

Vector Autoregression Analysis Of Gold, Exchange Rate And Stock Market Linkages

Dr. R. Pavithra¹, K. Bhagya Lakshmi², Rashmi Umarji³, Anitha A⁴

¹Assistant Professor, Department of BBA, Dayananda Sagar College of Arts, Science and Commerce, Bengaluru

²Assistant Professor, PG Department of Management, St. Claret College Autonomous, Bengaluru

³Assistant Professor, Department of B. Com, Dayananda Sagar College of Arts, Science and Commerce, Bengaluru

⁴Assistant Professor, Department of BBA, Dayananda Sagar College of Arts, Science and Commerce, Bengaluru

Abstract

Gold is considered a safe haven asset and is often seen as a hedge against inflation and economic uncertainties. As a result, when the price of gold rises, investors tend to shift their investments from equities to gold, which can lead to a fall in the Sensex. On the other hand, when the price of gold falls, investors may move their investments back to equities, leading to a rise in the Sensex. The current study uses monthly data and a regression analysis test to look at how the Indian SENSEX is affected by changes in currency exchange rates and gold prices for the years April 2020 to April 2022. In other words, this study looks into how the SENSEX, exchange rates, and gold price are related to one another as three financial elements between 2020 and 2022. The goal of the article is to give the investor factual information about investing in gold and money. Indian investors have recently shown no fear and no potential loss in the stock markets as a result of the ongoing rise in gold prices. Once more, changes in exchange rates will have an impact on international trade and consequently, the stock market. The results of the Johansen cointegration test show that the chosen variables have a lasting link. The outcome of a regression test can demonstrate that the variables must either have reciprocal causality or not.

Keywords: Gold price, Exchange Rate, Sensex, Stock market return, BSE

Introduction

The Sensex is one of the most widely tracked stock market indices in India and is considered a barometer of the health of the Indian economy. The prices of gold and exchange rates are two important factors that have an impact on the Sensex in the Indian economy. Exchange rates also play a crucial role in the Indian economy, as India is heavily dependent on imports for its energy and other requirements. When the Indian rupee depreciates against other major currencies, the cost of imports increases, leading to higher inflation and a rise in interest rates. This can lead to a fall in the Sensex as higher interest rates can make borrowing more expensive for companies. Conversely, when the Indian rupee appreciates against other major currencies, the cost of imports decreases, leading to lower inflation and a fall in interest rates. This can lead to a rise in the Sensex as lower interest rates can make borrowing cheaper for companies, leading to increased investment and economic growth.

Impact of Gold Price on Sensex:

Gold is considered a safe-haven asset, and investors tend to flock to it during times of economic uncertainty. When the price of gold rises, it can lead to a decline in the stock market as investors shift their investments from equities to gold. This can, in turn, cause the Sensex to

fall. On the other hand, a drop-in gold prices can be positive for the Sensex as investors may see equities as a more attractive investment option.

Impact of Exchange Rate on Sensex:

The exchange rate refers to the value of one currency in relation to another. In India, the US dollar is a commonly used benchmark currency. A depreciating rupee (strengthening dollar) can have a negative impact on the Sensex as it can lead to a rise in the cost of imports, which can, in turn, lead to inflation. However, a depreciating rupee can also make Indian exports more competitive in international markets, which can boost the earnings of companies and, in turn, the stock market. In summary, the impact of gold price and exchange rate on the Sensex can be significant, but it's important to consider other factors that can influence the stock market as well.

Statement of the problem

The research problem in the study of gold price and exchange rate on the Sensex can be framed as follows:

What is the nature of the relationship between gold price, exchange rate, and the Sensex in the Indian economy? Specifically, how do fluctuations in the gold price and exchange rate impact the performance of the Sensex, and what are the underlying economic mechanisms driving this relationship?

This research problem requires a detailed analysis of the historical trends and patterns in gold prices, exchange rates, and the Sensex, as well as an investigation of the various macroeconomic factors that can affect these variables. It also involves developing appropriate models and methodologies to quantify the relationship between these variables and to test hypotheses about the causal mechanisms involved. When the outlook for the economy and the financial markets is pessimistic or there is uncertainty regarding future trends, gold prices typically increase. Although it has the qualities of both a commodity and a currency, it is a liquid financial instrument and a significant asset class that differs from paper assets like equities due to its tangible nature (Steven W. Sumner et al., 2012). The causal linkages between the stock price index and the price of gold have been extensively studied in both industrialized and developing nations. Empirical findings provide evidence that the price of gold may seriously worry the stock market.

Scope of the study

The current study unravels the linkage between stock market & macroeconomic variables in the Indian context using techniques like regression, correlation test using EXCEL. A time span of 2 years has been chosen for this study from April, 2020 to April, 2022 uses monthly data to portray a larger view of the relationship. The study also attempts to analyse the impact of macroeconomic variables on stock market sector wise. Not only the domestic economic variables have been considered but the linkage with the external world through the exchange rate movement has also been included in the analysis. The study does not assume any a prior relationship between these variables and the stock market and is open to the possible two-way relationship between them which has been tested through Regression Analysis.

Objective of the study

1. The primary goal is to examine the relationship between the Indian stock market and two selected macroeconomic factors, dollar price, and gold price.

2. Analysing interdependence of stock price and macroeconomic factors.

Literature review

Darat and Mukherjee (1987) applied the Regression model and found that a significant causal relationship exists between stock returns and selected macroeconomic variables of India which are emerging economies of the world using gold price and exchange rate and found insignificant results which postulate inefficiency in market. Finally, they concluded that in emerging economies the domestic factors influence more than external factors, i.e., exchange rate and gold prices. **Bahmani and Sohrabian (1992)** studied the causal relationship between the Indian stock market (BSE index) and effective exchange rate of dollar in a short period of time. Their theory established bidirectional causality between the two for the time period taken. However, regression analysis is unable to identify long-run relationship between the two variables. **Abdalla and Murinde (1997)** investigated the intersections between exchange rates and stock prices in the emerging financial markets of India. They found that results show the causality from exchange rates to stock prices in country where they found that the stock price lead the exchange rate. **Mookerjee and Yu (1997)** studied the stock market pricing mechanism by investigating whether there were long-term relationships between macroeconomic variables and stock market pricing. They found that macroeconomic variables were cointegrated with stock market prices. Using the regression tests, they noted insignificant interactions among gold price and foreign exchange reserves and stock prices for the case of India. **Kwon and Shin (1999)** applied statistical tests and found that the Indian stock market was cointegrated with a set of macroeconomic variables. However, using the regression test on macroeconomic variables and the BSE stock index, the authors found that the Indian stock index was not a leading indicator for economic variables. **Ibrahim (1999)** also investigated the dynamic interactions between the BSE Composite Index, and two macroeconomic variables (Gold price and exchange rate) and concluded that there was little relation between the Indian stock market and the variables. **Pethe and Karnik (2000)**, using Indian data for April 2020 to April 2022, attempted to find the way in which stock price indices were affected by and had affected other crucial macroeconomic variables in India. But, this study had run regression test which shows relationship between the variables and the stock price. **Kumar (2008)** established and validate the long-term relationship of stock prices with exchange rate in Indian context. There were numerous studies on the relationship of stock indices with macroeconomic variables. This gave a strong subjective background to test the existence of any such relationship in India. The research primarily dealt with an empirical method by combining different statistical techniques to check the presence of co-integration between the stock index (Sensex) and other variables. The study took into consideration past two years of experience in Indian economy reflected into the stock index and exchange rates. A causal relationship could not be established without the existence of cointegration between the selected macroeconomic variable. **Dharmendra Singh (2010)** tried to explore the relation especially the causal relationship between stock market index i.e. BSE Sensex and two key macroeconomic variables by using correlation and regression test. Monthly data has been used for all the variables. **Tripathy (2011)** studied investigated the market efficiency and causal relationship between selected Macroeconomic variables and the Indian stock market by using statistical tool. The study confirms the presence of correlation in the Indian stock market and macroeconomic variables which implies that the market fell into form of Efficient Market Hypothesis. The study also reported unidirectional causality running from exchange rate and gold rate in domestic market indicating sizeable influence in the market movement. **Dasgupta (2012)** has attempted to explore the relationships between BSE Sensex and two key

macroeconomic variables of Indian economy by using statistical test. Monthly data for two years has been used for all the variables, i.e., BSE Sensex, gold price and exchange rate. So, it can be inferred that the Indian stock markets were not informationally efficient. **Mishra et al., (2010)** examined the volatility of gold price and stock market in India by considering the domestic gold prices and stock market returns based on BSE index during the period of 2020-2022 by applying the regression test and finds that the gold prices cause stock low returns in India. The study of **Shahzadi & Chohan, (2010)** and Baig et al, (2013) conduct study on impact of gold prices on stock exchange during the period of 2020-2022 by using statistical tools to find the impact of gold prices on Indian Stock Exchange and find out that there is a negative Correlation between the gold prices and Indian stock exchange indices. **Gayatri & Dhanabhakym (2014)** studied the relationship between the gold price and stock return and found that gold price and stock return were changing significantly and there is a need to validate the relationship. **Srinivasan & Karthigai, (2014)** conducted a study to investigate the causal relationship between gold price, stock price, and exchange rate in India by using a regression approach and find out that gold price and stock price tend to have long-run relationship with exchange rate in India and the study also indicates that there exists no causality from gold price to stock price or vice versa in the short run.

Hypothesis

- **Hypothesis 1:** - H0: There is no impact of gold price changes on SENSEX H1: There is an impact of gold price changes on SENSEX
- **Hypothesis 2:** - H0: There is no impact of the exchange rate on SENSEX H1: There is an impact of exchange rate on SENSEX

Research methodology

With a view to accomplishing the pre-determined set of objectives of our research, a different set of techniques and tests have been adopted. First and foremost, fulfil the research objectives, descriptive statistics techniques like mean, standard deviation, etc are carried out to show the nature and basic characteristics of the variables used in the analysis. Inferential statistics technique is used to inference about the results by using different ways of inferential statistics like Correlation matrix analysis which finds any strength of association between Bombay stock exchange indices (share price) and selected macroeconomic variables. Then the second type of inferential statistics is used which is linear regression analysis which create a mathematical model that can be used to predict the values of a stock price of Bombay stock exchange indices based upon the values of macroeconomic variables.

Data Collection

- The study is based enormously on secondary data acquired from the RBI database, BSE database, and the World Gold Council database.
- The data has been collected from www.investing.com and www.bseindia.com
- The data has been collected for the past 2 years from April 2020 to April 2022 monthly basis.

Plan of Analysis

To understand the research objectives, descriptive statistics techniques like mean, standard deviation, etc are carried to show the nature and basic characteristics of the variables used in the analysis

Regression analysis is used to find the correlation between gold price with Sensex and the

exchange rate with Sensex.

Descriptive statistical techniques

Descriptive statistics is the discipline of quantitatively describing the patterns and general trends of a dataset and summarizing it in a single value. It enables a reader to quickly understand and interpret the set of data that has been collected. In our study, descriptive statistics provide a useful quantitative summary of macroeconomic variables and BSE indices.

Data analysis : Empirical results and discussions are presented here in the different subsections.

Descriptive statistics analysis

TABLE 1 Sensex, Gold Price and Dollar price

Particular	Mean	SD
SENSEX	4295.58	1356.54579
GOLD PRICE	1,833.31	81.6628585
DOLLAR PRICE	84.3494	1.044038673

The descriptive Statistical table presents a summary of descriptive statistics of all the variables. The sample mean, and standard deviation has been reported. These variables are the Bombay stock exchange’s main sectors, the Index of Industrial Production and its sectors, dollar price, and gold price. In the group of 24 observations, the mean share price (SENSEX) is 4295.5368. The standard deviation is 1356.545799 which is considered to be very high. It reflects significant variability in stock prices (SENSEX). All Bombay stock exchange sectors also have very high and significant variability from their mean. The dollar price mean is 84.3494 and the standard deviation is 1.044. So, there is not so significant variability in the dollar performance its mean. The gold price mean is 1833.31 and its standard deviation is 81.66 respectively. There is high moderate variability in gold prices.

Informative statistical analysis

TABLE 2 Correlation Matrix

VARIABLE	SENSEX
GOLD PRICE	0.0037
EXCHANGE RATE	0.035

The correlation matrix table shows the correlation matrix of stock exchange indices and macroeconomic variables. Correlations of all variables with their difference have been reported. Here, we have used Karl Pearson’s correlation analysis with two tailed and 5% significant level. It assumes that the two variables are measured on at least interval scales, and it determines the extent to which the values of the two variables are proportional to each other. The results reveal that there is no significant instead there is very low or low or moderate relationship among gold price and exchange rate variables and Bombay Stock Exchanges indices. Correlation coefficient between Bombay Stock Exchanges indices and many macroeconomic variables showed the weak relationship in exchange rate is positively correlated with SENSEX, and gold rate is negatively correlated with SENSEX.

Econometric regression analysis

Econometric Regression analysis is a technique to check the effect macroeconomics variables

on stock exchange indices (share price) and we have found some interesting results for the relationship. Exchange rate and SENSEX, there is no relationship growth rate and its different sectors with Bombay stock exchange indices. Similarly, gold rate does affect BSE sectors. Simple regressions models between SENSEX and exchange rate and gold price have been reported. The null hypothesis has been tested on the basis of the P-value while the overall significance of model has been tested on the basis of F-sign. If the P value and F- sign is less than the critical P value and F- sign at 5% than the null hypothesis is rejected and there will be a significant relation between the variables.

Simple Regression Between Change in Sensex and Macroeconomic Variables

Table 3 correlation (gold price with sensex)

SUMMARY OUTPUT	
Regression Statistics	
Multiple R	0.061281938
R Square	0.003755476
Adjusted R Square	-0.041528366
Standard Error	0.050040802
Observations	24

Table 4.3 represent regression statistics analysis, where observation is 24. R Square states that R-squared (R^2) is a statistical measure that represents the proportion of the variance in a dependent variable that is explained by an independent variable or set of independent variables in a regression model. It is also known as the coefficient of determination. R^2 is typically expressed as a percentage and ranges from 0 to 100%, where a higher value indicates a better fit of the regression model to the data. An R^2 value of 1.0 indicates that the model explains all the variability of the response data around its mean. Conversely, an R^2 value of 0.0 indicates that the model explains none of the variability of the response data around its mean.

Table 4 regression analysis (gold price with sensex)

Hypothesis testing

	SIGNIFICANT F VALUE	REMARK
GOLD PRICE	0.776058324	ACCEPT H0
EXCHANGE RATE	0.377041856	REJECT H0

Null Hypothesis (H0): No significant relationship between SENSEX with each macroeconomic variable.

Alternative Hypothesis (Ha): Significant relationship between SENSEX with each macroeconomic variable.

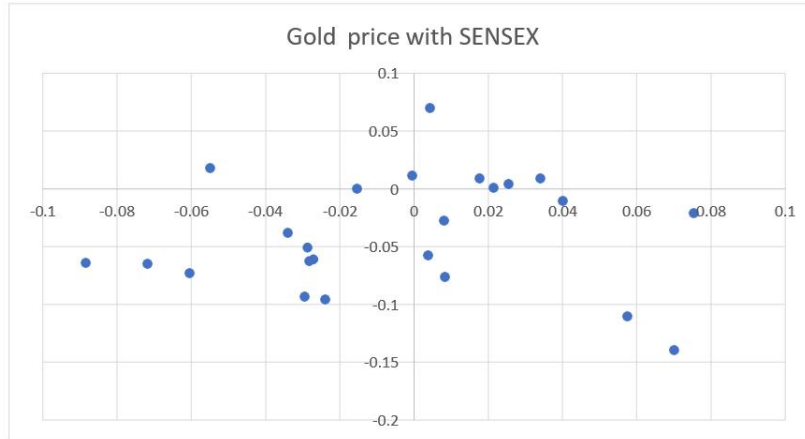
The table above shows a simple regression test for seven macroeconomic variables and BSE SENSEX. It was found through the P-value and F-sign that there is a significant relationship between the exchange rate and SENSEX, and gold rate and SENSEX. Hence, this means the exchange rate does affect SENSEX. We can accept the alternative hypothesis. Gold price does not affect SENSEX. We can accept the null hypothesis.

In the table, there are Intercept values and Slope values with help us in forming meaningful regression equations in the form $Y_i = \beta_0$

+ $\beta_1 X_i$.

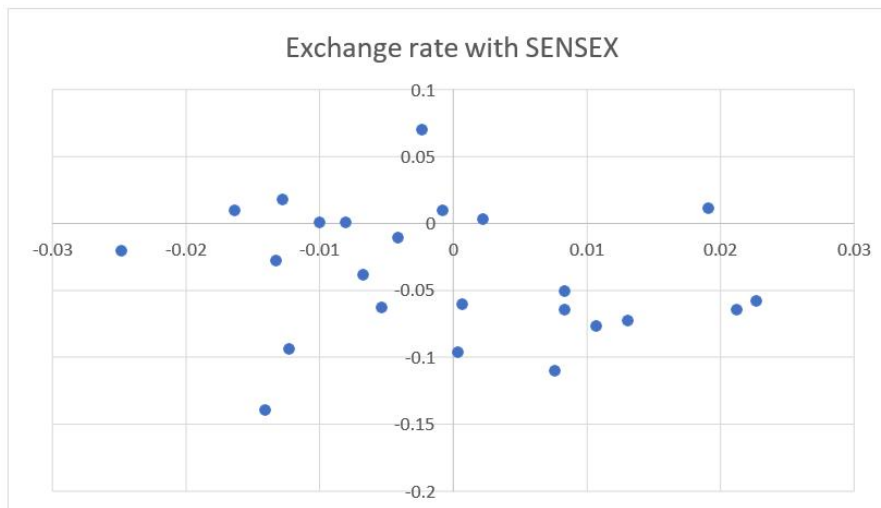
Where, Y= Dependent Variable X= Independent Variable

Graph 1. Relationship With Gold Price with Sensex



According to the Analysis the results are interesting and useful in understanding the Indian stock market pricing mechanism as well as its return generating process. While, there is a negative relationship between gold price and SENSEX. The results of this analysis should not be treated as conclusive for an investment on gold.

Graph 6 Relationship Between Exchange Rate with Sensex



According to the Analysis the results are interesting and useful in understanding the Indian stock market pricing mechanism as well as its return generating process. While, there is a positive relationship between exchange rate and SENSEX. So, the results of this analysis should be affected on SENSEX.

Findings

The above findings cleanly wrap up that in long term the Indian stock market is further obsessed by Indian macroeconomic causes more willingly than global causes. It was found through P-value and F-sign that there is significant relationship between exchange rate and

SENSEX, and gold rate and SENSEX. Hence, means exchange rate does affect SENSEX. We can accept the alternative hypothesis. Gold price does not affect SENSEX. We can accept the null hypothesis. In the table, there are Intercept values and Slope values with help us in forming meaning regression equations in the form $Y_i = \beta_0 + \beta_1 X_i$. According to the Analysis the results are interesting and useful in understanding the Indian stock market pricing mechanism as well as its return generating process. There is positive relationship between exchange rate and SENSEX. While, there is a negative relationship between gold price and SENSEX. So, the results of this analysis should not be treated as conclusive for an investment on gold. But investment in Exchange rate should be treated.

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