



Testing the Impact of Gold & Crude Oil on Stock Market in India

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ABSTRACT

This study investigates the impact of crude oil price and gold price on the Indian stock market, with specific reference to the Sensex BSE index. The research aims to discern the relationships between these key commodity prices and stock market movements, considering their significance in the Indian economy and the global financial landscape. The analysis utilizes a comprehensive dataset covering historical crude oil prices, gold prices, and Sensex BSE index values over a specified period. To achieve the objectives, a combination of quantitative methods, including correlation analysis, regression models, and time-series analysis, is employed. The study accounts for other relevant factors that may influence the stock market, such as macroeconomic indicators, political events, and global market trends. By controlling for these factors, the research aims to isolate the unique impact of crude oil and gold prices on the Indian stock market. This paper explores the casual relationship between the gold and crude oil price on Indian stock market movements, the daily data of gold and crude oil are used from the first business day of January 2012 to June 2023. To measure the effective relation efficient unit root tests are applied to examine the time series of the variables in terms of stationarity and non-stationarity. To determine stationarity in the time series data, unit root test analysis is used in this research and ADRL test is applied to check the co-integration. Our findings help to clarify how there is impact of each variables and resulted in proving no mutual impact on Sensex, Gold and Crude oil.

Keywords: Crude oil, Gold, Sensex, VAR model, Granger causality, Stock market

INTRODUCTION

The stock market plays a crucial part in the growth of the economy and is frequently covered in the top news for its movements. The extremely volatile nature of the stock market makes it difficult to predict its movement, making it tough for investors to identify securities that will, in fact, generate positive returns. This type of fluctuation is caused by a wide range of factors, including monetary policies, interest rates, variations in commodity market pricing, political circumstances, financial crises, global epidemics, and investor sentiment, making it difficult to develop an accurate stock market prediction model. Among all the various economic factors it is crude oil and gold which have high influence on the stock prices (Gokmenoglu & Fazlollahi, 2015)

Following the financial crisis, in the late 1990s and with the onset of the global financial crisis in 2007–2008, the investors were forced to temporarily distance themselves from stock market and withdraw their investments, as a result, investors started to invest in gold and other haven securities. For investors with short-term objectives, gold may not always serve as a hedge against inflation and market uncertainties. When held for a long period, it can really serve as an appropriate inflation or stock hedge. Due to the relative simplicity of the gold market, gold's movement may expand during uncertain times. Gold is a desirable investment because of its propensity to increase in value in response to adverse market shocks, especially during times of financial market uncertainty. Due to its unique characteristics, gold has historically been seen as a secure investment. For thousands of years, it has been used as a medium for transactions and a store of value. Being one of the earliest forms of money and traditionally used as inflation hedge, gold has been referred to as wealth "at all times and in all places" and is typically thought of as a safe asset (Ghazali et al., 2013). Thus gold, a haven, has been selected as the subject for the study and to know its impact on stock markets.

The other significant commodity is Crude oil which has been severely impacted by current tensions. Geopolitical and weather-related issues can cause unanticipated changes in supply and demand, which can increase oil price volatility.

Understanding the volatility of crude oil prices is crucial because it could lead to instability in the economies of both oil-exporting and -importing nations and uncertainty in all economic sectors as, the volatility in the price of oil puts industrial producers and consumers at risk (Pindyck, 2004) As the value of a commodity is dependent on an unforeseen claim which is affected by the volatility, the volatility of the oil price also has an impact on derivative markets

(Ng'ang'a & Oleche, 2022). Furthermore, fluctuating oil prices result in higher unemployment and inflation rates. As a lifeline for many of the nation's economies as well as the global economy in general, crude oil is gaining lots of significance. The commodity that is traded the most globally is crude oil.

The oil and energy sector are a very important sector in India and for the overall development of the world economy. The world economy is clearly impacted by rising oil prices since they affect employment, inflation, and the value of the dollar, all of which contribute to a downturn in the global economy. The overall performance of stock markets around the world is impacted by a significant rise or fall in crude oil prices. India is one of the largest importers of crude oil worldwide, many Indian businesses rely on consistent crude oil prices. This comprises businesses in the airline, lubricant, footwear, and tyre industries. The rising input costs for these businesses have a negative impact on their profitability, their stock prices can be adversely affected by this.

Due to the fact that Gold and crude oil are the two most traded commodities on international commodity markets, it can be used on elucidating how the movement in their price and volume affects the stock price, as crude oil is the main energy source in the world and has a high demand, crude oil has the power to affect the stock market. Additionally, gold and crude oil make up a significant portion of India's imports, hence this research aims to understand how these two commodities impact the Indian stock market. Thus, research into how they relate to stock market can help out in predicting changes and their casual relation therein. The ADF test shows the price of gold, crude oil, and the Sensex index over a period of time. The Sensex index has the highest return, followed by gold and then crude oil.

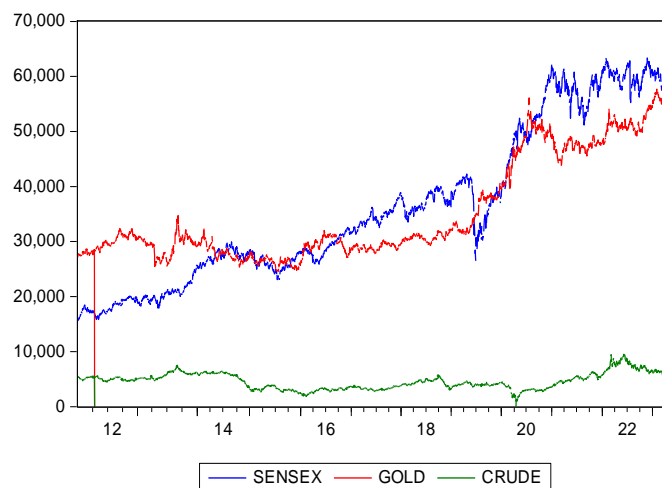


Fig: Augmented Dickey Fuller Test

Average price of the Market is 17049.26, while Expected returns per annum is 0.12 and Total return of the market index is 27%

REVIEW OF LITERATURE

(Jain & Biswal, 2016) examine the relationship between global gold, crude oil, USD-INR exchange rates, and the Indian stock market. DCC-GARCH (standard, exponential, and threshold) models are used, and symmetric and asymmetric Non-Linear Causality tests are conducted to examine the lead and lag relationships. The fall in gold prices and crude oil prices caused a fall in the Indian rupee and the benchmark stock index, i.e., the Sensex. Gold is emerging as an investment asset class for investors. With the use of gold and oil prices as instruments, dynamic policymaking can be used to contain fluctuations in exchange rates and stock markets. (Kanungo & Dang, 2021) analyze 19-year data through an Autoregressive distributed lag model, in which exchange rates hurt India's stock market, whereas gold and crude oil prices have a positive effect. It should be noted, however, that the impact of these factors on the stock market varies over time. It was also found that these elements had a long-term connection, demonstrating their interdependence. It also highlights how important it is to regularly analyze these factors because their interrelationships may change over time. These results confirm that gold and equity prices significantly influence crude oil prices. In addition, oil and forex rates significantly influence gold prices, and forex rates and equity prices influence each other.

Therefore, cointegration was not possible among the variables examined. These results indicate that regular analysis is essential because the relationships between the different markets may shift over time. They also suggest that investors should be aware of the intricate connections between different asset classes when making investment decisions.



Using the Johansen cointegration test, (Mitra, 2018) has found that crude oil prices and stock market prices exhibit long-term equilibrium relationships. (Huang & Chen, 2021) The purpose of this study was to determine whether the CNN model with gold and crude oil indicators could be used to predict stock values and provide useful information to investors and decision-makers. (Kumar, 2017) specifically positive when oil prices are low and negative when oil prices are high. It also examines how macroeconomic factors like inflation and exchange rates affect the correlation between the prices of crude oil and gold. This research is centered on the dynamic relationship between crude oil and gold prices using 10 years of data from nonlinear Granger Causality and ARDL tests.

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The findings say inflation has a big positive impact on this connection, exchange rates have a significant negative impact. (Rastogi, 2016) The traditional cointegration model is not as good a predictor of stock market returns as the neural network model. (Yadav et al., 2020) Using data spanning 18 years, the authors of this study analyze the complex relationship between the price of crude oil and the Sensex index of the Indian stock market. They find that this association is dynamic and changes over time, with short-term fluctuations having a more significant impact than long-term trends. As a result, investors in the Indian equity market should closely monitor changes in crude oil prices and adjust their investment strategy as necessary. (Ghosh & Kanjilal, 2016), Instead of having a direct detrimental effect on the profitability of companies listed on the stock market, changes in the price of crude oil have an indirect impact on the stock market through the budget deficit, inflation, and depreciation of the rupee.

(Kang et al., 2015) Using data from the past 40 years and a vector auto regression model, this study examines how domestic and foreign oil production contribute to the impact of oil price shocks on the U.S. stock market. The authors also found that the effect of oil price shocks on the stock market is more significant when U.S. oil output is high.

According to this finding, local oil production is essential for minimizing the negative effects of oil price shocks on the stock market. (Anil & Ajit, 2020) in the transfer of changes in oil prices to stock markets and the reverse. Rather than having a direct negative impact on the profitability of companies listed on the stock market, an increase in crude oil prices was transmitted to the stock market indirectly through the fiscal deficit, inflation, and depreciation of the rupee.

(Raju & Marathe, 2020) studied the relationship between gold, crude oil and exchange rate and its impact on stock market and concluded that international oil price variability has impact on Indian stock market.

Objectives of the Study

The specific objective of the research is to firstly study the role of the commodity market on the fluctuations caused in the stock market, secondly to know the impact of gold prices and crude oil on the Stock Market. Third, it is to find out the relationship between the price of Gold, the price of Crude Oil, and India's stock market and to find out if there is cointegration between the variables, i.e., gold, crude oil, and the stock market.

RESEARCH METHODOLOGY

The research design for this study will be a comparative study, comparing the impact of crude oil and gold and Sensex.

The data collected includes daily closes of stock index gold and crude oil. The data will be obtained from secondary sources such as investing .com and MCX and other databases.

The data collected will be analyze using descriptive statistics to obtained mean, stranded deviation and correlation and co efficient. Regression analysis will be conducted to determine the impact of god and crude oil on Sensex. The model to be used VAR And ADRL. We apply the Augmented Dickey-Fuller (ADF) and Phillips-Person (PP) unit root test on the all variables at their levels and first difference to check at what level series are stationary.

Variable name	web page	Units
Sensex	www.bseindia.org	Index
Gold	www.mcx.org	Rupees
Crude oil	www.investing.com	Rupees

DATA ANALYSIS AND INTERPRETATION

Normality Test

Ho – The selected data is normally distributed

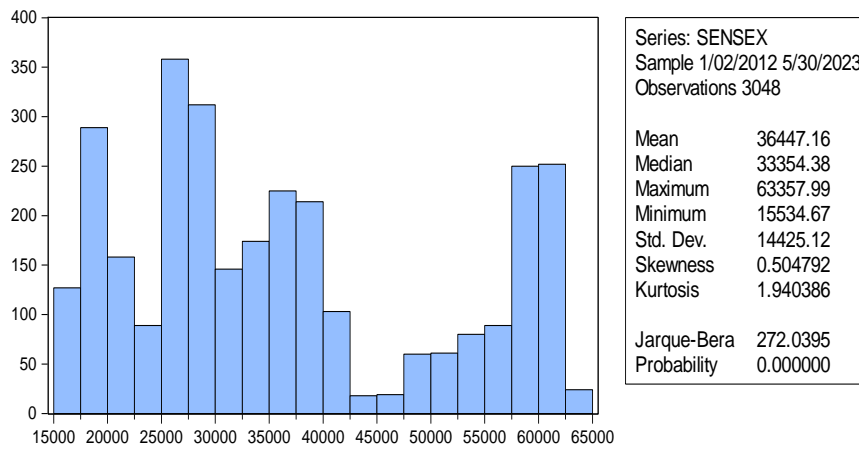


Fig 1: Normality Test for Sensex

The skewness suggests a mild right-skewness and kurtosis indicates a leptokurtic distribution, which means the data has a higher peak and heavier tails than a normal distribution, indicating the presence of outliers or extreme values. The P-value less than 0.05, hence rejecting Null Hypothesis and concludes that data is not normally distributed.

Normality test has been conducted for Gold and Crude oil and resulted that the Skewness indicating a positively skewed distribution with more data points on the left and few extreme values on the right, while Kurtosis of 2.4393 suggests a leptokurtic distribution with higher peak and thicker tails than the normal distribution and Jarque-Bera test statistic of 479.0528 confirms that the data significantly departs from a normal distribution, supporting the presence of skewness and kurtosis. While the results of Skewness in Crude oil indicates mild positive skewness and has leptokurtic distribution. Jarque-Bera test statistic of 110.68 concludes data may have some deviations from normal distribution, which is relatively closer to normal compared to distribution with higher Jarque-Bera values.

Testing of Stationarity

Ho – The selected data is nonstationary or has unit root problem.

Null Hypothesis: SENSEX has a unit root

Exogenous: Constant

Lag Length: 0 (Automatic - based on SIC, maxlag=28)

		t-Statistic	Prob.*
Augmented statistic	Dickey-Fuller test	-0.41	0.9
Test critical values:		1% level	-3.43
		5% level	-2.86
		10% level	-2.56

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation

Dependent Variable: D(SENSEX)

Method: Least Squares

Date: 07/19/23 Time: 22:57

Sample (adjusted): 1/03/2012 5/30/2023

Included observations: 3047 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
SENSEX(-1)	-0.0002	0.0005	-0.418	0.675
C	23.59	20.729	1.138	0.255



R-squared	0.001	Mean dependent var	15.525
Adjusted R-squared	-0.0002	S.D. dependent var	420.929
S.E. of regression	420.9	Akaike info criterion	14.92
Sum squared resid	539663041	Schwarz criterion	14.92
Log likelihood	-22734.3	Hannan-Quinn criterion	14.92
F-statistic	0.175	Durbin-Watson stat	2.096
Prob(F-statistic)	0.67		

Null Hypothesis: D(SENSEX) has a unit root
 Exogenous: Constant, Linear Trend
 Lag Length: 0 (Automatic based on SIC, maxlag=28)

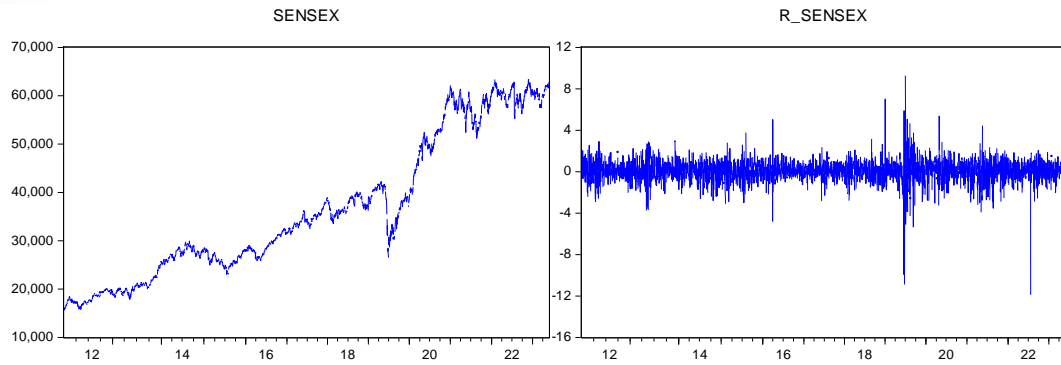
	t-Statistic	Prob*
Augmented Dickey-Fuller test statistic	-57.893	< 0.01
Test critical values:		
1% level	-3.961	
5% level	-3.411	
10% level	-3.127	

*MacKinnon (1996) one-sided p-values
 Augmented Dickey-Fuller Test Equation
 Dependent Variable: D(SENSEX,2)
 Method: Least Squares
 Date: 06/27/23 Time: 23:41
 Sample (adjusted): 1/04/2012 5/30/2023
 Included observations: 3046 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(SENSEX(-1))	-1.048	0.018	-57.89	<0.01
C	10.48	15.25	0.68	0.491
TREND("1/02/2012")	0.003	0.008	0.435	0.66

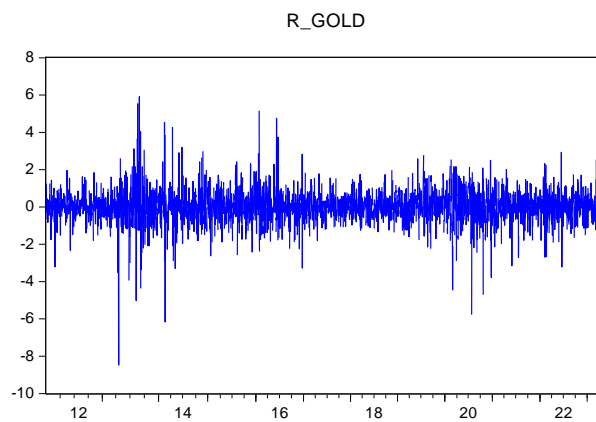
R-squared	0.52	Mean dependent var	-0.034
Adj R-squared	0.52	S.D. dependent var	609.5
S.E. of regression	420.63	Akaike info crit	14.92
Sum squared resids	538000.00	Schwarz criterion	14.92
Log likelihood	-22723.77	Hannan-Quinn	14.92
F-statistic	1675.83	Durbin-Watson stat	2
Prob(F-statistic)	<0.01		

At level, the test statistic (-57.89345) is much lower than all the critical values, we have strong evidence to reject the null hypothesis of a unit root. Thus, the time series D(SENSEX) is stationary.



Sl.No		At Level			At 1st Difference		
		t-stat	P value	Hypothesis	t-stat	P value	Hypothesis
1	Sensex	-57.89	0.001	Accept	-0.418	0.9	Accept
2	Gold	-36.78	0.01	Accept	-0.312	0.792	Accept
3	Crude	1.138	0.052	Accept	1.201	0.248	Accept

At 1st difference, the test statistic -36.787 which is much lower than all critical values, we have strong evidence to reject the null hypothesis of having a unit root. Thus, the time series D(GOLD) is stationary. The coefficient of D(GOLD(-1)) is -2.0354 and it represents the coefficient of the first lagged difference of D(GOLD) and its significant t statistic confirms its importance in making the series stationary.



The extremely low p-value (<0.01) provides strong evidence against the null hypothesis of having a unit root. As a result, we reject the null hypothesis in favour of the alternative hypothesis, which states that the time series D(CRUDE) is stationary where an highly negative test statistic, such as -39.553 exhibits strong tendency to return to constant level over time.

Correlation

	R_CRUDE	R_GOLD	R_SENSEX
R_CRUDE	1	0.000927	0.002469
R_GOLD	0.000927	1	-0.00278
R_SENSEX	0.002469	-0.00278	1

Correlation matrix concludes that there exists no correlation between Crude oil prices on Gold, Sensex on Crude oil and vice versa.



Multiple Regression

Ho = There is no significant impact from Gold and crude oil on Sensex.

$$\text{Equation: } R_m = (\alpha_i) + \beta_i R_{mg,t-1} + \beta_i R_{mc,t-1}$$

Where,

R_m is Market Returns on Sensex

B_{i,t} is the coefficient that measures the effect of the previous period's stock return on current period stock return

R_{mg} is Market Returns on Gold

R_{mc} is Market Returns on Crude Oil

Dependent Variable: R_SENSEX

Method: Least Squares

Date: 07/19/23 Time: 23:29

Sample (adjusted): 1/03/2012 5/30/2023

Included observations: 3045 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
R_GOLD	-0.003	0.022	-0.153	0.878
R_CRUDE	0.000	0.001	0.136	0.89
C	0.046	0.019	2.350	0.018
R-squared	0.001	Mean dependent var		0.046
Adjusted R-squared	-0.001	S.D. dependent var		1.082
S.E. of regression	1.080	Akaike info criterion		2.998
Sum squared resid	3566.700	Schwarz criterion		3.003
Log likelihood	-4561.400	Hannan-Quinn criterion		3
F-statistic	0.021	Durbin-Watson stat		2.08
Prob(F-statistic)	0.970			

Here the Durbin Watson stat is = 2.084181, thus the model fitness is good.

R-squared value is nearer to zero, so the model does not explain any of the variability in the target variable. It means that the model's predictions are no better than using the mean of the target variable as a constant predictor but Durbin Watson Statistic value is greater than R-squared value, thus the model fitness is good

Granger Causality Tests

Pairwise Granger Causality Tests

Date: 07/19/23 Time: 23:32

Sample: 1/02/2012 5/30/2023

Lags: 2

Null Hypothesis: Observations F-Statistic Prob.

R_GOLD does not Granger Cause R_SENSEX	3041	0.932	0.393
R_SENSEX does not Granger Cause R_GOLD		1.07	0.342
R_CRUDE does not Granger Cause R_SENSEX	3041	1.118	0.326
R_SENSEX does not Granger Cause R_CRUDE		1.605	0.2
R_CRUDE does not Granger Cause R_GOLD	3041	1.792	0.166
R_GOLD does not Granger Cause R_CRUDE		1.234	0.291



Returns of Gold and Sensex and Returns on Gold do not cause effect on Returns of Sensex, Returns of crude on Returns of Sensex and likewise returns on crude on returns of gold. As the test prob is less than 0.05 in all the cases, it is concluded that there is no cause-and-effect relationship between crude oil, gold and Sensex.

Vector Auto Regression Estimates

Vector Auto regression Estimates

Date: 07/18/23 Time: 10:45

Sample (adj): 1/05/2012 5/30/2023

Included observations: 3041 after adjustments

t-statistics in []

	R_CRUDE	R_GOLD	R_SENSEX
R_CRUDE(-1)	-0.662	0.0007	-0.001
	0.017	0.0009	0.001
	[-38.237]	[0.7310]	[-1.444]
R_GOLD(-1)	-0.297	-0.0529	-0.029
	0.3171	0.018	0.022
	[-0.93]	[-2.92]	[-1.31]
R_SENSEX(-1)	0.251	-0.011	-0.043
	0.258	0.014	0.0181
	[0.972]	[-0.784]	[-2.377]
C	-0.007	0.025	0.048
	0.279	0.015	0.0196
	[-0.0260]	[1.580]	[2.468]
R-squared	0.326	0.007	0.003
Adj. R-squared	0.325	0.005	0.001
Sum sq. residuals	717222.4	2343.3	3542.1
S.E. equation	15.3	0.878	1.06
F-statistic	245.5	3.589	1.64
Log likelihood	-12621.7	-3918.73	-4546.9
Akaike AIC	8.3	2.58	2.99



Schwarz SC	8.31	2.59	3
Mean dependent	0.001	0.025	0.046
S.D. dependent	18.72	0.881	1.081
<hr/>			
Determinant resid covariance (adj)		213.07	
Determinant resid covariance		211.61	
Log likelihood		-21086.8	
Akaike information criterion		13.8	
Schwarz criterion		13.92	

The coefficient estimates indicate the relationship between the variables at different lags. The coefficient of -0.6623 for Returns on crude suggests that a one-unit increase in the lagged value of Returns on crude is associated with a decrease of approximately 0.6623 units in the current value of Returns on crude.

CONCLUSION

This research examined the causal relation between international crude oil prices, gold prices, exchange rates and Indian stock market. We considered the daily stock price from 1st June 2012 to 31st June 2023.

Our findings have major implications for the many market participants in the Indian equity and commodity markets, including investors and portfolio managers. Additionally, with the help of these findings, "investors" can quickly spot emerging stock market trends by examining changes in other factors that influence the stock market.

In this research study we have examined the relationship between crude oil and gold prices on Sensex the outcome of multiple regression analysis shows that there is no impact of gold and crude oil prices on Sensex price and we find the model significant with the P value of less the 0.05.

The result of the Granger Causality test, the prob is less than 0.05 in all the cases, it is concluded that there is no cause-and-effect relationship between crude oil, gold and Sensex.

Based on the findings of our models' traders need not place a significant emphasis on gold and crude prices as factor effecting Sensex prices, however this may only be true in a longer time frame.

Practical Implications

- The results of this study are crucial for numerous market participants and stakeholders who deal in Gold, Crude Oil, and the Indian stock market.
- The research findings can be used by fund managers and investors to understand the link between these variables and identify chances for cross-hedging.
- Given that India imports a lot of crude oil, which has a direct impact on transportation costs and ultimately on the price that consumers pay, this study may be useful in advancing other, more generalized areas of research.
- It has potential for the academics to continue focusing on the problem of how changes in the prices of these variables affect India's inflation rate. The report also directs further research into other commodity variables, such as silver and natural gas, which may exhibit comparable or dissimilar spillover effects.

Suggestions for the Future Research

1. Use more advanced econometric techniques. Many research papers have used relatively simple econometric techniques, such as the Granger causality test.



2. Availability of advanced techniques are there to identify the causal relationship between these variables. Like, vector autoregression (VAR) models can be used to estimate the short-term and long-term effects of changes in one variable on another.
3. Consider other factors that may affect the relationship.
4. Use data from other countries to see if there are any cross-country differences in the causal relationship between gold, crude oil, and stock market prices.

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