Exploring relationship between Gold & Silver Prices (Impact of Covid Crisis)

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Abstract
Gold and silver have been alternatives for thousands of years signifying that there is a long run relationship between these two metals.

This paper studies if the long established relationship between Gold and Silver prices continue in the recent period, specially focusing on the relationship during recent economic crisis caused to Covid 19. Cointegration test is performed to check whether the prices of gold and silver, even if they drift apart in short term, demonstrate a long run relationship or not. The Error Correction model has been followed to show that price of gold drives the demand for the price of silver in the long run.

Findings suggest that the relationship continues to exist between these variables and establishing a presence of Error Correction which is bringing the prices back to Equilibrium. Findings also suggest that the exist slow rate of of adjustment to equilibrium during Covid crisis period establishing the fact that prices of Gold and Silver are more closely cointegrated in this period.
Keywords: Cointegration, Gold, Silver, Error correction

I.   Introduction

Gold and Silver prices have been an area of interest for researchers for a long period due to their vast usage over the years. They are various factors which drive prices of Gold and Silver from domestic demand such as jewellery ranging to industrial usage of Silver to Central Bank demand for Gold. Precious materials such as Gold and Silver also are a good hedge against inflation, thus they are preferred investors choice for save haven investments.

Gold is considered as the chief driver for silver prices. Since Silver has a relatively smaller market as compared to gold, it does not take a lot of time for silver prices to follow the prices of gold. During the subprime crisis too, when the prices of gold increased silver prices also increased. In the past it has also been observed that when the gold prices declined, the silver prices plummeted by even greater margin. It has been observed that silver prices tend to follow gold prices, hence in this paper this fact has been taken into account.

II.   Literature review

There has been various studies on relationship between prices of Gold and Silver over the years demonstrating relationship across periods and business cycles.

Recent study include, Meriem Bel Haj Mohamed et al (2014) [1] in their paper studied the relationship between gold prices and various factors including silver price for period January 2000, through 28, 2013 using "the Johansen approach, the result reveals the existence of a long-run relationship between variables"

Zouheir Ahmed Mighri et al (2018) [2] in their paper also discuss the relationship between gold and silver prices using cointegration approach from January 1968 to May 2016 in their study they concluded that "asymmetric threshold cointegration between these two series, instead of the linear cointegration well established in the literature. Also, gold has a much faster reaction to negative deviations from long-term equilibrium than positive deviations".

There were also study contradicting the popular belief of relationship between Silver and Gold prices by C. Ciner et al (2001) [3] in their study of prices of gold and silver futures contracts traded on the Tokyo Commodity Exchange for period between 1992 and 1998 had concluded that "long-term stable relationship between the prices of gold and silver has disappeared".

However, Brian M Lucey et al (2003) [4] re-examine the results of C. Ciner and note that, "this was a period when with rare exceptions and observed non-rejection of the null of no cointegration. In the overall context however this period is unexceptional – at some time periods we will find cointegration, at others not. This may indicate that the results of Ciner (2001) are driven by the period under analysis."

Overall their findings indicate that in the long run the stable relationship historically observed between gold and silver has been maintained. However, there are significant periods when it is weakened or broken.

Alvaro Escribano et al (1998) [5] where some early work which focused on behaviour of prices during various cycle, with monthly data from 1971 to 1990, they found that "cointegration could have occurred during some periods and specially during the bubble and post bubble period. That gold and silver prices have been strongly related is evident from their behaviour during the bubble period."
Dirk G. Baur et al (2014) [6] closely follow Escribano (1998) and extend their study
The paper finds that such episodes, in particular bubbles, cause such relationships. If bubble periods are accounted for in the models, the evidence of a long-run relationship either disappears or weakens substantially. "Interestingly, the global financial and economic crisis in 2008 does not display an impact on the gold-silver relationship similar to be bubbles and thus can be clearly distinguished from such episodes."
Oleg Kucher et al (2016) [7] in their study analysed the long-run relationships between futures prices of precious metals including gold and silver prices with weekly data from 1975 to 2015. "Their findings indicate that there are cointegrating relationships, However, the long-run relationships are unstable. The findings also reveal that the cointegration relationships between precious metal prices decline around business cycle peaks and shift upward during recessions."

III.   Objective of the study:

Basis the above mentioned studies, we try to study the existence of the long-run relationship between goldand silver prices in recent years. Also as previous studies mentions the cointegration relationship varies during various business cycle and period of economic crisis, **we see the impact of economic crisis in Gold and silver prices and impact on rate of adjustment to the equilibrium in error correction model.**
Silver has been taken as the dependent variable and gold has been considered to be the independent variable for the purpose of research

IV.   Data and Sources of Data:

The study has been done using secondary source of data for period of January 2014 to December 2020. The data uses is average monthly price in rupee value unit per troy ounce.
The Gold prices data been collected from the website of the World Gold Council and Silver prices have been collected from statista (published by World Bank).The sample size of the data is 84 observations.
For analysis of Covid impact, daily closing price of Gold and silver are considered.
The sample size for this analysis is 253 observations.
LN of each data value is computed as it's a convenient means of transforming a highly skewed variable into a more normalized dataset.

V.   Research Methodology

To determine if there is any cointegration relationship between Gold and Silver price we have run Engel-Granger test for cointegration. The steps for Engel-Granger test include, first,computing residuals based on the static regression and then testing the residuals for the presence of unit roots (ie stationarity). Testing of Stationarity is done through Augmented Dickey-Fuller Test (ADF)
As per Engle-Granger method, if the residuals are stationarity then the data is said to be cointegrated, as residuals being stationary suggest that the errors are "equilibrating".
In other words, there is an error correction mechanism which is going on and trying to make the series come back to an equilibrium, ie trying capture the short run phenomenon, this short run adjustment process leads to long run relation.
Therefore we model see and quantify how and to what extent error is getting corrected in the short run. This is done by regressing Differential LN of Silver price as Dependant variable and Differential LN of Gold price and lagged residual as Independent variable.The Coefficient of lagged residual is the error correction term which is also referred as gamma.
Similar method steps have been followed for both set of data.

VI.   Results & Interpretation of the results

The Dependant variableie LN Silver Prices and independent variable ie LN Gold Prices were testedNon Stationary using ADF test.The residuals were computed from regressing the dependant variable ie LN Silver Prices on independent variable ie LN Gold Prices and time. The residuals were tested Stationary using ADF test.The output table for ADF test is illustrated below:

ADF Test	Silver	Gold	Residual
criteria	schwert	schwert	Schwert
drift	yes	yes	No
trend	yes	yes	No
alpha	0.05	0.05	0.05
tau-stat	-2.02	-1.42	-3.39
tau-crit	-3.46	-3.46	-1.94
stationary	no	no	Yes
p-value	> .1	> .1	< .01

Thus as the residuals arestationary, thereby illustrating the fact that Gold and Silver prices are cointegrated, which means they continue to have a long term relationship even in recent period.

As the cointegrating relationship has been established, we model to see the error correction mechanism. The output is illustrated below:

ANOVA

	df	SS	MS	F	Significance F
Regression	2	0.140933929	0.07046696	38.9155317	0.00%
Residual	80	0.144861368	0.00181077		
Total	82	0.285795297			

	Coefficients	Standard Error	t Stat	P-value
Intercept	0.00	0.00	-0.70	0.48
df LN (G)	1.11	0.15	7.19	0.00
lag residual	-0.16	0.07	-2.34	0.02

As theSignificant F is less than 5%, thus the regression model is significant and can be used for prediction.

The coefficient of the error-correction term of about –0.16 suggests that about 16%
of the discrepancy between long-term and short-term Silver prices is corrected within a month., suggesting a swift rate of adjustment to equilibrium.

To see the relationship of Gold and Silver prices and error correction mechanism during Covid crisis, similar steps have been followed for data of this period.

The observation of analysis of this period data is as below:

LN Silver Prices and LN Gold Prices were testedNon Stationary using ADF test.The residuals, which were computed from Regressing LN Silver Prices on LN Gold Prices were tested Stationary using ADF test.The output table for ADF test is illustrated below:

ADF Test	Silver	Gold	Residual
criteria	schwert	Schwert	schwert
drift	yes	Yes	No
trend	yes	Yes	No
alpha	0.05	0.05	0.05
tau-stat	-1.36	-1.93	-2.11
tau-crit	-3.43	-3.43	-1.94
stationary	no	No	Yes
p-value	> .1	> .1	0.04

Thus as the residuals are stationary, thereby illustrating the fact that Gold and Silver prices are cointegrated even for the period of Covid crisis of 2020

As the cointegrating relationship has been established, we model to see the error correction mechanism. The output is illustrated below:

ANOVA

	df	SS	MS	F	Significance F
Regression	2	0.09	0.05	94.17	0.00
Residual	249	0.12	0.00		
Total	251	0.21			

	Coefficients	Standard Error	t Stat	P-value
Intercept	0.00	0.00	0.15	0.88
DF LN G	1.49	0.11	13.43	0.00
lagged residual	-0.02	0.01	-1.95	0.04

As theSignificant F is less than 5%, thus the regression model is significant and can be used for prediction.

The coefficient of the error-correction term of about -0.02 suggests that only about 2% of the discrepancy between long-term and short-term Silver is corrected within a day suggesting a slow rate of adjustment to equilibrium.

Thereby illustrating the fact that prices of Silver and Gold during economic and financial crisis are more closely cointegrated, which is in line with Alvaro Escribano et al (1998)[5] findings.

VII.   Conclusion:

In this paper, we studied the relationship between Gold and Silver prices from January 2014 to December 2020. Our findings indicate that the long established relationship between the two variables exist in the period under our study. The prices of Gold and Silver arenon-stationaryi.e they drift apart in short term, However as they are cointegrated, in long term the series are brought back together by means of error correction mechanism.

Further, the study also establishes the relationship between the variables during economic crisis as discussed by with Alvaro Escribano et al (1998) [5] for period of Covid crisis of 2020, Our finding suggest that the Silver and Gold prices are more closely cointegrated,as there exist slow rate of of adjustment to equilibrium during this period.

Thus these findings can be used for investors seeking investment into these precious materials, specially during the tenure of economic crisis.

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