Causal Relationship between Gold Price and Sensex: A Study in Indian Context

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ABSTRACT

Gold has been used around the world as an instrument for investment to hedge against inflation or in the form of jewellery. All these factors are the reason for hyping the demand for gold day by day. As per world gold council gold demand in India is about to rise 33% by 2020.The cumulative annual demand will be excess of 1,200 tonnes by 2020.Recently India has become the largest consumer of gold and price of gold is likely to breach Rs 32,000 mark in the next calendar year. There is an inverse relationship between gold price and dollar. In this paper, an attempt has been made to investigate the existence of unidirectional or bidirectional relationship between gold price and Sensex for the period of 10 years (2002-2012). The results of the analysis show that there is no causality between the gold price and Sensex.

Keywords: *Gold Prices, Stock Market Return, BSE, Volatility, Co-integration.*

I. Introduction:

Gold appears to have its own "logics" and mystique. It has traditionally been very conservative investment due to it's relatively scarcity, but it tends to accurate reflector of short term fear about the economy in general. Gold has traditionally been considered an attractive investment in India and its excellent performance in recent years has substantially confirmed the wisdom of that tradition. When markets are volatile and investors panic they tend to move out the risky assets such as stock and invest into assets such as gold. Gold like virtually all commodities is traded on a dollar dominated basis. In times of crisis, capital often flow out of emerging markets currencies. This makes it a doubly attractive investment for Indian investors in volatile times, the rise in the rupee price of gold is fuelled by both the increase in international gold prices and by the appreciation of the dollar against the rupee.

Gold as an investment option was dramatically illustrated in early 2009. Gold surged even as global stock markets plunged and the rupee briefly traded at Rs. 51 to the dollar.

Prior to the introduction of liberalization and globalization policies, gold prices in India showed an increasing trend (Figure-1). In the post liberalization period, the average annual prices of gold also showed an increasing trend from the year but, it showed a decreasing trend in 1997 and 1998 and again showed an increasing trend in the year 2000. From 2002 to 2012, gold prices are continuously increasing. The domestic gold price in India is continuously increasing due to its heavy demand in the country. There are several reasons gold has high demand in India. The first reason is security; gold offers full security as long as it is retained by central banks. There is no credit risk attached to gold. Secondly, gold is able to maintain its liquidity even at times of crisis situations like high global inflation or political turbulence. The third reason for holding gold is to build a diversified portfolio. Gold also has taken the role of an asset of last resort. World Economic History shows that countries have repeatedly used gold as security against loans when they have had difficulties with their Balance of Payments and have felt the need to borrow on the international capital markets.

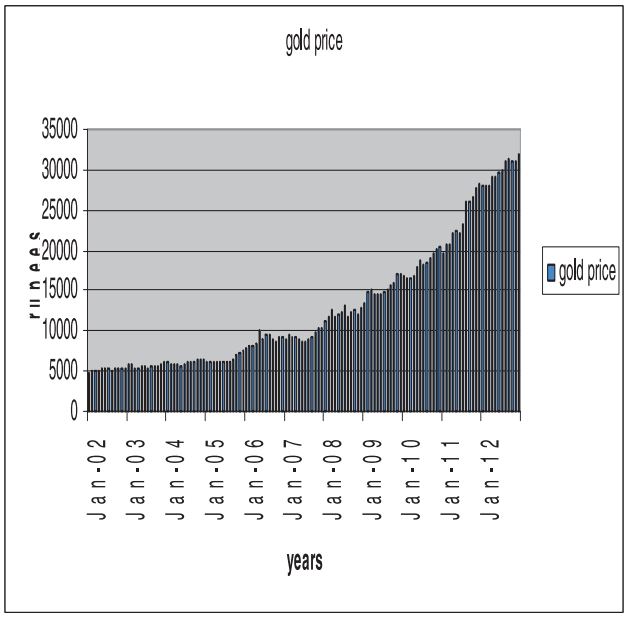

Figure 1: Yearly Movement of Gold Price
Source: Bombaybullion.com

Analysis of the historical data reveals that when the stock market crashes or dollar weakens, gold continues to be a safe haven investment because of rising gold prices in such circumstances. It can be safely concluded that investors increasingly hedge their investments through gold at the time of crises.

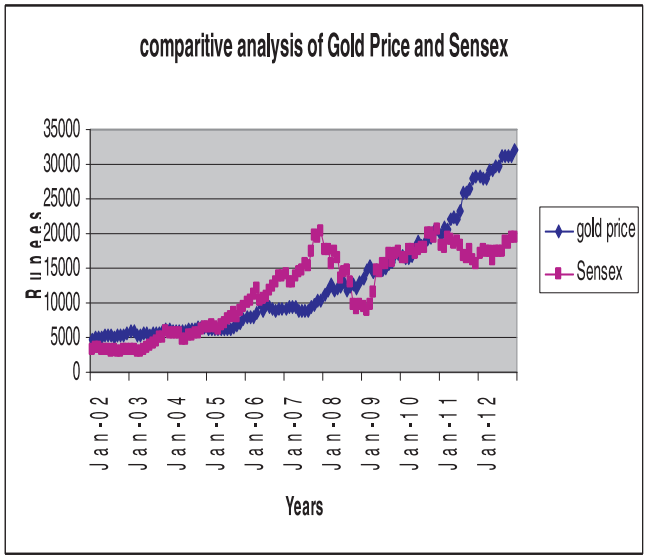

Figure 2: Movement of gold price and Sensex
Source: Handbook of Statistics, SEBI

Figure 2 clearly demonstrates the trend in the movement of Sensex and Gold price from 2002 to 2006. It appears they are moving in same direction but when market crashed in 2008 gold price were increasing at a steady rate and in the year 2011-12 when Sensex was down the price of gold reached a new height . This clearly points out that there can be possibility of inverse relationship between the two variables. There are other factors which drive gold price.

Gold is often used as an inflation hedge. Inflation tends to increase because of higher demand and higher salaries i.e. wage inflation, increasing the cost of goods and services along with this consumption increase and people buy more goods-cars and house in particular causing prices of oil and industrial metals to rise. Inflation has the effect of reducing the purchasing power of a currency-a given amount of money less as time passes. Historically, in such times, gold and other tangible assets such as real estate have acted as stores of value.

II. Data and Methodology

This paper aims at investigating the dynamic relationship between gold prices and stock market returns in India for the period 2002 to 2012. This study is mainly based on secondary data that have been collected from the database on Indian economy maintained by Reserve Bank of India and Bombay Bullion Association. The study analyses the monthly data on domestic gold prices and stock market returns in India for the aforesaid period. Wherever data were missing, the averages of the data of the previous month and next month have been taken.

The monthly stock market returns (*R t)* based on BSE Sensex have been calculated by the logarithmic difference change in the Sensex, i.e.

R_t=Log (I_t / I_{t-1}) where I_t and I_{t-1} are the closing value of monthly Sensex index at time 't' and "t-1" respectively.

At the outset, Karl Pearson's correlation coefficient between the aforesaid time series has

been calculated and its significance has been tested by the t-test. The correlation has been calculated by using the formula:

$$r = \frac{N\sum XY - \sum X \sum Y}{\sqrt{\sum X^2 - (\sum X)^2}\sqrt{\sum Y^2 - (\sum Y)^2}}$$

And the significance of this correlation coefficient has been tested by the t-test using t-statistics

$$t_{n-2} = \frac{r\sqrt{n-2}}{\sqrt{1-r^2}}$$

Under the null hypothesis $H_0: \rho = 0$ against the alternative hypothesis of $H_1: \rho \neq 0$ with n-2 degrees of freedom. If the calculated value of t exceeds the critical value of t, then the null hypothesis will be rejected; otherwise accepted.

Once the correlations are computed, the Granger causality between the variables has been investigated in the Vector Error Correction framework. However the variables are checked for the stationarity and along with presence of co integration between variables. The Augmented Dickey-Fuller unit root test has been used to examine the stationarity of the time series and order of integration between the variables.

The equation of ADF unit root test is given by:

$$\Delta Y_t = \alpha_0 + \alpha_1 Y_{t-1} + \sum \gamma_j \Delta Y_{t-j} + \varepsilon_t$$

The ADF unit root test is based on the null hypothesis H_0: Y_t is not I (0). If the calculated ADF statistic is less than the critical value, then the null hypothesis is rejected; otherwise accepted. If the variable is stationary at level, the variable is said to be integrated of order zero, I (0). If the variable is non-stationary at level, the ADF test can be utilized and the first difference of the variable can be used for testing a unit root. In this case, the variable is said to be co-integrated of order one, I (1).

In the second step, the Johansen's co integration test has been applied to check whether the long run equilibrium relation exists between the variables. The Johansen approach to co integration test is based on two test statistics, viz., the trace test statistic, and the maximum Eigen value test statistic.

The trace test statistic can be specified as: $\tau_{trace} = -T \sum \log (1-\lambda_i)$,

Where λ is the i^{th} largest Eigen value of matrix Π, and T is the number of observations. In the trace test, the null hypothesis is that the number of distinct co integrating vector(s) is less than or equal to the number of co integration relations (r).

The maximum Eigen value test examines the null hypothesis of exactly r co integrating relations against the alternative of $r+1$ cointegrating relations with the test statistic:

$\tau_{max} = -T \log (1- \lambda_{r+1})$. Where λ_{r+1} is the $(r+1)^{th}$ largest squared Eigen value. In the trace test, the null hypothesis of $r = 0$ is tested against the alternative of $r + 1$ co integrating vectors. At the end, the Granger Causality test has been used to determine whether one time series is useful in forecasting another thereby finding out the direction of relationship between the variables of the study.

In the Granger Causality test, the vector of endogenous variables is divided in two sub-vectors, Y_{1t} and Y_{2t} with dimensions K_1 and K_2 respectively, so that $K = K_1 + K_2$. The sub-vector Y_{1t} is said to be Granger-causal for Y_{2t} if it contains useful information for predicting the latter set of variables.

Empirical Analysis

It is clear from the Figure 2 that the direction of movements of gold prices and BSE Sensex in India is consistent till 2007 and then their movements were inversely related from January 2010. The value of Pearson's correlation coefficient (r) between these two time series over the period 2002 to 2012 is 0.77467.

To test whether this value of 'r' shows a significant relationship between two time series, student's t-test has been used. The null hypothesis of the test is r = 0 against the alternative of r ≠ 0. Since the t-statistic at 226 degrees of freedom is 26.9 and the critical value of t at 5% level of significance is less than it, the null hypothesis is rejected. So, it can be said that the correlation between Gold Price Volatility and Stock Market Returns in India is statistically significant.

Table 1 Augmented Dickey-Fuller Test

Variables in their First Differences	ADF Statistics	Critical values	Decision
Gold Prices	**-8.60382**	**At 1% -3.48331 At 5% -2.88467 At 10% -2.57918**	**Reject Null hypothesis of no unit root**
Sensex	**-7.40122**	**At 1% -3.48331 At 5% -2.88467 At 10% -2.57918**	**Reject Null hypothesis of no unit root**

Table 2 Granger Casualty Test

Result of Granger Causality Test (Total Observation 129)

Null Hypothesis	F-Statistic	Probability	Decision
SENSEX does not Granger Cause GOLDPRICE GOLDPRICE does not Granger Cause SENSEX	**1.31572 0.8334**	**0.2724 0.4784**	**Accept Accept**

The results of ADF presented in Table 1 show that variable are stationary. The Granger Casualty Test is done on the stationary values. It can be inferred from Table 2. We will accept the null hypothesis that Gold price does not cause and effect the Nifty index return or Nifty index return does not cause and effect gold price.

Table 3 Results of Johansson Co-integration test

Time Period : January 2002 to December 2012			**No. of observations: 129 after adjustments**	
Lags interval (in first differences): 1 to 2				
Unrestricted Co integration Rank Test (Trace)				
Hypothesized No. of CE(s)	**Eigen value**	Trace Statistic	**0.05 Critical Value**	**Prob.****
None *	**0.100312**	**15.15231**	**15.49471**	**0.0563**
At most 1**	**0.011684**	**1.516052**	**3.841466**	**0.2182**
Unrestricted Co integration Rank Test (Maximum Eigen value)				
Hypothesized No. of CE(s)	**Eigen value**	**Max-Eigen Statistic**	**0.05 Critical Value**	**Prob.****
None *	**0.100312**	**13.63626**	**14.26460**	**0.0627**
At most 1**	**0.011684**	**1.516052**	**3.841466**	**0.2182**

Table 3 summerizes the result of Co- integration between the two variables Since the P value is more than 5 %, null hypothesis that there is no co-integration between the two variable i.e. Gold price and Sensex index is accepted. In other words, there is no long run association between these two variables.

Conclusion

In this paper, the casual relationship has been examined between Sensex and gold price. The study uses the monthly data which is collected from Reserve bank of India, Bombay bullion association and from bse-india.com. The results of Augmented Dickey- Fuller test conclude that the series are stationary and integrated of order one. There is a positive correlation between stock returns and gold price from 2002 to 2007 but due to economic crisis in USA in 2008 and 2011 this correlation seems to be fading and it was establish by using correlation and Johansen's co-integration test that there is no relation between gold prices and stock returns i.e. Sensex return in the long run period. The results of Granger causality test reveals that returns of Sensex index does not lead to increase in gold price and rise in gold price does not lead to increase in Sensex.

REFERENCES

[1] Abken A. Peter (1980), *"The Economics of Gold Price Movements"*, Federal Reserve Bank of Richmond, Economic Review, March /April. pp 3-13.

[2] Aggarwal R. and Soenen, L. A. (1988), *"The Nature and Efficiency of the Gold Market"*, the Journal of Portfolio Management, Vol. 14, pp. 18-21

[3] Agarwal, Sanjeev (2004), *"Bullion Markets",* BSE Review of Markets, pp.46-48.

[4] Aggrarwal, R., Inclan, C., & Leal, R. (1999). *"Volatility in Emerging Stock Markets".* Journal of Financial and Quantitative Analysis, Vol.34, 33-55.

[5] Bhattacharya, Himadri, (2004), *"Deregulation of Gold in India - A Case Study in Deregulation of a Gold Market", Research Study No 27*, *World Gold Council*, pp.1-28

[6] Blose, Laurence E. (1996), *"Gold Price Risk and the Returns on Gold Mutual Funds", Journal of Economics and Business, Vol.* 48, pp. 499-513.

[7] Brodsky, David A. and Gray P. Sampson (1980), *"The Value of Gold as a Reserve Asset", World Development*, Volume 8, Issue 3, March 1980, Pages 175-192.

[8] Dun's Review (1980), *"Bring Back the Gold Standard",* Vol. 115, No.2, pp.58-67.

[9] Gaur, A. and Bansal, M. (2010), *"A Comparative Study of Gold Price Movements in Indian and Global Markets", Indian Journal of Finance*, Vol.4, No.2, pp.32-37.

[10] Ghosh, Dipak, Levin, E. J., Macmillan, Peter and Wright, R. E. (2002), *"Gold as an Inflation Hedge", Discussion Paper Series No.0021*, Department of Economics, University of St. Andrews.

[11] Gujarati, D. N., & Sangeetha. (2007). *Basic Econometrics.* New Delhi: TMH Publishing Company Ltd.

[12] RBI (1997), *"Gold in India",* Reserve Bank of India Bulletin.

[13] Ruff, J. and Hirsch, F. (1965), *"The Role and the Rule of Gold- An Argument", Princeton Paper No. 47*, June.

[14] Toda, H. Y., & Philips, C. B. (1993). *"Vector Auto regression and Causality". Econo-metrica*, Vol.61, No.6, 1367-1393.

[15] Tschoegl, A. E. (1980), "Efficiency in the Gold Market", *Journal of banking and Finance*, Vol. 4, No. 4, pp. 371-379.