (estimated) cointegrating relationship.

There are two types of Johansen test, either with trace or with eigenvalue, and the inferences might be a little bit different. The null hypothesis for the trace test is that the number of cointegration vectors is r=r*<k, vs. the alternative that r=k. Testing proceeds sequentially for r*=1,2,etc. and the first non-rejection of the null is taken as an estimate of r. The null hypothesis for the "maximum eigenvalue" test is as for the trace test but the alternative is r=r*+1 and, again, testing proceeds sequentially for r*=1,2,etc., with the first non-rejection used as an estimator for r

The Johansen test is a test for cointegration that allows for more than one cointegrating relationship, unlike the Engle–Granger method, but this test is subject to asymptotic properties, i.e. large samples. If the sample size is too small then the results will not be reliable and one should use Auto Regressive Distributed Lags (ARDL). And here there is two hypothesis where there is no cointegration or there is at least one cointegration, there is both Trace test and Maximum Eigenvalue both of these is considered here following data shows the cointegration test of future gold and silver prices and spot gold and silver prices

Table 3
Unrestricted Cointegration Rank Test (Trace)

Hypothesized		Trace	0.05	
No. of CE(s)	Eigenvalue	Statstic	Critical value	Prob.**
None**	0.007355	16.05591	15.49471	0.0411
Atmost 1*	0.005593	6.931739	3.841466	0.0085

Trace test indicates 2 cointegrating eqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

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

Table 4
Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized		Max-Eigen	0.05	
No. of CE(s)	Eigenvalue	Statstic	Critical value	Prob.**
None	0.007355	9.124172	16.26460	0.2760
Atmost 1*	0.005593	6.931739	3.841466	0.0085

Max-eigenvalue test indicates no cointegration at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

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

Here in trace test it shows there is cointegrating equations and there cointegration between gold and silver future prices but the Maximum Eigenvalue shows there is no cointegrating equations and there is no cointegration

Cointegration result of spot gold and silver prices

Table 5

Unrestricted Cointegration Rank Test (Trace)

Hypothesized		Trace	0.05	
No. of CE(s)	Eigenvalue	Statstic	Critical value	Prob.**
None	0.004931	10.51259	15.49471	0.2433
Atmost 1*	0.003522	4.378539	3.841466	0.364

Trace test indicates no cointegration at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

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

Table 6
Unrestricted Cointegration Rank Test (Trace)

Hypothesized		Max -Eigen	0.05	
No. of CE(s)	Eigenvalue	Statstic	Critical value	Prob.**
None	0.004931	6.134053	14.26460	0.5961
Atmost 1*	0.003522	4.378539	3.841466	0.0364

Max-eigenvalue test indicates no cointegration at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

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

Here both in Trace test and Maximum Eigenvalue there is two hypotheses normally set firstly there is no cointegration and secondly at most one cointegration so here we see that there is in trace test and Maximum Eigenvalue there is no cointegration so hypothesis is rejected here.

So we conclude that there is no cointegration between future gold and silver price and also there is no cointegration between spot gold and silver prices.

Efficiency of gold and silver market in price discovery

Price discovery in commodity market means the future prices are efficient enough to predict the future spot prices and here in this paper the price discovery in commodity market is analyzed using Granger Causality model. Here just use the similar steps up to testing the causality all other steps are similar and here need to test the short-term relationships also if there is short term relationship there should be price discovery

Granger causality test is used to identify the short-term relationships of the data also it is used for price discovery it is used to identify whether the future contract price is efficient enough to predict the future price or not. The causality is used to identify where the future price predicts the future spot price or not if it predicts it means there is price discovery and it is possible here.so causality is used to identify both the short-term relationship and the price discovery in gold and silver market. The following figures show causality in Gold and Silver market. The steps for causality are similar to that of cointegration test

4.3.1 Granger Causality between Spot and Future Gold prices

Table 4.9
Granger Causality between Gold future and spot prices

Null Hypothesis	Obs	F-Statistic	Prob.
			0.00000000
ZGS does not Granger Cause ZGF	1241	59.2724**	5
ZGF does not Granger Cause ZGS		15.3211**	0.0000037

** The null hypothesis is rejected at 1 % significance level

In the case of gold spot and future price there is two hypotheses where the gold spot prices does not granger causes gold future prices and gold future price does not granger causes gold spot prices and we accept the hypothesis where the probability value is more than 0.05 otherwise, we reject it and say that there is granger cause. By analyzing the above figures, we can say that the both the probability value is less

than 0.05 so we can reject the null hypothesis in both the cases and we can say that there is causality between gold spot and future market.

So in the case of commodity gold market there is causality between the spot and the future market and price discovery is possible here the future contract price is efficient enough to predict the future spot price and the market is efficient

4.3.2 Granger Causality between Spot and Future silver prices

Table 4.10

Granger Causality between Silver future and spot prices

Null Hypothesis	Obs	F-Statistic	Prob.
ZGS does not Granger Cause ZSF	1242	191.600**	0.00000000
ZGF does not Granger Cause ZSS		5.92341	0.0151

** The null hypothesis is rejected at 1 % significance level

In the case of silver spot and future price there is two hypothesis where the silver spot prices does not granger causes silver future prices and silver future price does not granger causes silver spot prices and we accept the hypothesis where the probability value is more than 0.05 otherwise we reject it and say that there is granger cause. By analyzing the above figures we can say that the both the probability value is less than 0.05 so we can reject the null hypothesis in both the cases and we can say that there is causality between silver spot and future market.

So in the case of commodity silver market there is causality between the spot and the future market and price discovery is possible here the future contract price is efficient enough to predict the future spot price and the market is efficient

Conclusion

There is some studies shows long term relationship and some studies shows no relationship between different commodities in the commodity derivative market and price of one commodity lead to the price of other commodity. In the previous studies commodity gold and silver market can see that there is price discovery and short-term relationships. The future prices of the commodity predict the future spot prices. Here the problem under the study is "Performance Analysis of Indian gold and silver Commodity Derivative Market. The results are obtained by evaluating the data taken from the MCX website and two tests are applied and after all these

made some findings. The commodity gold and silver spot and future prices are evaluated here and, Johansen cointegration and Granger causality is applied for getting the result.

After conducting the study, following findings are made:

1. There is no long term relationship between spot prices of Gold and Silver; it has no relationship in long run.

2. There is no long term relationship between future prices of Gold and Silver, can found any relationship in long run.

3. Future price of Silver is efficient enough to predict the future spot prices, Silver spot price granger causes commodity Silver future prices and vice versa so the price discovery is possible here.

4. Future price of Gold is efficient enough to predict the future spot prices, Gold spot price granger causes commodity Gold future prices and vice versa so the price discovery is possible here.

The study suggests that There is no long term relationship between future prices and spot prices of Gold and Silver so there is no cointegration or association between them in long run. In this case for an investor this Gold and Silver are good investment avenues in the long run. Both Gold and Silver has no relationship in the long run so by investing in these commodities the investor can diversify the risk and it's a diversified portfolio. The study suggests that the investment in gold and silver is good for risk averse investors.

The result of cointegration test shows that there is no long term relationships with gold and silver spot prices and also the results shows that there is no relationship with gold and silver future prices. When consider the third objective where there is efficiency in price discovery we can identify that there granger cause between spot and future prices of commodity gold and spot and future prices of commodity silver. So can conclude that there is efficiency in commodity market for predicting the future spot prices, the future price discovers the future spot prices and there are short term relationships between gold and silver spot and future prices

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