

# Impact Of Gold, Crude Oil And Exchange Rate On Indian Stock Market : An Empirical Study

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## Abstract

This study examines the long-term relationships between the Indian stock market and three key macroeconomic variables: gold prices, crude oil prices, and exchange rates. Utilizing monthly data from April 2012 to March 2020, it employs Unit Root, Johansen Cointegration, and Vector Error Correction Model (VECM) tests. Findings reveal significant cointegrating relationships, with gold showing a negative correlation, and both crude oil and exchange rates demonstrating positive correlations with the stock market. The study aims to assist investors and traders in making informed decisions based on these dynamic interactions.

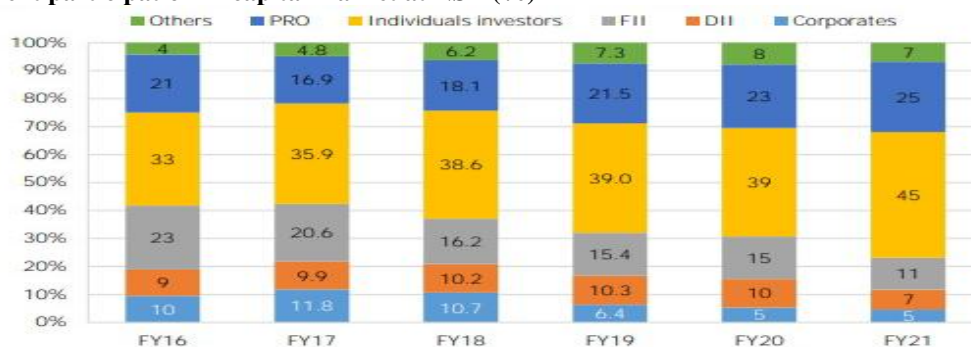
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## I. Introduction

Crude oil, gold, dollar exchange rate and stock market are most discussed topics amid Russia Ukraine crises which trembled the Indian stock market. When the nation was experiencing economic downturn due to Covid-19, stock market was flourishing due to increased participation of retail investors.

### Share of client participation in capital market at NSE (%)



Source: NSE

Gold being an important financial precautionary asset, impacts equity market to some extent. It is assumed as a defense asset of diversified portfolio as when value of all assets decline it might yield positive return.

With the rising globalization, financial integration, and global interdependencies, equity market became sensitive to exchange rates. As of September 2022, FIIs contribute \$1975.98 million, in primary Indian stock market. They lower the capital cost in emerging economies by pumping their savings. Investment by FII majorly depends on exchange rate. Changes in exchange rates affect profitability of listed firms and so the stock market returns.

Crude oil is power house of any economy, serving as major source of energy. From production to transportation, it is an essential and thus any fluctuation in its prices affects profitability of business which affects their stock prices. Thus, it become important to analyse relation between crude oil and stock market.

India's Stock Market Capitalization to GDP was reported 97.29% in 2020, and literature establishes a relation of these macroeconomic variables with stock market. In India, nearly 7.7 crore traders and investors, study the trend between the variables and thus the study aims at assisting these active demat holders in their investing and trading decisions by studying the unilateral relation between stock prices and Gold, Crude oil, and exchange rate. It studies the deviations in stock prices due to mentioned variables.

All these factors play a vital role in decision making of trader and investor community. Thus, the study will play a tremendous role in establishing causal relationship between Indian stock market and mentioned macroeconomic variables. The research will contribute to the growing economics of stock market.

## II. Literature Review

**Bahmani-Oskooee, M., & Sohrabian, A. (1992)** This paper argued to possible for stock prices to affect the exchange rates, i.e. there could be a two-way relationship between the two variables. It used monthly observations over the period July 1973-December 1988 for a total of 186 observations from the US economy.

**N. Tripathy(2011)** This paper investigated the market efficiency and causal relationship between selected Macroeconomic variables and the Indian stock market during the period January 2005 to February 2011 by using Ljung-Box Q test, Breusch-Godfrey LM test, Unit Root test, Granger Causality test.

**Sujit and R. kumar (2011)** the paper explored the extent of linkages of crude oil price, stock market returns price and exchange rate on gold prices using vector autocorrelation and cointegration technique with the more recent data. The study took daily data from 2nd January 1998 to 5th June 2011, constituting 3485 observations. The results showed that exchange rate is highly affected by changes in other variables. However, stock market had fewer roles in affecting the exchange rate.

**Cakan Esin (2013)** The study examined dynamic linkages between the exchange rates and stock prices for twelve emerging market countries. The empirical results showed that stock prices and exchange rates have linear and non-linear bi-directional causality in most cases.

**Korhan K. Gokmenoglua Negar Fazlollahia (2015)** aimed to investigate the long-run relationship among oil price, gold price, oil price volatility index, gold price volatility index, and S&P price index by applying bounds test.

**Arfaoui Mongi Rejeb Aymen (2016)** examined theoretical relationships among oil, gold, US dollar and stock prices, using simultaneous equations system to identify direct and indirect linkages.

**Jain and Biswal (2016)** said that governments impose taxes and levies to manage the effect of gold and crude oil imports on the exchange rate. These in return have relations with the economy of the country, best reflected in the stock market index.

**Nancy Estefania Saucedo (2018)** This paper analyzed the variables of oil price, exchange rate and stock market index to explain how they interact with each other in the Mexican economy.

**Shabbir Kousar (2019)** Studied the impact of gold and oil prices on the stock market from period 1985-2016 in Pakistan. This study applied descriptive statistics, augmented Dickey–Fuller test, correlation, and autoregressive distributed lag test.

**A Kumar (2019)** The paper identified the causal relationship amongst forex, gold, stock market and oil. From the World Gold Council, the weekly gold spot prices were used in terms of dollar, from OPEC the oil spot prices were withdrawn, from the website of IMF the data of Exchange rate (rupee/dollar) is taken, lastly from the BSE the data of closing price of Sensex is considered.

## III. Research Objectives

To investigate and analyze the existence of a long term cointegration relationship between stock market and crude oil, gold price, exchange rate.

To help investors and traders in their technical and fundamental analysis.

### HYPOTHESIS

Ho: There is no cointegration relationship between stock market and Gold.

Ha: There is cointegration relationship between Stock market and Gold.

Ho: There is no cointegration relationship between stock market and Crude oil.

Ha: There is cointegration relationship between Stock market and Crude oil.

Ho: There is no cointegration relationship between stock market and Exchange rate.

Ha: There is cointegration relationship between Stock market and Exchange rate.

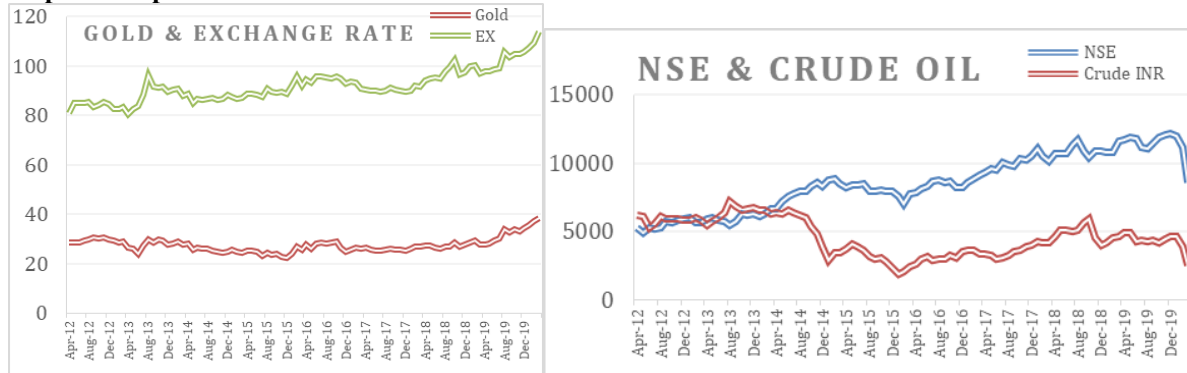
### DATA

The research is empirically conducted by taking monthly data from period April 2012 to March 2020. Nifty50 has represented the Indian Stock Market as it contains 50 companies with wider representation selected on basis of market capitalization, whereas Sensex have 30 companies which are part of Nifty50. The data is taken from official website of NSE. The data of crude oil spot prices is taken from website of petroleum planning and analysis cell as Indian basket of crude. USD as a most favored currency is taken as exchange rate w.r.t foreign exchange rate, the data for same is taken from website of RBI. Data for gold is taken as proxy of gold ETF fund of Axis Gold ETF Fund from NSE website. To simplify the study and compress data, monthly closing price of candle is used. The research is an empirical evidence based on observations and historical data.

**Data Sources and Description**

| Variable           | Description           | Data Source                     |
|--------------------|-----------------------|---------------------------------|
| Stock Market (NSE) | Monthly closing price | National Stock Exchange         |
| Gold               | Monthly gold ETF data | National Stock Exchange         |
| Crude Oil          | Monthly closing price | Petroleum Planning and Analysis |
| Exchange Rate      | Monthly closing price | Reserve Bank of India Website   |

**Graphical Representation of Data**



**IV. Methodology**

- 1) **Unit Root Test:** A unit root test is conducted to test whether a timeseries variable is non-stationary and possesses a unit root. A well-known test which is valid in large samples is Augmented Dickey-Fuller (ADF) test to determine whether the mean, variance and covariance of a time series are independent of time.
- 2) **Johansen Cointegration Test:** To test the cointegrating relationships between several non-stationary time series data Johansen cointegration test is used. Presence of cointegration depicts long run relation between variables.
- 3) **Vector Error Correlation Method:** To analyze time series data that exhibit cointegration, meaning they have a long-term equilibrium relationship. It is used because it captures short-run relationship among cointegrated variables. VECM captures the adjustment process in the short run when deviations from the long-term equilibrium occur. VECM is applicable to non-stationary time series data, as it incorporates differencing to achieve stationarity and allows for modeling the relationship among the differenced variables. It incorporates error correction mechanism (ECM), which captures the speed of adjustment of variables towards their long-run equilibrium relationship.

**V. Empirical Results**

**Unit Root Test**

**Stock exchange:** As concluded by the results, following hypothesis are stated

Ho: NSE has unit root (non-stationary)

Ha: NSE has no unit root (stationary)

Decision rule: If probability value < level of significance (0.05), then reject Ho.

Result: Prob. Value (0.000) < Level of significance (0.005) thus, reject Ho.

Thus, NSE data is I (1)

| Variable | Probability at level | Probability I diff. | Decision             |
|----------|----------------------|---------------------|----------------------|
| Gold     | 0.9475               | 0.000               | Reject Ho at I diff. |

**Gold:** As concluded by the results, following hypothesis are stated

Ho: Gold has unit root (non-stationary)

Ha: Gold has no unit root (stationary)

Decision rule: If probability value < level of significance (0.05), then reject Ho.

Result: Prob. Value (0.000) < Level of significance (0.005) thus, reject Ho.

Thus, Gold data is I (1).

| Variable | Probability at level | Probability I diff. | Decision             |
|----------|----------------------|---------------------|----------------------|
| Gold     | 0.9475               | 0.000               | Reject Ho at I diff. |

**Crude Oil:** As concluded by the results, following hypothesis are stated

Ho: NSE has unit root (non-stationary data)

Ha: NSE has no unit root (stationary data)

Decision rule: If probability value < level of significance (0.05), then reject Ho.

Result: Prob. Value (0.000) < Level of significance (0.005) thus, reject Ho in favor of alternative. Thus, Crude Oil data is stationary at level 1.

| Variable  | Probability at level | Probability I diff. | Decision             |
|-----------|----------------------|---------------------|----------------------|
| Crude Oil | 0.4744               | 0.000               | Reject Ho at I diff. |

**Exchange rate:** As concluded by the results, following hypothesis are stated

Ho: NSE has unit root (non-stationary)

Ha: NSE has no unit root (stationary)

Decision rule: If probability value < level of significance (0.05), then reject Ho.

Result: Prob. Value (0.000) < Level of significance (0.005) thus, reject Ho.

Thus, Exchange Rate data is stationary at level 1.

| Variable      | Probability at level | Probability I diff. | Decision             |
|---------------|----------------------|---------------------|----------------------|
| Exchange Rate | 0.5405               | 0.000               | Reject Ho at I diff. |

### **V. Johansen Cointegration Test**

As per the results of unit root test, all the data is stationery at level one. Thus, to determine the long run relationship between dependent and independent variable, and due to its suitability for multiple variables, Johansen Cointegration test is conducted with lag length 14 based on Akaike Information Criterion on log values of variable.

Hypothesis:

Ho: There is no cointegration relationship between variables.

Ha: There is cointegration relationship between variables.

Decision rule:

If 0.05 critical value < Max-Eigen Statistic, then reject Ho in favor of alternative.

If 0.05 critical value < Trace Statistics, then reject Ho in favor of alternative.

Date: 04/23/24 Time: 21:05  
 Sample (adjusted): 2013M07 2020M03  
 Included observations: 81 after adjustments  
 Trend assumption: Linear deterministic trend  
 Series: LN\_NSE LN\_GOLD LN\_EX LN\_CO  
 Lags interval (in first differences): 1 to 14

Unrestricted Cointegration Rank Test (Trace)

| Hypothesized No. of CE(s) | Eigenvalue | Trace Statistic | 0.05 Critical Value | Prob.** |
|---------------------------|------------|-----------------|---------------------|---------|
| None *                    | 0.723776   | 163.1758        | 47.85613            | 0.0000  |
| At most 1 *               | 0.338650   | 58.96580        | 29.79707            | 0.0000  |
| At most 2 *               | 0.223295   | 25.47459        | 15.49471            | 0.0011  |
| At most 3 *               | 0.059935   | 5.006318        | 3.841465            | 0.0252  |

Trace test indicates 4 cointegrating eqn(s) at the 0.05 level  
 \* denotes rejection of the hypothesis at the 0.05 level  
 \*\*MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

| Hypothesized No. of CE(s) | Eigenvalue | Max-Eigen Statistic | 0.05 Critical Value | Prob.** |
|---------------------------|------------|---------------------|---------------------|---------|
| None *                    | 0.723776   | 104.2100            | 27.58434            | 0.0000  |
| At most 1 *               | 0.338650   | 33.49120            | 21.13162            | 0.0006  |
| At most 2 *               | 0.223295   | 20.46828            | 14.26460            | 0.0046  |
| At most 3 *               | 0.059935   | 5.006318            | 3.841465            | 0.0252  |

Max-eigenvalue test indicates 4 cointegrating eqn(s) at the 0.05 level  
 \* denotes rejection of the hypothesis at the 0.05 level  
 \*\*MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegrating Coefficients (normalized by b\*\*S11\*b=I):

| LN_NSE    | LN_GOLD   | LN_EX     | LN_CO     |
|-----------|-----------|-----------|-----------|
| -31.20781 | -21.52063 | 133.3701  | 4.854588  |
| 2.601733  | 12.13266  | -22.78904 | -10.77328 |
| -15.14438 | -53.48196 | 10.89989  | 9.093268  |
| -15.93550 | 10.82538  | 30.01907  | -1.866515 |

**Results:**

0.05 Critical Value < Trace Statistics, thus we reject Ho in favor of alternative.

0.05 Critical Value < Max-Eigen Statistic, thus we reject Ho in favor of alternative.

Thus, there exist cointegrating relation between the variables concluding that there is long run equilibrium relationship between variables.

**Vector Error Correction Model:**

Given the identification of a long-run cointegrating relationship among the variables, the Vector Error Correction Model (VECM) is utilized to ascertain both the magnitude and swiftness of adjustment.

Sample (adjusted): 2012M07 2020M03  
 Included observations: 93 after adjustments  
 Standard errors in ( ) & t-statistics in [ ]

| Cointegrating Eq: | CoIntEq1                             |
|-------------------|--------------------------------------|
| LN_NSE(-1)        | 1.000000                             |
| LN_GOLD(-1)       | 3.916985<br>(1.50543)<br>[ 2.60191]  |
| LN_EX(-1)         | -3.994936<br>(1.57337)<br>[-2.53910] |
| LN_CO(-1)         | -1.364094<br>(0.47693)<br>[-2.86016] |
| C                 | 6.059305                             |

| Error Correction: | D(LN_NSE)                            | D(LN_GOLD)                           | D(LN_EX)                             | D(LN_CO)                             |
|-------------------|--------------------------------------|--------------------------------------|--------------------------------------|--------------------------------------|
| CointEq1          | -0.037523<br>(0.01326)<br>[-2.83048] | 0.004864<br>(0.01229)<br>[ 0.39587]  | 0.011257<br>(0.00600)<br>[ 1.87729]  | 0.031286<br>(0.02776)<br>[ 1.12696]  |
| D(LN_NSE(-1))     | 0.052965<br>(0.15735)<br>[ 0.33660]  | -0.122749<br>(0.14584)<br>[-0.84170] | 0.057033<br>(0.07118)<br>[ 0.80130]  | 0.512004<br>(0.32951)<br>[ 1.55382]  |
| D(LN_NSE(-2))     | -0.084230<br>(0.16072)<br>[-0.52407] | 0.007129<br>(0.14896)<br>[ 0.04786]  | 0.052205<br>(0.07270)<br>[ 0.71808]  | 0.106579<br>(0.33657)<br>[ 0.31666]  |
| D(LN_GOLD(-1))    | 0.137250<br>(0.13132)<br>[ 1.04518]  | -0.138984<br>(0.12171)<br>[-1.14197] | -0.123725<br>(0.05940)<br>[-2.08294] | 0.009106<br>(0.27499)<br>[ 0.03312]  |
| D(LN_GOLD(-2))    | 0.167852<br>(0.12998)<br>[ 1.29136]  | 0.001421<br>(0.12047)<br>[ 0.01180]  | -0.200223<br>(0.05880)<br>[-3.40543] | -0.169433<br>(0.27220)<br>[-0.62247] |
| D(LN_EX(-1))      | -0.322060<br>(0.30603)<br>[-1.05239] | -0.175463<br>(0.28363)<br>[-0.61863] | 0.049645<br>(0.13843)<br>[ 0.35863]  | 0.142137<br>(0.64086)<br>[ 0.22179]  |
| D(LN_EX(-2))      | -0.169381<br>(0.29408)<br>[-0.57598] | 0.366662<br>(0.27255)<br>[ 1.34529]  | 0.162432<br>(0.13302)<br>[ 1.22110]  | 0.562815<br>(0.61583)<br>[ 0.91392]  |
| D(LN_CO(-1))      | 0.118304<br>(0.05871)<br>[ 2.01508]  | -0.018681<br>(0.05441)<br>[-0.34332] | 0.000925<br>(0.02656)<br>[ 0.03482]  | 0.373500<br>(0.12294)<br>[ 3.03796]  |
| D(LN_CO(-2))      | 0.013430<br>(0.05945)<br>[ 0.22591]  | -0.029099<br>(0.05510)<br>[-0.52812] | -0.033351<br>(0.02689)<br>[-1.24022] | -0.156579<br>(0.12450)<br>[-1.25770] |
| C                 | 0.006740<br>(0.00568)<br>[ 1.18587]  | 0.003611<br>(0.00527)<br>[ 0.68548]  | 0.002233<br>(0.00257)<br>[ 0.86868]  | -0.014140<br>(0.01190)<br>[-1.18793] |

**Results:**

**NSE & Gold:** A one-unit increase in the logarithmic change in the price of gold (d(ln gold)) is associated with a decrease of approximately 3.92 units in the logarithmic change in the Indian stock market (d(ln NSE)) keeping other variables constant.

**Theoretical Reason:** In the long run, a cointegrating relationship may exist between NSE and gold due to gold's status as a safe-haven asset, its inverse relationship with equities during market downturns, its function as an inflation hedge, and its sensitivity to global economic factors.

**NSE & Exchange rate:** A one-unit increase in the logarithmic change in the exchange rate (d(ln ex)) is associated with an increase of approximately 3.99 units in the logarithmic change in the Indian stock market (d(ln NSE)) keeping other variables constant.

**Theoretical Reason:** Exchange rate changes affect Indian companies' international competitiveness. A depreciating rate can boost exports by making Indian goods cheaper for foreign buyers, potentially increasing revenues for NSE-listed companies.

A depreciating exchange rate may attract foreign investors seeking investment opportunities in Indian assets, leading to increased demand for stocks listed on the NSE.

**NSE & Crude oil:** A one-unit increase in the logarithmic change in the price of crude oil (d(ln crude oil)) is associated with an increase of approximately 1.36 units in the logarithmic change in the Indian stock market (d(ln NSE)) keeping other variables constant.

**Theoretical Reason:** The Nifty 50 includes companies from various sectors, including energy. When crude oil prices surge, energy sector stocks tend to benefit, leading to potential gains in the Nifty 50. Conversely, falling oil prices can weigh on energy sector stocks and the index.

India's growing prominence in the global market as a supplier of refined petroleum products means that higher crude oil prices can boost the revenues of refining companies. Since many of these companies are significant players on the NSE, their improved financial performance can positively impact the stock index.

| Independent Variable | Impact on NSE | Relation |
|----------------------|---------------|----------|
| Gold                 | -3.92         | Negative |
| Exchange rate        | 3.99          | Positive |
| Crude Oil            | 1.36          | Positive |

Error Correction Value: The magnitude of the ECT (0.037) implies that approximately 3.7% of the disequilibrium in the dependent variable is corrected each month. This is relatively slow, suggesting it would take many months for the full adjustment back to the long-term equilibrium to occur after a disturbance.

ECT of -0.037 states that if there is a shock that causes a deviation from the long-term equilibrium, the system will adjust each period to bring the variable back towards equilibrium at a rate of 3.7% of the disequilibrium per period

## VI. Conclusion

Thus, the study concludes that there exist long run cointegrating relation between Indian stock market and Gold, Crude oil, and Exchange rate.

- **Gold and NSE:** Gold's negative coefficient (-3.92) implies an inverse relationship with the Indian stock market, indicating its role as a safe-haven asset during market uncertainties.
- **Exchange Rate and NSE:** The positive coefficient (3.99) suggests that a depreciating exchange rate boosts NSE-listed companies' competitiveness in global markets, potentially leading to increased stock market performance.
- **Crude Oil and NSE:** The positive coefficient (1.36) indicates a positive relationship between crude oil prices and the Indian stock market, driven by the presence of energy sector stocks and India's position in the global refined petroleum market.
- **Error Correction Value (ECT):** The ECT's slow adjustment rate (3.7% per month) indicates a gradual return to equilibrium following market disturbances, highlighting the market's resilience to shocks.

In summary, these findings underscore the dynamic interactions between gold, exchange rates, crude oil prices, and the Indian stock market, providing valuable insights for investors and policymakers alike.

## VII. Limitations

The model's use of the Axis Bank ETF as a proxy for gold might introduce potential biases, as this ETF itself is subject to demand and supply dynamics within the stock exchange. This could influence the relationship between gold and the Indian stock market, possibly affecting the accuracy of the results.

## VIII. Recommendations

- **Gold as a Market Indicator:** Keep an eye on gold prices for market sentiment shifts, especially during downturns.
- **Exchange Rate Competitiveness:** Monitor exchange rate changes for their impact on Indian companies' international competitiveness.
- **Crude Oil Influence:** Track crude oil prices closely due to their significant impact on energy sector stocks and overall market performance.
- **Integrated Analysis:** Combine insights from gold, exchange rates, crude oil, and other factors for a comprehensive understanding of NSE movements.

## Way Forward

To enhance the study's findings, future research could incorporate additional variables like Inflation, foreign markets (Dow Jones, Nasdaq), money supply influencing the stock exchange. By expanding the scope, a more comprehensive understanding of the impact of gold, crude oil, and exchange rates on the Indian stock market can be achieved.

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