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"A STUDY ON RELATIONSHIP BETWEEN GOLD PRICE AND EXCHANGE RATE AND ITS IMPACT ON SENSEX"

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Abstract: The goal of the research is to examine the connection between the price of gold and currency exchange rates, as well as how this affects the Sensex.
One of the trickiest problems for investors is how the financial and commodity markets interact. Since the past to the present day, the financial markets have witnessed many tumultuous events involving the Indian economy. The price index of the other market is impacted by the volatility in the first market.
This study focuses on the relationship between the price of gold, the value of the dollar, and the effect it has on the Sensex from January 2016 to December 2021.

The Granger causality test was used to see how the variables related to one another. The findings showed a favourable link between gold and exchange, exchange, and Sensex. SENSEX does not display impact on the exchange, and neither does the exchange reflect impact on the price of gold.

INTRODUCTION:

A valuable metal that is both a commodity and a financial asset is gold. The finance industry and other areas of the Indian economy are particularly affected by it. It serves as a wealth generator and a means of commerce. It is a valuable metal used to produce jewellery and a very liquid investment. In the past, gold investing was more appealing than bank savings, stocks, and bonds. Even now, investors are putting more money into gold. Gold is a financial asset that also exhibits characteristics of a commodity. Gold both predicts future inflation and serves as an inflation hedge. For economic security and diversity, central banks and other international financial institutions keep a significant amount of gold on hand.
The Indian foreign exchange market, which was protected from external influences, has begun integrating into global markets. All three of these assets the price of gold, stock prices, and the US dollar share traits like asset price inflation and momentum. They have a strong correlation with one another and the business cycle. The market-determined value of each of these assets. This is a crucial sign of what the general public anticipates for the future of the global economy. The rupee has been losing value versus the dollar in the foreign exchange markets, which was followed by volatility in gold prices and stock index prices. The majority of empirical research show a co-integration between changes in the price of gold, the exchange rate, and stock market returns. As a result, the current study aims to investigate the connection between gold and exchange rates as well as how it affects the sensex.

LITERATURE REVIEW

In the study of Chaudhry and Choudhary (2006) investigated in Pakistan the relationship between stock prices and gold prices in relation to inflation. used Granger causality and co-integration analysis for the KSE 100 index as well as weighted average gold prices versus inflation. According to the study, there is a positive correlation between gold prices and inflation, but a negative correlation between inflation and the KSE 100 Index.

Sjaastad (2008) examined the theoretical and empirical link between the price of gold and the main currency rates from January 1991 to June 2004. The outcome of using the asset pricing model to forecast the relationship between gold and exchange rates shows that instability in the gold market was caused by the flexible exchange rate system, which had a significant impact on the price of gold when the US dollar's value changed.

Sharma and Mahendra (2010) During January 2008 and January 2009, researchers used multiple regression models to examine the long-term relationships between the BSE and four macroeconomic variables, including exchange rates, foreign exchange reserves, inflation rates, and gold price data. According to the study, the exchange rate and gold price have an impact on Indian stock prices.

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Contuk et al. (2013) GARCH modelling was suggested after discovering an ARCH effect in both the gold price and stock price while researching the impact of stock price fluctuations on gold prices. Their findings demonstrated that both variables were impacted by their own shocks as well as the shocks of others.

Razvan and stefanescu and Ramona Dumitriu (2013) the effect of changes in foreign exchange rates on the returns and volatility of stock prices from the Romanian capital market between January 2000 and December 2012 was examined. Their analysis found that changes in foreign exchange rates had an impact on returns and that these changes were caused by a variety of reasons, including capital inflows and how the global financial crisis affected people's perceptions of their own country's economy.

Bampinas and Panagiotidis (2015) used dynamic bootstrap causality analysis to examine the causal connection between the spot prices of gold and crude oil before and after the most recent financial crisis. The analysis found that causality is straight, unidirectional, and runs from oil to gold during the pre-crisis period. Bidirectional nonlinear causation relationships were found in the post-crisis period. Additionally, the analysis shows that at this time, volatility spillover acts as a source of nonlinearity. Decisions made by investors and portfolio rebalancing may also serve as conduits for shocks that spread to various commodities and other markets.

Objectives of the study

To study the relationship between variables of gold price and exchange rate

2. To study the impact of gold price on the sensex.
3. To study the impact of exchange rates on the sensex.
4. To examine the fluctuations of gold price and exchange rates on sensex.

RESEARCH METHODOLOGY

According to the objective, Secondary data was collected from websites like world gold council, RBI data base and BSE website and also from journals. In the Present study, gold prices data were collected from daily spot prices of gold in dollars‟ Council and exchange rate (rupee/dollar) as given by the RBI data source and closing prices of stock index (Sensex) from BSE website was taken. Data was collected on Monthly basis for the period from 2016-2021. The analysis was done using the computer software EVIEWS. In order to analyse the data Unit root test were carried out to know about stationarity in a time series. A commonly used test that is valid in large samples is the augmented dicky –fuller test (ADF) was carried on. Johansen cointegration test and Granger causality test was done to investigate causality between two variables in a time series.

Empirical Results and discussions

A statistical approach called correlation demonstrates the relationship between the variables of gold, exchange, and Sensex and illustrates how these variables are connected.

Table 1.1 CORRELATION ANALYSIS

	GOLD	EXCHANGE	SENSEX
GOLD	1		
EXCHANGE	0.00584	1	
SENSEX	-0.0734	0.56288645	1

Interpretation: The above table 1.1. the relationship between the Gold and currency has a positive correlation with a correlation coefficient of 0.04, however, the relationship between the Gold and Sensex has a negative correlation. This demonstrates that a rise in currency rates has a positive correlation of 56.1 with the gold price, currency rate, and Sensex. According to the results of the correlation research, the Sensex and currency both move in a favourable direction, but the correlation between gold and currency is quite low.

Unit root test

To determine whether a time series is stationary, unit root tests are carried out. It is used to test the order of integration as well as the stationarity of the variables. The model's variables should all be stationary for all of them. To determine if the variables are stationary or not, the unit root test is utilised. The Augmented Dickey Fuller method (ADF) was employed in the unit root test. Under this test, the variables taken are SENSEX values, gold rates, and Exchange values. ADF stated three equations as below they are:

$\Delta Yt = B1 + ZYt\text{-}1 + ai + et \rightarrow$ Equation 1 →Intercept only.

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$\Delta Yt = B1 + B2t + ZYt\text{-}1 + ai + et \rightarrow$ Equation 2 → Trend & Intercept.
$\Delta Yt = ZYt\text{-}1 + ai + et \rightarrow$ Equation 3 → No trend, No intercept.

Hypothesis for unit root test:
Null Hypothesis H0: the variable is not stationary or got unit root.
Alternative Hypothesis H1: the variable is stationary or no unit root.
At level- Equation 1 & 2 (Intercept and trend & intercept):
Null Hypothesis(H_0): GOLD has a unit root
Null Hypothesis(H_0): EXCHANGE has a unit root
Null Hypothesis(H_0): SENSEX has a unit root

Exogenous: Constant

Lag Length: 0 (Automatic - based on SIC, maxlag=4)

Augmented Dickey-Fuller test statistic	t-Statistic	Prob.*	1% level	5%level	10%level
GOLD	-2.954868	0.0452	-3.546099	-2.911730	-2.593551
EXCHANGE	-1.671083	0.7517	-4.121303	-3.487845	-3.172314
SENSEX	-0.386495	0.9043	-3.546099	-2.911730	2.593551

Null Hypothesis(H_0): GOLD has a unit root
Null Hypothesis(H_0): EXCHANGE has a unit root
Null Hypothesis(H_0): SENSEX has a unit root
Exogenous: Constant, Linear Trend

Lag Length: 0 (Automatic - based on SIC, maxlag=4)

Augmented Dickey-Fuller test statistic	t-Statistic	Prob.*	1% level	5%level	10%level
GOLD	-2.954868	0.0452	-3.546099	-2.911730	-2.593551
EXCHANGE	-1.671083	0.7517	-4.121303	-3.487845	-3.172314
SENSEX	-1.667806	0.7531	-4.121303	-3.487845	-3.172314

At 1st Difference D(GOLD)- Equation 1 & 2 (Intercept and trend & intercept):
Null Hypothesis(H_0): D(GOLD) has a unit root
Null Hypothesis(H_0): D(EXCHANGE) has a unit root
Null Hypothesis(H_0): D(SENSEX) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=10)

Augmented Dickey-Fuller test statistic	t-Statistic	Prob.*	1% level	5%level	10%level
GOLD	6.590105	0.0000	-3.548208	-2.912631	-2.594027
EXCHANGE	-6.058407	0.0000	-3.548208	2.912631	-2.594027
SENSEX	-7.923200	0.0000	-3.548208	2.912631	-2.594027

Null Hypothesis(H_0): D(GOLD) has a unit root
Null Hypothesis(H_0): D(EXCHANGE) has a unit root
Null Hypothesis(H_0): D(SENSEX) has a unit root
Exogenous: Constant, Linear Trend

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Lag Length: 0 (Automatic - based on SIC, maxlag=10)

Augmented Dickey-Fuller test statistic	t-Statistic	Prob.*	1% level	5%level	10%level
GOLD	-6.570552	0.0000	-4.124265	-3.489228	-3.173114
EXCHANGE	-6.434395	0.0000	-4.124265	-3.489228	-3.173114
SENSEX	-7.857020	0.0000	-4.124265	-3.489228	-3.173114

In the first stage unit root test is done in LEVEL. In this stage the variables don't show stationary. In second stage unit root test is done in 1st DIFFERENCE noted as D (variable name). Here the variables show as stationary. The result of ADF test is presented with lag 4 However, several other lags were also selected and the result is invariant.

INTERPRETATION:

Unit root test: "We can reject the null hypothesis and accept the alternative hypothesis if the absolute test statistics are greater than the absolute crucial value @5%. The test statistic level value in the aforementioned equations 1 and 2 is greater than 5%. Therefore, the alternative hypothesis is accepted and the null hypothesis is rejected. Consequently, the values are static.

Gold: from the equation 1&2test statistics is more than 5 percent level value then Null hypothesis is rejected and alternative hypothesis is accepted. Consequently, the values are static.

Exchange: If the test statistic from equations 1 and 2 is greater than the threshold value of 5%, the null hypothesis is rejected, and the alternative hypothesis is accepted. The values are stationary as a result.

SENSEX: If the test statistic from equations 1 and 2 is greater than the threshold value of 5%, the null hypothesis is rejected, and the alternative hypothesis is accepted. The values are stationary as a result.

The Johansen cointegration test is used to determine the long-run cointegrating relationship between the price of gold, the exchange rate, and the Sensex after testing for stationarity. Table 2 displays the outcomes of the trace test and the maximum eigenvalue test. Both of these tests identified a single cointegrating equation at the 5% level of significance.

The Johansen's cointegration test (Johansen and Juselius, 1990) has been used in the second stage to determine whether the variables have a long-run equilibrium relationship. Calculating the trace test statistic and maximum eigenvalue test statistic is how the Johansen cointegration test is run. The trace test statistic is calculated by using maximum likelihood ratio as per the following formula:

$$\text{Trace (r, k)} = -T \sum_{i=r+1}^{k} In(1 - \lambda i) \quad \text{... (4)}$$

where T denotes the number of observations, λi denotes the maximum eigenvalue of the cointegrating vectors. The trace statistic takes into account whether the trace is boosted by including additional eigenvalues in addition to the r eigenvalue. The null hypothesis that there are no more cointegrating vectors than there are cointegrating vectors is examined by the trace test (r). The process of locating the typical root forms the foundation of the maximum eigenvalue test. The exact existence of r cointegrating vectors is the null hypothesis for this test, and the alternative hypothesis is the existence of r+1 cointegrating vectors. The formula for calculating maximum eigenvalue is as follows:

$$\lambda_{max}\,(r, r+1) + = -T\, In(1 - \lambda_{r+1}) \quad \text{…. (5)}$$

Table 2: Results of Johansen's Cointegration Test

	H_0	Trace Test	5% Critical Value	Maximum Eigenvalue Test	5% Critical Value
Sensex and Gold	r = 0	32.02960	15.49471	31.57013	14.26460
	r ≤ 1	0.459468	3.841466	0.459468	3.841466

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Exchange and Gold	r = 0	31.86961	15.49471	31.50590	14.26460
	r ≤ 1	0.363705	3.841466	0.363705	3.841466
Sensex and exchange	r = 0	29.95369	15.49471	28.32620	14.26460
	r ≤ 1	1.627489	3.841466	1.627489	3.841466
Note: Trace test and Max.-eigenvalue test indicate 1 cointegrating equation(s) at 0.05 level.					

GRANGER CAUSALITY TEST:

Investigating the causal relationship between two variables in a time series using Granger causality. The approach uses a probabilistic causality account. Cause-and-effect thinking and causality go hand in hand. To determine whether the lags of one variable enter the equation of another variable, Granger Causality is used. The summary of the Granger Causality Test between the variables gold, exchange rates, and SENSEX is shown in the table below:

Table 1.3 Summary of Granger Causality Test

Null Hypothesis	F-Statistic	Prob.
GOLD Granger Cause EXCHANGE	6.94031	0.0109
EXCHANGE does not Granger Cause GOLD	3.59599	0.0631
GOLD does not Granger Cause SENSEX	2.79789	0.1000
SENSEX does not Granger Cause GOLD	0.05551	0.8146
EXCHANGE does not Granger Cause SENSEX	1.03862	0.3125
SENSEX does not Granger Cause EXCHANGE	0.03016	0.8628

Table 1.3 above shows that the P-value for the first hypothesis, which states that there is a causal relationship between gold and the exchange rate, is less than 0.05, or 0.01. As a result, the alternative hypothesis is accepted and the null hypothesis is rejected. The null hypothesis is accepted in the second hypothesis statement of the exchange does not granger cause gold statement since the P-value is greater than 0.05, or 0.06 in this case. As a result, an exchange rate is caused by an increase in gold, not an increase in exchange. The null hypothesis is accepted in the third hypothesis statement of causality between gold and the Sensex since the P-value is greater than 0.05, or 0.10, in this case. The null hypothesis is accepted in the fourth hypothesis statement since the P-value is greater than 0.05, or 0.81. As a result, Sensex does not increase the price of gold (no causality between Sensex and gold). The null hypothesis is supported since the P-value is greater than 0.05, or 0.31, in the fifth hypothesis statement of causality between Exchange rate and Sensex. The null hypothesis is accepted in the sixth hypotheses since the P-value is greater than 0.05, or 0.86. As a result, Sensex does not drive exchange (no causality between Sensex and exchange).

CONCLUSIONS:

The goal of the study is to use the Granger Causality Test to examine the connection between gold and the exchange rate and how it affects the Sensex. The investigation' findings make it abundantly evident that while gold does not ultimately depend on the Sensex, volatility in gold prices are heavily influenced by the exchange rate. The exchange impacts the price of gold rather than the Sensex.

if the Sensex has no effect on any other factors. Compared to currency rates, gold fluctuates a lot. Compared to other variables, gold's mean value is higher (exchange, Sensex). Gold offers a high rate of return. In order for the investors to buy additional gold. Portfolio managers offer guidance to investors on how to invest in gold during periods of extreme market volatility.

The gold market also aids businesses and investors in hedging their gold against changes in world markets. The right hedging can protect businesses and investors from negative repercussions while also helping investors profit from currency depreciation. Investors should have expertise on gold and exchange and also on stock markets. The shift in these has higher impact for better decision-making.

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