Impact of Gold Price and Oil Price on the Indian Stock Market : With Special Reference to the Bombay Stock Exchange Market

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Abstract

Purpose : This study aimed to investigate the causative relationship between oil, gold, and the stock market and the effects of gold and oil prices on the stock market, focusing on the BSE SENSEX.

Methodology : Daily data were used in the study for the sampling period spanning from January 1996 to October 2022. The factors under investigation were the price of gold, the BSE SENSEX, and WTI crude oil. The most closely followed bellwether indicator in India is the BSE SENSEX. SENSEX aims to assess the performance of the 30 largest, most liquid, and soundest financial companies listed on the BSE Ltd. in India's several economic sectors. Gold, oil, and stock prices were all analyzed using the vector autoregression (VAR) model. When one or more variables in a model change, the impulse response function (IRF) has been used to explain how the variables in the model change as well.

Findings : No long-term correlation was found in this analysis between the prices of stocks, gold, and oil. The long-term relationship (co-integration) between stock, gold, and oil prices was not found in this study. The oil price influenced both the gold price and the SENSEX in the short term. The analysis also showed that the price of gold and the SENSEX were causally related in a one-way fashion.

Originality : The short- and long-term effects of gold prices on macroeconomic factors like inflation, growth rates, exchange rates, employment effects, and monetary policy have all been studied in economic research. However, little research has been done on how changes in the price of gold and oil affected the SENSEX.

Keywords : **ARDL, causality, gold price, oil price, SENSEX, stock market, VAR**

JEL Classification Code : C1, C5, C58

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Financial markets play a pivotal role in the foundation of any economy's stable and efficient financial system. The impact of the financial market can be seen in consumption, industrial production, and investment. Price fluctuations for gold and oil impact the capital market and the stock market. Stock market performance is impacted, either directly or indirectly, by a multitude of national and international factors. Even though modern nations no longer use gold as their primary currency, it substantially impacts macroeconomic indicators. As one of the most talked about metals, it has a lot of significance in the consumer and investing community. Numerous researchers have discovered quantitative and qualitative relationships between stock and gold prices. Gold has always been a valuable asset in portfolio allocation, an inflation indicator, and a hedge against inflation.

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Additionally, gold has demonstrated its value in times of crisis by serving as a hedge to spread the rising market risk. Central banks and international financial organizations significantly keep gold for diversification and economic security (Kaufmann & Winters, 1989). Even while gold is valuable for trading and currency hedging, more gold price volatility can have a negative impact on financial markets because it indicates riskier investments. Safer investments are those with less fluctuation in the gold price (Baur, 2012). Increased volatility in gold serves as a warning to producers and investors about potential hazards. Thus, an awareness of the volatility of the price of gold contributes to our comprehension of financial markets (Tully & Lucey, 2007).

Oil is considered a variable that is up for debate. Crude oil prices have an impact on how industries operate. Stock prices react instantly to changes in the price of oil. Oil price shocks negatively affect stock prices; therefore, increasing oil prices could impact projected future earnings (Huang et al., 1996). Through the interest rate channel, there is also a negative relationship between equities prices and oil price changes. In response to growing oil prices, policymakers may raise interest rates to reduce inflationary pressures. Two ways rising interest rates may impact stock prices. The stock price algorithm's discount rate is first raised. Secondly, it increases the attractiveness of alternative investment options such as bonds. Both impacts negatively impact stock values (Huang et al., 1996).

Review of Literature

Economic literature has studied gold prices' short-term and long-term effects on macroeconomic variables such as inflation, growth rate, exchange rates, employment effects, and monetary policy. However, modest research has been done on how oil and gold prices influence the stock market. Prakash (2021) analyzed the long-term relationship between the external macroeconomic factors and the Nifty 50 index of the National Stock Exchange (NSE). This study considered macroeconomic factors like foreign exchange reserves, crude oil prices, foreign institutional investment, the balance of payments, and gold prices. Apart from crude oil, none of the elements considered for the study correlated with the market index (NSE Nifty 50).

Furthermore, as there was no discernible relationship during the research period, it was discovered that the stock market weakened. Mohana Kumari et al. (2018) analyzed the interdependence between oil, gold, and exchange rate and the stock market in India. Data from 2003 to 2007 are included in the study. The Granger causality and cointegration test methodologies were used in the analysis. The investigation proved that the variables were co-integrated. The results showed that there was a sustained relationship between the variables. Increased exchange rate volatility would result from higher oil prices, suggesting a long-term effect on changes in the stock market. The Granger causality test showed that changes in BSE SENSEX influenced the exchange rate and gold prices.

On the other hand, the exchange rate is highly affected by changes in gold prices and oil prices. Kaur and Singh (2020) analyzed how the fluctuation in gold price affects SENSEX. Secondary data were collected from SEBI and RBI websites. According to the findings, there was a positive association between gold prices and the SENSEX, and gold prices are considerably influenced by the BSE SENSEX. Rahman and Mustafa (2018) explored the impact of changes in crude oil and gold prices on US stock market movements. Data from January 1, 1986, through December 30, 2016, were assessed for this investigation. It has been observed that gold and crude oil price fluctuations have a detrimental effect on the stock market. The price of crude oil was determined to be insignificant, but the price of gold was significant. Savadatti (2018) analyzed the possibilities of volatility spillover between the Indian and US stock markets. The results of the Granger causality test showed a unidirectional connection between the Indian and American stock markets.

Additionally, the research demonstrated volatility spillover from the American stock market to the Indian stock market. Singh and Tandon (2019) investigated the linkage between the spot price of oil and gold. The study used the co-integration and causality approach for the analysis. The study showed that crude oil and gold have no

long-run equilibrium, and gold price was the cause of oil prices and bears long-term causality. Arfaoui and Ben Rejeb (2017) analyzed the interdependencies of oil, gold, the US dollar, and stock prices and attempted to identify their direct and indirect linkages. The direct and indirect relationships between 1995 and 2015 were determined using simultaneous equations. The authors attempted to develop theoretical solutions to the study's main question by discussing their causal bilateral linkages and concentrating on multilateral interactions. The study found that oil and stock prices had a negative link but that gold prices and the US dollar considerably and positively impacted oil prices.

The stock market was one of the country's most important economic growth indicators. They are integrated with the financial market and financial indicators. Several interrelated macroeconomic factors, such as gold and crude oil, influence stock market returns, and their volatilities significantly impact stock prices. Similarly, the stock market significantly impacted international crude oil and gold prices. Therefore, investors and the stock market were affected by any geopolitical or economic occurrences. Knowing how these factors relate will help investors get the highest profits. Investors may diversify their investment portfolios based on how these macro variables interact.

Even though much research has been conducted on the relationship between oil prices, gold prices, and the stock market, there were a few gaps in the literature. The effect of oil and gold prices on the Indian stock market has been the subject of very few research. Secondly, this study covers 1996 through 2022 and has 6,320 observations.

Objectives of the Study

(1) To look into the influence of changing oil and gold prices on stock market pricing, emphasizing the SENSEX.

(2) To investigate the causality between oil, gold, and SENSEX prices.

Hypotheses

A review of the literature led to the establishment of the following relationship.

- **H01 :** There is no relationship between oil price, gold price, and SENSEX.
- **Ha1 :** There is a relationship between oil prices and stock market prices.
- **H02 :** No causality exists between oil, gold, and SENSEX.
- **Ha2 :** There is causality between oil prices and gold prices.

Methodology

Data was gathered for the project daily from January 1996 through October 2020. The BSE SENSEX, gold, and crude oil are among the variables considered. The London Bullion Market Association, the BSE website, and an OPEC data source provided the daily statistics. Since the BSE SENSEX is India's most widely watched bellwether index, it has been considered for the study. Its main objective is to evaluate the performance of the top 30 largest, liquid, and financially secure corporations listed on the BSE Ltd. in India's primary economic sectors. The Augmented Dicky–Fuller (ADF) unit root test was used to determine whether the data was stationary (Dicky & Fuller, 1979). The Johansen co-integration test is used to examine the long-term relationship between the variables since all of the variables are of type I (1). Furthermore, the vector autoregression (VAR) model was employed as there is no long-run association between the prices of the three variables. The optimal lag length was

determined using the VAR lag criterion. The impulse response function has been used to characterize the evolution of a model's variables in response to a shock in one or more variables. Each endogenous variable in this model is explained by its lagged or previous values and the lagged values of all other endogenous variables. All of the variables in this model are described as endogenous. No external variables exist in the model. In the short run, the causal relationship between the three variables was ascertained using the VAR Granger causality test.

Data Analysis and Results

The prices of gold, crude oil, and the BSE SENSEX are shown in Figure 1. The oil price graph exhibits higher volatility than the SENSEX and gold.

Table 1 displays descriptive statistics for the variables. The Jarque–Bera test contradicts the null hypothesis of normal distribution for the returns. The SENSEX has an extremely high standard deviation, suggesting considerable volatility, followed by gold and oil prices.

Figure 1. ***Sensex, Gold, and Oil Prices***

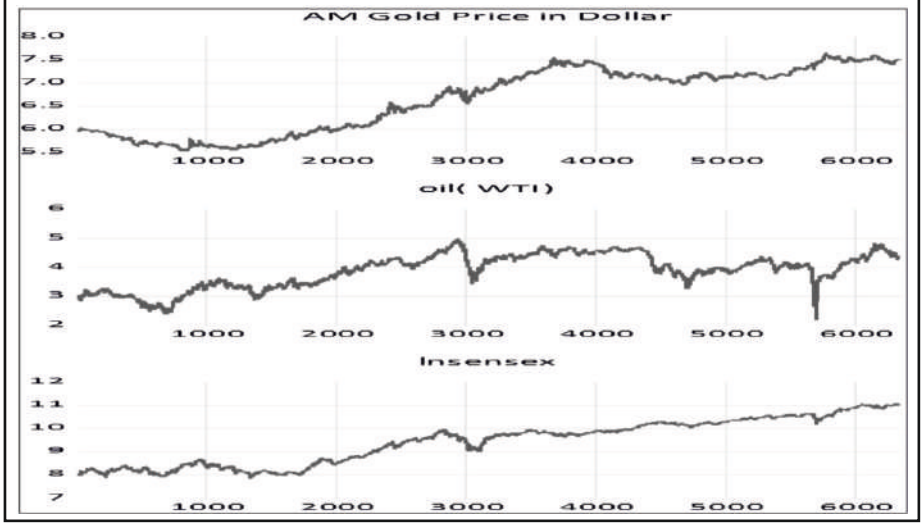


Table 1. ***Descriptive Statistics***

	LNGOLD	*LNOIL*	*LNSENSEX*
Mean	6.633981	3.877156	9.433155
Median	6.863411	3.979495	9.700116
Maximum	7.631189	4.978869	11.05539
Minimum	5.532994	2.187174	7.863313
Std. Dev.	0.690550	0.581085	0.949896
Skewness	–0.273820	–0.453564	–0.141244
Kurtosis	1.458238	2.241708	1.653343
Jarque–Bera	705.3739	368.3432	498.8805
Probability	0.000000	0.000000	0.000000
Sum	41953.30	24519.13	59655.27
Sum Sq. Dev.	3015.180	2135.025	5705.259
Observations	6,324	6,324	6,324

Table 2. ***Correlation Matrix of Gold Price, Oil Price, and SENSEX***

Correlation *t*-Statistic Probability	*LNGOLD*	*LNOIL*	*LNSENSEX*
LNGOLD	1.000000		
	–		
	–		
LNOIL	0.765742	1.000000	
	94.66710	–	
	0.0000	–	
LNSENSEX	0.943554	0.721241	1.000000
	226.5063	82.78893	–
	0.0000	0.0000	–

Table 3. ***Results of ADF Unit Root Test***

Variables	Level			Intercept			Decision
	Intercept	Trend and Intercept	None	Intercept	Trend and Intercept	None	
LNGold	–0.37	–1.89	1.74	–81.49	–81.48	–81.45	I(1)
	(0.91)	(0.65)	(0.98)	(0.001)*	(0.001)*	(0.001)*	
LNOil	–1.98	–2.12	0.18	–19.73	–19.74	–19.73	I(1)
	(0.29)	(0.53)	(0.73)	(0.00) *	(0.00) *	(0.00) *	
LNSensex	–0.45	–2.70	2.26	–74.81	–74.81	–74.54	I(1)
	(0.89)	(0.23)	(0.99)	(0.001)*	(0.001)*	(0.001)*	

Note. * 1% level of significance.

Pearson's correlation coefficient was used to assess the correlation and determine the strength of the association between the variables. The correlation between the price of gold, oil, and the SENSEX is seen in Table 2. The findings show a far larger association between the SENSEX and gold prices than between the SENSEX and oil prices. Prices for gold and oil are also strongly positively correlated.

The unit root test is used to determine whether the data are stationary. This is accomplished through the use of ADF. The data become stationary at the first difference rather than at the level. Table 3 displays the results of the ADF test.

Lag selection is performed before testing long-run co-integration. Lags have been chosen based on VAR. The results are shown in Table 4. Following the ADF stationary test, the Schwarz information criterion (SIC) determines the optimal lag selection. The ideal log length, according to the SIC value, is 2.

Johansen Co-integration Test

The Johansen co-integration test is used to ascertain whether a long-term relationship exists between the variables after establishing the time series features of the data. If a stationary linear combination of nonstationary variables exists, it can be found using the Johansen test. Using the established lag values, the Johansen co-integration test is run to ascertain whether or not there is a long-term relationship between the variables.

↳ **H01 :** There is no co-integration equation.

Table 4. ***VAR Lag Length Selection***

Lag	LogL	LR	FPE	AIC	SC
0	10974.74	NA	0.00649	3.479376	3.477281
1	50726.24	123323.8	2.13E–11	–16.059	–16.0545
2	50791.26	129.8983	2.09E–11	–16.076	–16.0689
3	50807.18	31.8025	2.09E–11	–16.078	–16.0678
4	50842.78	71.04675*	2.07E–11*	–16.087*	–16.0728*

Note. * indicates lag order selected by the criterion.

LR : sequential modified; LR test statistic (each test at 5% level) ; FPE : Final prediction error ;

AIC : Akaike information criterion; SC : Schwarz information criterion; HQ : Hannan–Quinn information criterion.

↳ **Ha1 :** There is a co-integration equation.

The results reveal that the BSE SENSEX, oil, and gold prices have no long-run association. At a 5% significance level, Table 5 reveals the absence of a co-integrating equation. This could be because gold and oil prices fluctuate regularly. People may be more interested in short-term dynamics than long-term investing. Since there is no co-integration, the study will proceed with the VAR model for short-term analysis.

The short-term VAR model findings are shown in Table 6. The delays of oil prices and the BSE SENSEX impact each other. The current SENSEX gains when oil prices lag by one day, whereas the current SENSEX loses when oil prices lag by two days. The SENSEX increases by 1.05% for every 1% increase in the one-day lag oil price, whereas the current SENSEX decreases for every two-day preceding oil price value. Therefore, we reject the H01, that is, there is no relationship between oil price, gold price, and SENSEX.

Table 5. ***Johansen's Co-Integration Test Results***

Unrest recited Co-integration Rank Test *(Trace)*				
Hypothesized No. of CE(s)	**Eigenvalues**	**Trace Statistic**	**0.05 Critical Value**	**Prob.****
None•	0.002017	19 .38921	29 .79707	0.4652
At most 1	0.001042	6 .630431	15 .4947 1	0.62 10
At most 2	7.3 1E–06	0.046 197	3 .8414 65	0.8298

Note. The trace test indicates no co-integration at the 0.05 level.

• denotes rejection of the hypothesis at the 0.05 level.

**Mackinnon–Haug–Michelis (1999) *p*-values.

Table 6. ***Results of the VAR Model***

LNSENSEX = *C*(1)**LNSENSEX*(–1) + *C*(2)**LNSENSEX*(–2) + *C*(3)**LNGOLD*(–1) + *C*(4)**LNGOLD*(–2) + *C*(5)**LNOIL*(–1) + *C*(6)**LNOIL*(–2) + *C*

	Coefficient	**Std. Error**	***t*-Statistic**	**Prob.**
LNSENSEX(–1)	1.055512	0.012558	84.05009	0.0000
LNSENSEX(–2)	–0.056716	0.012558	–4.516248	0.0000
LNGOLD(–1)	–0.002102	0.017622	–0.119300	0.9050
LNGOLD(–2)	0.003586	0.017620	0.203517	0.8387

LNOIL(–1)	0.022137	0.006638	3.334886	0.0009
LNOIL(–2)	–0.021952	0.006628	–3.312108	0.0009
C	0.001222	0.001915	0.638169	0.5234
R-squared	0.999747	Mean dependent var.		9.433447
Adjusted *R*-squared	0.999746	SD dependent var.		0.949725
SE of regression	0.015123	AIC		–5.544045
Sum squared residual	1.444114	SIC		–5.536568
Log-likelihood	17528.95	HQ		–5.541455
F-statistic	4152933.	Durbin–Watson stat.		1.995088
Prob(*F*-statistic)	0.000000			

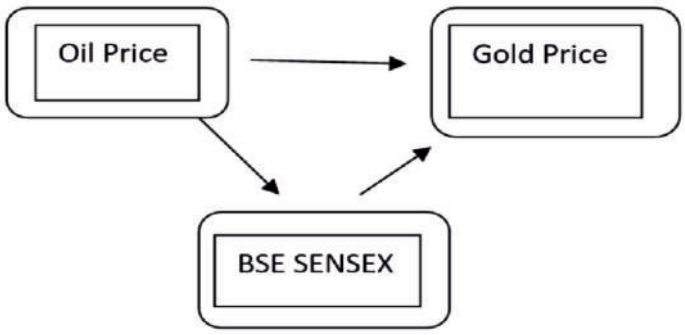
Short-Run VAR Granger Causality Test

According to the VAR Granger causality test results, the SENSEX and the gold price are caused by the oil price (Table 7). One-way causality from the SENSEX to the price of gold is also seen in Figure 2. Therefore, we reject the H02, that is, there is causality between oil prices and gold prices.

Table 7. ***VAR Granger Causality Test Results***

Dependent variable *LE :* *LNS ENSEX*			
Excluded	**Chi-square**	***df***	**Prob.**
LNGO LD	2 .517551	2	0.2 840
LNO IL	11 .73483	2	0.0028
All	15.3736 2	4	0.0040
Dependent variable : *LNGOLD*			
LNS ENS EX	6 .53504 1	2	0.0381
LNO IL	65 .8432 4	2	0.0000
All	73 .24587	4	0.0000
Dependent variable : *LNOIL*			
LNS ENS EX	2 .00794 1	2	0.3664
LNGO LD	2 .03561 4	2	0.361 4
All	8 .603400	4	0.0718

Figure 2. ***Analysis of Short-Term Granger Causality Test***



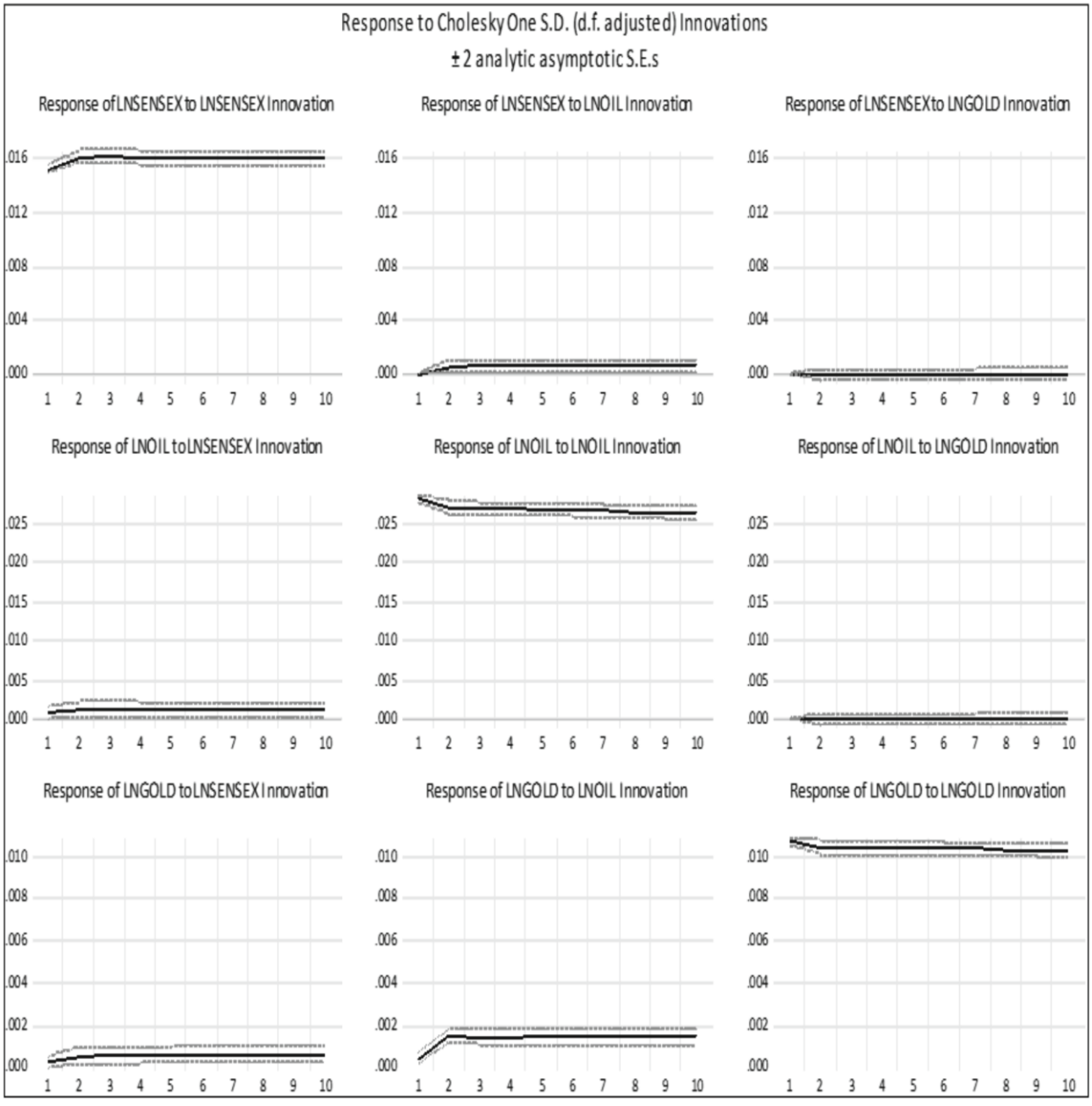
Note. *Unidirectional →

Impulse Response Function

The impulse response function is used in this study to determine each variable's long-term response to shocks and other variables. IRF illustrates a variable's dynamic response route to a shift in another variable innovation.

The results of the impulse response function are displayed in Figure 3. According to the IRF data, the SENSEX first reacted favorably and strongly to changes in the price of gold and oil before stabilizing for about ten days. This conclusion is consistent with the Granger causality findings and validates the co-movement of the variables.

Figure 3. ***Results of the Impulse Response Function***



Findings and Conclusion

Oil, gold, stock prices, and returns extensively impact India's economic and financial activities. This paper investigates the short-run and long-run relationship between oil prices, gold prices, and SENSEX. The analysis concludes that there is no long-term relationship, or co-integration, between the price of oil, gold, and the SENSEX. The short-term causal relationship between the variables indicates that the oil price influences both the SENSEX and the price of gold. Additionally, the study shows a one-way causal relationship between the price of gold and the SENSEX. The VAR results reveal that the price of oil affects the SENSEX. The SENSEX will rise if the price of one lag oil rises. As a result, before investing in the SENSEX, investors might look at the previous day's oil price. According to the Granger causality test, the price of oil has a major impact on both the price of gold and the SENSEX.

Limitations of the Study and Scope for Further Research

This study's extension will examine how the variables above affect the industry sectors, transportation, energy, and various BSE stock markets. The goal is to develop a thorough and insightful policy recommendation.

Authors' Contribution

Binu Joseph and Dr. Rajeshwari U.R. conceived the idea and developed the qualitative and quantitative designs to undertake the empirical study. Binu Joseph also extracted research papers with high repute, filtered these based on keywords, and generated concepts relevant to the study design. Dr. Rajeshwari U.R. verified the analytical methods and supervised the study. Binu Joseph collected the data. The numerical computations were done by Dr. Rajeshwari U.R. using Eviews 12. Dr. Rajeshwari U.R. and Binu Joseph wrote the manuscript in consultation with each other.

Conflict of Interest

The authors certify that they have no affiliations with or involvement in any organization or entity with any financial interest, or non-financial interest in the subject matter or materials discussed in this manuscript.

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