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An empirical study on the relationship between stock market performance and gold prices in India

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Abstract
This study investigates the relationship between stock market performance and gold prices in India, aiming to understand the dynamic interplay between these two key financial assets. Utilizing historical data from Indian stock indices and gold prices over a significant period, the study employs econometric methods such as correlation analysis, Granger causality tests, and co-integration techniques. The findings reveal that gold prices and stock market performance exhibit a complex, inverse relationship, particularly during periods of economic uncertainty. The study also explores the role of gold as a hedge against stock market volatility and its significance for Indian investors. Insights from this research contribute to portfolio diversification strategies and offer implications for policymakers and financial market participants in India. The paper finds that gold returns are significantly independent of the returns of the benchmark indices of BSE and NSE.

Keywords: Stock market, prices, causality, co-integration

Introduction
The relationship between stock market performance and gold prices has long been a subject of interest among economists, investors, and policymakers. In India, both the stock market and gold have unique roles within the economy and are viewed as important investment avenues. Gold, often regarded as a "safe haven" asset, tends to attract investors during times of economic uncertainty, while the stock market reflects broader trends in economic growth, corporate performance, and investor sentiment. Understanding the dynamics between these two asset classes is crucial for investors, as it helps in portfolio diversification and risk management.

In recent years, the Indian economy has experienced significant fluctuations due to both domestic and global factors. Stock market volatility, influenced by economic cycles, geopolitical tensions, and policy changes, often leads investors to explore alternative assets like gold. Conversely, gold prices in India are influenced not only by global gold trends but also by the country's cultural affinity for the metal, inflationary pressures, and currency movements. This study aims to investigate the interrelationship between the performance of the Indian stock market and gold prices, examining how shifts in one market might influence the other and whether these two markets move in tandem or exhibit a counter-cyclical relationship. Volatility, particularly with respect to the Indian Rupee, has been found to significantly influence gold prices, with a depreciating rupee leading to higher domestic gold prices.

Review of Literature
The relationship between stock market performance and gold prices has been extensively studied in various economies, including India. Several studies have examined whether these asset classes are substitutes or complementary to one another, especially in times of financial uncertainty. Studies conducted globally often emphasize the role of gold as a safe-haven asset. Baur and McDermott (2010) [1] investigated the safe-haven properties of gold and found that gold provides a hedge against declining stock markets during extreme financial market stress, especially in developed countries. Similar findings have been echoed by Hood and Malik (2013) [31], who found that gold's role as a hedge is more pronounced in periods of extreme market downturns.

On a broader scale, the study by Ghosh, Levin, Macmillan, and Wright (2004) [3] highlighted that the price of gold tends to move inversely with stock markets, particularly during periods of inflation and currency depreciation.

In the Indian context, several studies have explored the correlation between stock market indices, such as the BSE Sensex or NSE Nifty, and gold prices. Mishra *et al*. (2010) [2] examined the causality between gold prices and stock market performance in India, and their study found evidence of a short-term inverse relationship, particularly during periods of market volatility. Bhunia and Das (2012) [25] confirmed that the two markets exhibit a negative correlation, indicating that when stock prices fall, gold prices tend to rise, and vice versa. However, other studies present a more nuanced view. Kaur and Dhillon (2010) [32] found that the strength of the inverse relationship between gold and stock market indices in India is not consistent over time. Their findings suggest that during stable economic conditions, the two markets may move independently of each other, while during economic stress, gold emerges as a preferred investment.

Gold prices and stock market performance in India are also influenced by broader macroeconomic variables, including inflation, interest rates, and exchange rates. Sood and Jain (2014) [33] emphasized the role of inflationary pressures and currency fluctuations in shaping the gold-stock dynamic. During periods of high inflation, gold prices tend to rise as investors seek to preserve the value of their wealth. Similarly, exchange rate

Research has also pointed to the time-varying nature of the relationship between gold prices and stock markets. During periods of financial crises, such as the global financial crisis of 2008 or the COVID-19 pandemic, gold prices tend to exhibit a stronger negative correlation with stock markets. Jain and Biswal (2016) [9] found that during these crisis periods, gold serves as a more robust hedge against declining stock markets in India.

In conclusion, the literature suggests that while there is generally a negative correlation between stock market performance and gold prices in India, this relationship is influenced by various factors, including economic conditions, investor sentiment, and global market trends. The nature of this relationship also varies across time, making it crucial to examine this interplay over different periods to gain a comprehensive understanding. This study builds upon these insights and seeks to further explore the long-run relationship between the stock market and gold prices in India, particularly in the context of recent economic developments.

Statement of the Problem

Despite the extensive research on the relationship between gold prices and stock market performance, there remains a lack of clarity about how this relationship behaves specifically in the Indian context over the long term. The Indian economy, characterized by its unique combination of emerging market volatility and traditional reliance on gold as a store of value, requires a more nuanced understanding of how these two markets interact. The absence of clear evidence on whether investors should consider gold as a reliable hedge during periods of stock market volatility presents a significant gap in the existing literature. This study aims to address this gap by providing a detailed analysis of the correlation between stock market performance and gold prices in India, with a focus on identifying trends, causality, and implications for investors.

Objectives of the Study

The primary objectives of this study are as follows:

1. To investigate the historical relationship between stock market performance and gold prices in India.
2. To determine whether gold prices serve as a hedge against stock market volatility in the Indian context.
3. To provide insights and recommendations for investors on how to balance portfolios using both stock market investments and gold in periods of economic instability.

Methodology

This study employs a quantitative approach to analyze the relationship between stock market performance and gold prices in India. The methodology includes the following steps:

Data Collection: The study will utilize historical data (Secondary) on the BSE Sensex and NSE Nifty stock indices as proxies for stock market performance, and historical gold price data (in INR per 10 grams) will be collected from reliable sources such as the World Gold Council and the Reserve Bank of India. The timeframe of the analysis will span from 2000 to 2023 to capture both short-term and long-term trends.

Statistical Analysis

The study examines the impact of gold prices on the Indian stock market using daily data from January 1, 2000, to December 31, 2023. The independent variable is world gold prices, while the dependent variables are the SENSEX and Nifty Fifty indices. Data for these indices were gathered from official stock exchange websites, while gold prices were obtained from the www.goldpriceindia.com website. The study employed statistical tests like descriptive statistics, Kurtosis, Skewness, and the Jarque-Bera test to check the normality of the data. The Augmented Dickey-Fuller (ADF) unit root test was used to assess whether the data were stationary. After confirming non-stationarity, the Johansen co-integration test was applied to explore any long-term relationship between the stock indices and gold prices. Additionally, the Granger causality test was used to determine the causal relationship between the Indian stock market and gold prices, assessing which variable influences the other. The results from the statistical analyses will be interpreted to understand the relationship between stock market movements and gold prices. Additionally, the findings will be contextualized within the broader economic environment to provide meaningful insights for investors and policymakers.

Results and Discussion

Table 1 provides the descriptive statistics for the BSE SENSEX, NSE Nifty Fifty, and gold prices over the 24-year study period from 2000 to 2023. It includes the mean, median, maximum, and minimum values, along with the standard deviation, skewness, kurtosis, and the results of the Jarque-Bera test with its corresponding P-value. To assess

the normality of the data, a null hypothesis was tested, stating that the selected indices and gold prices are not normally distributed, using the Jarque-Bera test.

Table 1: Descriptive Statistics of BSE Sensex, NIFTY Fifty and Gold Prices

	BSE Sensex	NSE nifty fifty	Gold
Mean	6,543.69	4,124.52	1,051.49
Median	7,095.83	4,411.28	1,060.17
Maximum	13,414.60	10,484.45	2,098.35
Minimum	968.71	649.59	267.81
Std. Dev.	3,409.67	2,132.84	497.83
Skewness	0.86	0.11	0.06
Kurtosis	2.18	2.16	1.81
Jarque Bera	146.48	134.57	264.67
Probability	0.00	0.00	0.00
Observations	5,160.00	5,160.00	5,160.00

The results of the Jarque-Bera test of BSE Sensex, NSE Nifty Fifty and gold price stood at 146.48,134.57 and 264.67respectively, they are statistically significant at 5% level, hence the null hypothesis is rejected and therefore the indices of BSE Sensex, NSE Nifty Fifty and gold price are normally distributed during the study period.

Correlation Analysis

The correlation between BSE Sensex and NSE Nifty Fifty is very high and positive (0.839), it is also significant. It shows that both the markets BSE and NSE are moving simultaneously during the study period. Correlation between Gold and BSE Sensex is 0.071 and between Gold price and NSE Nifty Fifty is 0.069, both the results are statistically significant at 5 percent level. Hence Indian stock market and gold price have significant positive relationship, but the quantum of relationship is very low.

Table 2: Correlation between of BSE Sensex, Nifty Fifty and gold Prices

	BSE Sensex	NSE Nifty Fifty	Gold
BSE Sensex	1	0.839 (0.000)	0.071 (0.000)
NSE Nifty Fifty	0.839 (0.000)	1	0.069 (0.000)
Gold	0.071 (0.000)	0.069 (0.000)	1
No of Observations	5159		

Regression Analysis

Regression analysis has also been made between gold price and Indian stock market to know the quantum of impact of gold price changes on the movement of Indian stock market. For this purpose return on BSE Sensex and NSE Nifty Fifty are calculated for 5,159 trading days and return on gold price is also calculated. Gold price has been taken as independent variable and market proxies of the indices BSE Sensex and NSE Nifty Fifty are taken as dependent variables. Table 3 gives ANOVA results and regression results for gold price and movement of Indian stock market in terms of return on BSE Sensex and NSE Nifty Fifty.

Table 3: Regression Analysis of Gold Price and Stock Market Indices in India

BSE Sensex					
Model	**Unstandardised Coefficients**		**Standardised Coefficients**	**t**	**Sig.**
	B	**Std. Error**	**Beta**		
Constant	0.077021	0.022006		3.31	0
Gold Price	0.099027	0.022006	0.088024	4.38	0
Adj. R2			0.006003		
F Value under ANOVA			22.974		
NSE Nifty Fifty					
Model	**Unstandardised Coefficients**		**Standardised Coefficients**	**t**	**Sig.**
	B	**Std. Error**	**Beta**		
Constant	0.07	0.03		2.6	0.01
Gold Price	0.1	0.02	0.07	4.38	0
Adj. R2	0.0050025				
F Value under ANOVA	20.139				

ANOVA results between gold price and return on BSE Sensex and NSE Nifty Fifty show that the calculated value of F-statistics are (22.974 & 20.139), which are statistically significant at 1 percent level. Hence the regression model is fit for the study.

It is observed from table 4 that the calculated value of ADF statistics of Gold price, BSE Sensex and NSE Nifty Fifty are -1.51, -0.86 and -0.85 respectively, They are not statistically significant as shown by the results of P value, Since they are less than the table value. Hence the null hypothesis is accepted (Ho1: Gold price, BSE Sensex and NSE Nifty Fifty are non-stationary) and therefore the variables gold price, BSE Sensex and NSE Nifty Fifty have unit root and they are unpredictable. In other words, the time series data of these variables are not stationary and they are fit for further analysis such as co-integration and causality test.

Table 4: ADF Test

Variable	ADF Statistics	P-Value	Critical Value @ 5%	Hypothesis
Gold Price	-1.51344	0.56	-2.8621	Accepted
BSE Sensex	-0.86182	0.81		Accepted
NSE Nifty Fifty	-0.85131	0.81		Accepted

Johansen co-integration Test

Johansen co-integration test analyses whether gold price and Indian stock market are moving together or not. For this purpose a null hypothesis has been framed as follows and the results are presented in table 5. The calculated values of trace statistics and maximum eigen value of the index of BSE Sensex and NSE Nifty Fifty are less than the respective critical values. So, the results are not statistically significant. Hence the null hypothesis is accepted and therefore gold price and Indian stock market in terms of BSE Sensex and NSE Nifty Fifty are not co-integrated. In other words, these two variables are not moving together.

Table 5: Johansen Co-Integration Test Results

Unrestricted Co-integration Rank Test (Trace) at 5%							
Hypothesized No. of CE(s)	**Eigen Value**		**Trace Statistic**		**Critical value at 5% level)**	**Prob.****	
	BSE Sensex	**NSE Nifty Fifty**	**BSE Sensex**	**NSE Nifty Fifty**		**BSE Sensex**	**NSE Nifty Fifty**
None	0.0006	0.0006	2.90	2.90	15.49	0.97	0.98
At most 1	0.0002	0.0002	0.64	0.68	3.84	0.42	0.40
Unrestricted Co-integration Rank Test (Maximum Eigen Value) at 5%							
Hypothesized No. of CE(s)	**Max-Eigen Statistic**		**Trace Statistic**		**Critical value at 5% level)**	**Prob.****	
	BSE Sensex	**NSE Nifty Fifty**	**BSE Sensex**	**NSE Nifty Fifty**		**BSE Sensex**	**NSE Nifty Fifty**
None	0.0006	0.0006	2.90	2.26	15.49	0.98	0.97
At most 1	0.0002	0.0002	0.68	0.64	3.84	0.40	0.40

Granger Causality Test

The regression analysis tests the impact of an independent variable on dependent variable. There, a particular variable has been assumed as dependent and another one or few as dependent. But in stock market it cannot be said that variable X influences variable Y, variable Y may influence variable X. So, the researcher has applied Granger causality test. It tests which variable causes another one. For this purpose null hypotheses are framed and the results are presented in table 6

Table 6: Results of Granger Causality Test

BSE Sensex & Gold Prices				
Null Hypothesis:	**Observations**	**F-Statistic**	**Probability**	**Decision**
BSE Sensex does not Granger Cause Gold price	5159	0.582	0.661	Accept
Gold price does not Granger Cause BSE Sensex		0.370	0.795	Accept
NSE Nifty Fifty & Gold Prices				
Null Hypothesis:	**Observations**	**F-Statistic**	**Probability**	**Decision**
NSE Nifty Fifty does not Granger Cause Gold price	5159	0.728	0.582	Accept
Gold price does not Granger Cause NSE Nifty Fifty		0.560	0.672	Accept

Table above shows that gold price did not have granger cause on Indian stock market in terms of return on BSE Sensex and BSE Sensex did not granger cause on gold price, since the calculated F-statistics are 0.582 and 0.370 respectively and they are not statistically significant as shown by the results of P values. The calculated values of F-statistics of hypotheses one and two between gold price and the index of NSE Nifty Fifty are 0.728 and 0.560, they are not statistically significant, hence both the null hypotheses are accepted and therefore gold price did not have granger cause on NSE Nifty Fifty and NSE Nifty Fifty did not granger cause on gold price

Conclusion

The study analyzed the impact of gold prices on the Indian stock market, focusing on BSE SENSEX and NSE Nifty Fifty. It found a significant positive correlation between gold prices and the stock market, but the influence of gold was minor due to other factors affecting market movement. Gold prices and stock indices were non-stationary, and Johansen co-integration tests showed that gold and the stock market moved independently, with no long-term relationship. The Granger causality test also indicated no causal relationship between them. The results are in confirmation of the results of Valarmathi, A., Umamaheswari, S., & Lakshmi, M. R.

The study concludes that while gold prices do affect the stock market, the impact is not substantial. It suggests that investors can use gold to manage portfolio risk, particularly as a safe haven in specific sectors like IT, where returns are negatively related to gold. However, gold is less effective for hedging risks in other sectors. Investors are advised to adjust their strategies according to market conditions.

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