

Impact of Macroeconomic Indicators on Stock Market Volatility: An Empirical Analysis of the Indian Sensex

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Abstract—The stock market plays a crucial role in economic development by mobilizing savings and allocating capital efficiently. However, stock market movements are often influenced by various macroeconomic factors, resulting in fluctuations and volatility. This study examines the impact of selected macroeconomic indicators, namely Inflation Rate, Gold Rate, Crude Oil Prices, Exchange Rate, and Gross Domestic Product (GDP) Growth Rate, on the performance of the Bombay Stock Exchange (BSE) Sensex during the period 2021–2025. Secondary data were collected from BSE India and Trading Economics. Statistical tools such as Arithmetic Mean, Standard Deviation, Correlation, and Regression Analysis were employed to examine the relationship between macroeconomic indicators and Sensex values. The findings reveal that Gold Rate and Crude Oil Prices exhibited a significant positive influence on Sensex during most years of the study period. Inflation Rate showed a significant positive impact only in 2025, while Exchange Rate demonstrated significance during the initial years but weakened subsequently. GDP Growth Rate exhibited an inconsistent relationship and remained statistically insignificant in most years. The study concludes that macroeconomic indicators affect stock market performance differently across periods, highlighting the dynamic nature of financial markets and the importance of economic conditions in determining stock market volatility.

Index Terms—Stock Market Volatility, Sensex, Inflation Rate, Gold Rate, Crude Oil Prices, Exchange Rate, GDP Growth Rate, Macroeconomic Indicators.

I. Introduction

The Indian stock market has emerged as one of the fastest-growing financial markets in the world. Economic liberalization, technological advancements, increasing investor participation, and globalization have significantly expanded market capitalization and trading activity. Alongside this growth, stock market volatility has become a major concern for investors, policymakers, and financial institutions.

Stock market volatility refers to the degree of variation in stock prices over time and is commonly measured using standard deviation. Volatility reflects uncertainty and risk in financial markets and influences investment decisions. Macroeconomic factors such as inflation, exchange rates, crude oil prices, gold prices, and economic growth significantly affect investor sentiment and stock market performance.

The Bombay Stock Exchange Sensitive Index (Sensex) serves as an important indicator of India's economic and financial health. Since its introduction in 1986, the Sensex has reflected various economic reforms, financial crises, and growth phases of the Indian economy. Understanding the relationship between

macroeconomic indicators and stock market performance is essential for investors, policymakers, and researchers.

II. Review of Literature

Several researchers have examined the relationship between macroeconomic variables and stock market performance.

Kuri and Kattimani (2020) found that monetary policy instruments, crude oil prices, and exchange rates significantly influence Indian stock market volatility. Gurloveleen and Bhatia (2015) reported weak-form efficiency in the Indian stock market, indicating limited predictability from historical information.

Bhullar (2017) compared India and China and observed that the Shanghai Stock Exchange was more sensitive to macroeconomic variables than the Bombay Stock Exchange. Sharma (2018) identified positive relationships between money supply, exchange rate, inflation, and stock market indices, while gold prices showed a negative association.

Makol and Mittal (2021) found positive relationships between money supply, inflation, exchange rate, and stock market performance, whereas gold prices exhibited a negative correlation. Rani and Singh (2021) highlighted that GDP growth significantly affects investor sentiment and market volatility. Agrawal (2025) concluded that economic growth does not directly predict stock market returns in India.

Although previous studies provide valuable insights, empirical evidence on the recent post-pandemic period remains limited. Therefore, the present study investigates the impact of selected macroeconomic indicators on Sensex performance during 2021–2025.

III. Objectives of the Study

1. To examine the relationship between Inflation Rate and Sensex.
2. To analyze the relationship between Gold Rate and Sensex.
3. To study the impact of Crude Oil Prices on Sensex.
4. To examine the relationship between Exchange Rate and Sensex.
5. To investigate the impact of GDP Growth Rate on Sensex.

IV. Research Methodology

Research Design

The study adopts a descriptive and analytical research design.

Data Source

The study is based on secondary data collected from:

- BSE India
- Trading Economics

Period of Study

The study covers the period from 2021 to 2025.

Variables

Independent Variables

- Inflation Rate
- Gold Rate
- Crude Oil Prices
- Exchange Rate
- GDP Growth Rate

Dependent Variable

- BSE Sensex

Statistical Tools

- Arithmetic Mean
- Standard Deviation
- Correlation Analysis
- Regression Analysis

V. Analysis and Interpretation

Table No 1: Relationship Between Inflation Rate and Sensex						
Year	Mean		SD		β	p-value
	Inflation Rate	Sensex	Inflation Rate	Sensex		
2021	5.17	53499.05	0.81	4582.61	0.05	0.50
2022	6.69	58141.45	0.65	2684.40	0.25	0.12
2023	5.66	63853.99	0.97	3908.46	0.02	0.71
2024	4.95	77593.19	0.73	4198.48	0.02	0.72
2025	2.22	80795.18	1.23	3613.44	0.62	0.00

Source: Calculated by the Researcher using MS-Excel.

There has been a weak positive relationship between Inflation Rate and Sensex in the year 2021 with a beta (β) value of 0.05, which signifies that a 100% change in inflation rate will bring about only a 5% change in Sensex value in the same direction. However, the relationship is not statistically significant as the p-value (0.50) is greater than 0.05. Thus, it can be inferred that inflation had no statistically significant impact on Sensex during 2021.

In the year 2022, the relationship between Inflation Rate and Sensex remained positive with a beta value of 0.25, indicating that a 100% increase in inflation rate would lead to a 25% increase in Sensex. However, the p-value (0.12) is greater than 0.05, which shows that the relationship is statistically insignificant. Hence, inflation did not have a statistically meaningful influence on Sensex in 2022.

Further, in the year 2023, a very weak positive relationship was observed between Inflation Rate and Sensex with a beta value of 0.02, implying that changes in inflation had a negligible effect (2%) on Sensex. Additionally, the p-value (0.71) is much higher than 0.05, confirming that the relationship is not statistically significant.

Similarly, in 2024, the beta value stood at 0.02, again indicating a negligible positive relationship between Inflation Rate and Sensex. The p-value (0.72) further suggests that the relationship is statistically insignificant, and inflation changes did not influence Sensex movements in a meaningful way.

In the year 2025, the beta coefficient increased to 0.62, suggesting a moderate positive relationship where a 100% change in inflation rate would result in a 62% change in Sensex in the same direction. However, the p-value (0.00) indicates that the relationship is statistically significant at the 95% level of confidence. Thus, it can be inferred that inflation had a statistically significant and moderate positive impact on Sensex during 2025.

The overall analysis concludes that although there exists a positive relationship between Inflation Rate and Sensex across all the years under study, the relationship is statistically insignificant in most of the years except 2025. Hence, it can be stated that inflation does not consistently influence Sensex, and its impact appears to be time-varying and significant only in specific periods.

Table No 2: Relationship Between Gold rate and Sensex						
Year	Mean		SD		β	p value
	Gold Rate	Sensex	Gold Rate	Sensex		
2021	47329.62	53,499	923.03	4582.61	0.00	0.94
2022	50941.85	58141.45	1509.01	2684.40	0.14	0.22
2023	91493.68	63853.99	22253.10	3908.46	0.59	0.00
2024	70725.56	77593.19	5059.56	4198.48	0.42	0.02
2025	107151.78	80795.18	20793.13	3613.44	0.60	0.00

Source: Calculated by the Researcher using MS - Excel.

The Study reveals a varying relationship between Gold Rate and Sensex over the years 2021 to 2025. There was no observable relationship between Gold Rate and Sensex in the year 2021, as indicated by an R value of 0.00. This shows that a 100% change in Gold Rate would result in no change in Sensex. Furthermore, the p- value (0.94) is higher than 0.05, proving that the relationship is not statistically significant. Therefore, Gold Rate had no significant impact on Sensex during 2021.

In 2022, the relationship between Gold Rate and Sensex was slightly positive with an R value of 0.14, suggesting that a 100% rise in Gold Rate could lead to a 14% increase in Sensex. However, since the p- value (0.22) exceeds 0.05, the relationship is statistically insignificant. Thus Gold Rate did not meaningfully affect Sensex in 2022.

In 2023, a moderate positive relationship was identified between Gold Rate and Sensex with an R value of 0.59, indicating that fluctuation in Gold Rate had a noticeable (59%) influence on Sensex. Moreover, the p – value (0.00) is below 0.05, confirming that the relationship is statistically significant.

Likewise, in 2024 the R value of 0.42 reflects a moderate positive association between Gold Rate and Sensex. The p – value (0.02) being less than 0.05 indicates that this relationship is statistically significant, meaning that changes in Gold Rate had a meaningful effect on Sensex movements.

In 2025, the correlation further strengthened with an R value of 0.60, showing a strong positive relationship where a 100% change in gold rate would result in a 60% change in Sensex in the same direction. Additionally, the p - value(0.00) confirm statistical significance at the 95% confidence level. Hence, gold rate had a strong and significant impact on Sensex during 2025.

Overall, the findings suggest that although a positive relationship exists between Gold Rate and Sensex across the years, it was not statistically significant in the earlier years. The relationship becomes stronger and

significant from 2023 onwards, indicating that the influence of gold rate on Sensex has increased in recent periods.

Table No 3: Relationship Between Crude Oil and Sensex						
Year	Mean		SD		β	P value
	Crude Oil	Sensex	Crude Oil	Sensex		
2021	70.68	53499.05	7.86	4582.61	0.71	0.00
2022	97.82	58141.45	10.20	2684.40	0.47	0.01
2023	82.04	63853.99	5.45	3908.46	0.00	0.87
2024	79.32	77593.19	5.57	4198.48	0.41	0.03
2025	66.85	80795.18	6.36	3613.44	0.63	0.00

Source: Calculated by the Researcher using MS- Excel

A strong positive association was found between Crude Oil and Sensex in the 2021, with a beta (β) value of 0.71. which signifies that a 100% variation in Crude Oil prices would cause about a 71% change in Sensex value in the same direction. (β) Additionally, the p- value (0.00) is below 0.05, indicating that the relationship is statistically significant. Hence, Crude Oil prices had a considerable impact on Sensex during 2021.

In 2022, the relationship between Crude Oil and Sensex continued to be positive with an R value of 0.47, implying that a 100% increase in Crude Oil prices might result in a 47% rise in Sensex. Since the p- value (0.01) is less than 0.05, the relationship is statistically significant. Therefore, Crude Oil prices had a noticeable influence on Sensex in 2022.

During 2023, no relationship was identified between Crude Oil and Sensex, has the R value stood at 0.00. This indicates that fluctuation in Crude Oil prices did not affect Sensex movements. More over, the p- value (0.87) is greater than 0.05, confirming that the relationship is not statistically significant.

Addition in 2024, the R value of 0.41 reflects a moderate positive relationship between Crude Oil and Sensex, indicating that changes in Crude Oil prices were linked with movements in Sensex. The p-value (0.03), being lower than 0.05, confirms that this relationship statistically significant. Thus, Crude Oil price variation had a meaningful effect on Sensex during 2024.

In 2025, the relationship became stronger with an R value of 0.63, showing a strong positive connection where a 100% change in Crude Oil prices would lead to a 63% change in Sensex in the same direction. The p- value (0.00) further proves that the relationship is statistically significant at the 95% confident level. Hence, Crude Oil prices had a strong and significant influence and Sensex during 2025.

Overall, the study indicates that all though a positive relationship exists between Crude Oil and Sensex in most years, it was absent in2023. In general, Crude Oil prices tend to affect Sensex movements, but the strength and consistency of this effect vary over different period.

Table No 4: Relationship Between Exchange Rate and Sensex

Years	Mean		SD		β	p-value
	Exchange rate	Sensex	Exchange Rate	Sensex		
2021	73.92	53499.05	0.86	4582.61	0.40	0.03
2022	78.60	58141.45	2.82	2684.40	0.37	0.04
2023	82.60	63853.99	0.51	3908.46	0.39	0.03
2024	83.87	77593.19	0.85	4198.48	0.03	0.60
2025	87.15	80795.18	1.48	3613.44	0.18	0.17

Source: Calculated by the Researcher using MS- Excel

There exists a moderate positive relationship between Exchange Rate and Sensex in the year 2021 with a beta (β) value of 0.40, which indicates that a 100% variation in Exchange Rate would lead to approximately a 40% movement in Sensex in the same direction. The P-Value (0.03) is less than 0.05, which shows that the relationship is statistically significant. Therefore, it can be inferred that Exchange Rate had a significant impact on Sensex during 2021.

In the year 2022, the relationship between Exchange Rate and Sensex continued to remain positive with a beta value of 0.37, implying that a 100% increase in Exchange Rate would result in a 37% rise in Sensex. The P-Value (0.04) is below 0.05, indicating that the relationship is statistically significant. Hence, Exchange Rate changes had a meaningful influence on Sensex in 2022.

Further, in the year 2023, a moderate positive relationship was observed between Exchange Rate and Sensex with a beta value of 0.39, suggesting that changes in Exchange Rate had a considerable effect (39%) on Sensex. Additionally, the P-Value (0.03) is less than 0.05, confirming that the relationship is statistically significant.

Similarly in 2024, the beta value declined sharply to 0.03, indicating a very weak positive relationship between Exchange Rate and Sensex. The P-Value (0.60) is greater than 0.05, which suggests that the relationship is statistically insignificant. Thus, Exchange Rate variations didn't significantly affect Sensex movements during this year.

In the year 2025, the beta coefficient increased slightly to 0.18, indicating a weak positive relationship where a 100% change in Exchange Rate would bring about an 18% change in Sensex in the Same direction. However, the P-Value (0.17) is greater than 0.05, which indicates that the relationship is not statistically significant.

The overall analysis concludes that although there is positive relationship between Exchange Rate and Sensex across all the years under study, the relationship is statistically significant only in the year 2021, 2022 and 2023. Hence, it can be stated that Exchange Rate doesn't consistently influence Sensex, and its effect appears vary over time and is significant only during certain periods.

Table No 5: Relationship Between GDP Growth rate and Sensex						
Year	Mean		SD		β	p-value
	GDP Growth Rate	Sensex	GDP Growth Rate	Sensex		
2021	10.63	53499.05	8.32	4607.32	0.04	0.80
2022	7.8	58141.45	3.90	2617.12	0.75	0.13
2023	9.18	63853.99	0.55	3712.64	0.39	0.38
2024	6.48	77593.19	0.74	4364.57	0.93	0.04
2025	7.43	79972.57	0.69	3414.94	0.00	0.98

Source: Calculated by the Researcher using MS- Excel

There has been a weak positive relationship between GDP Growth Rate and Sensex in the year 2021 with an R value of 0.04, which signifies that a 100% change in GDP Growth rate will bring about only a 4% change in Sensex value in the same direction. However, the relationship is not statistically significant as the P-value (0.80) is greater than 0.05. Thus, it can be inferred that GDP growth had no statistically significant impact on Sensex during 2021.

In the year 2022, the relationship between GDP growth rate and Sensex remained positive with an R value of 0.75, indicating that a 100% increase in GDP growth rate would lead to a 75% increase in Sensex. However, the P-value (0.13) is greater than 0.05, which shows that the relationship is statistically insignificant. Hence, GDP growth did not have a statistically meaningful influence on Sensex in 2022.

Further, in the year 2023, a moderate positive relationship was observed between GDP growth rate and Sensex with an R value of 0.39, implying that changes in GDP growth had a 39% effect on Sensex. Additionally, the P-value (0.38) is much higher than 0.05, confirming that the relationship is not statistically significant.

Similarly, In 2024, the R value stood at 0.93, again indicating a very strong positive relationship between GDP growth rate and Sensex. The P-value (0.04) further suggests that the relationship is statistically significant, and GDP growth changes influenced Sensex movements in a meaningful way.

In the year 2025, the R value is 0.00, suggesting no relationship between GDP Growth Rate and Sensex. The P-value (0.98) indicates that the relationship is statistically insignificant, GDP growth did not influence Sensex in 2025.

The overall analysis concludes that although there exists a positive relationship between GDP Growth Rate and Sensex across all the years under study, the relationship is statistically insignificant in most of the years.

except 2024. Hence, it can be stated that GDP growth does not consistently influence Sensex, and its impact appears to be time – varying and significant only in specific periods.

VI. Findings and Suggestions

Findings

- The study revealed that relationship between inflation rate and Sensex from 2021–2025 is positive with low magnitude and statistically insignificant. But in the year 2025, the relationship between inflation rate and Sensex with a high magnitude and significant impact. Overall, during 2021-2025, the relationship is positive and statistically insignificant.
- It was found that relation between gold rate and Sensex during 2021–2025 shows a gradual strengthening over time, with no relationship in 2021 and a low magnitude, insignificant relationship in 2022, followed by a moderate magnitude and statistically significant relationship in 2023 and 2024, and finally a high magnitude and statistically significant relationship in 2025, indicating an increasing influence of gold rate on Sensex. In overall period, the relationship is positive and statistically significant.
- It has been identified GDP growth rate and Sensex during 2021–2025 is inconsistent, showing low to moderate magnitude positive but statistically insignificant relationships in most years, with a high magnitude and statistically significant impact observed only in 2024, and no relationship in 2025. Overall, the relationship is positive and statistically insignificant.
- It was discovered the exchange rate and Sensex during 2021–2025 is generally positive, showing moderate magnitude and statistically significant impact in the initial years, but becoming low magnitude and statistically insignificant in the later years, indicating a declining influence over time. During the period, the relationship is positive and statistically insignificant.
- It was found that crude oil prices and Sensex during 2021–2025 is mostly positive, showing a high magnitude and statistically significant impact in 2021 and 2025, and a moderate magnitude significant relationship in 2022 and 2024, while in 2023 there is no relationship and it is statistically insignificant, indicating that the influence of crude oil on Sensex fluctuates over the years. Finally, the relationship is positive and significant.

VII. Conclusion

The stock market is a broad financial marketplace where buyers and sellers trade shares of publicly held companies. It serves two primary purposes: it allows businesses to raise capital by selling ownership (shares) to the public, and it provides investors an opportunity to grow wealth through price appreciation and dividends.

Volatility tells us how fast stock prices move up or down. When price change a lot in a short time, the market is highly volatile and risky. When prices change slowly and stay stable, volatility is low and the market is safer for investors.

The objective of this study is to examine the relationship between choosen macroeconomic indicators and the Indian stock market, using Sensex as the benchmark. It also aims to understand how these selected factors influence stock market performance. The research concludes that, based on the correlation analysis, all five indicators Inflation Rate, Gold Rate , Crude Oil Prices , Exchange Rate and GDP Growth Rate have shown a positive association with Sensex value during 2021 to 2025, though with varying strength. While Inflation Rate, Gold Rate and Crude Oil Prices displayed strong positive correlation in most years, Exchange Rate and GDP Growth Rate showed Moderate to weak positive Correlations in certain years. From the regression analysis, it is found that Inflation Rate , Gold Rate and Crude Oil Prices have a stronger positive impact on Sensex. However Exchange Rate , GDP Growth Rate have a Relatively lower positive impact on Sensex values during the study period. Overall economic indicators are statistical metrics used to evaluate the overall health, performance, and future trajectory of an economy.

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