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MACROECONOMIC DETERMINANTS AND EQUITY MARKET DYNAMICS: A JOHANSEN CO-INTEGRATION AND GRANGER CAUSALITY ANALYSIS OF THE BSE SENSEX

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ABSTRACT

Stock markets play a vital role in channelling capital and driving economic growth. They act as platforms where investors trade assets at established prices. A variety of factors influence the returns investors expect, with macroeconomic indicators being among the most critical. Changes in these indicators can have a substantial impact on stock price movements. For both investors and policymakers, macroeconomic variables are key signals that reflect the overall economic environment. Stock market trends also provide valuable insights into investor sentiment and expectations regarding the economy's future trajectory. By offering a comprehensive view of economic health and stability, macroeconomic factors shape investment strategies and guide policy decisions. The study aims to examine the impact of select macroeconomic variables on the performance of the BSE Sensex. It analyses monthly data from June 2022 to March 2024, including variables such as the BSE Sensex, GDP, gold prices, inflation rate, unemployment rate, and exchange rate. To identify any issues related to stationarity, the ADF test was applied. The Johansen co-integration method was then used to explore long-term relationships between the dependent and independent variables. Additionally, the Granger causality test was conducted to determine the direction and nature of causal relationships among the variables.

Keywords: BSE Sensex, GDP, Exchange Rate, Inflation Rate, Gold Price, Unemployment Rate

1. INTRODUCTION

The stock market is an essential component for the distribution of capital and the growth of the economy. The significance of macroeconomic indicators in determining the returns that investors receive is a vital factor. Because of the enormous influence that fluctuations in these variables may have on stock price movements, policymakers can get useful insights from these fluctuations. The patterns of the stock market are reflecting the emotions of investors and helping to estimate future economic performance. These trends also influence investment strategies and the formation

of policy. For the purpose of this study, monthly data from June 2022 to March 2024 are utilized in order to investigate the influence that several macroeconomic factors have on the BSE Sensex. For the purpose of determining whether or not there were unit roots, the ADF test was utilized, whilst the Johansen co-integration method was utilized to investigate the long-term connection between the variables. In addition, the Granger causality test was carried out in order to investigate the direction of causation related to the variables that were investigated.

2. GROSS DOMESTIC PRODUCT

When it comes to economic activity, the GDP is an essential economic metric. When the GDP increases, it indicates that the economy is healthy and expanding, with improved company performance and larger corporate profitability. The confidence of investors is boosted as a result of this increasing trend, which encourages further investment in the stock market.

1) Gold

Gold, often referred to as a "safe haven," is a popular choice for investors seeking capital protection during economic uncertainty or market volatility. The relationship between gold prices and stock markets is inversely proportional. Gold demand increases during stock market slumps due to stability, while favorable market sentiment, driven by solid corporate results and economic expansion forecasts, reduces gold investment attraction. Thus, gold's value is inversely related to stock market sentiment.

2) Inflation

There is a close relationship between the elements that influence the stock market, which include inflation, unemployment, and currency rates. The reduction of purchasing power, the narrowing of profit margins, and the increase in interest rates are all ways in which excessive inflation can have a detrimental influence on stock prices. On the other side, moderate inflation can be beneficial to equity markets since it indicates that the economy is making progress. For investors to be able to make judgments that are informed, it is essential for them to understand these dynamics. A number of factors, including the policies of the central bank, the investment of companies, and the spending of consumers, all have an impact on unemployment. A high unemployment rate is indicative of economic weakness, whereas a low unemployment rate is indicative of a healthy economy and has the potential to enhance stock prices and to boost investor confidence. To achieve a balance between these linkages, the responses of policymakers are essential, and having a grasp of these dynamics may assist investors in making decisions that are well-informed. Exchange rates, on the other hand, are impacted by a variety of factors, including direct implications on the profitability and competitiveness of firms, as well as indirect influences from economic development, investor mood, and monetary policy.

3. REVIEW OF LITERATURE

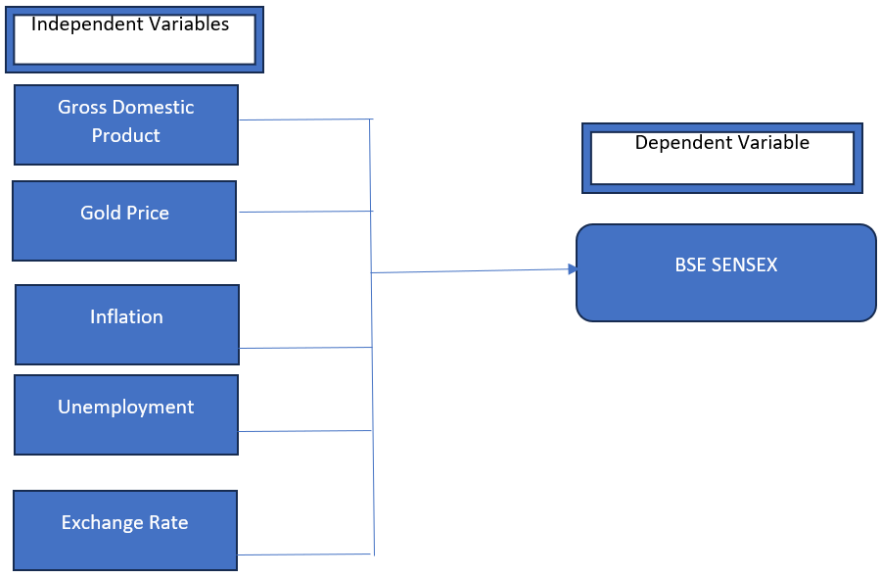
Researchers Baranidharan and Dhivya (2020) discovered that the correlation between risk and high returns was significantly stronger than the correlation between risk and the partial normal distribution of chosen macroeconomic variables. Through the entirety of the research period, the returns of the BSE Sensex were not significantly impacted by the short-term correlations that existed between the series that were investigated or the selected macroeconomic factors. It was discovered by Jain, T., and Singh, S. P. (2020) that the Indian stock market is influenced by macroeconomic indicators such as the Index of IIP and the currency rate. The exchange rate has a negative impact on the Sensex, but it is not particularly large. On the other hand, the IIP has a positive impact that is significant. Nitin Kumar Agarwal and colleagues (2020) investigated the causal link between the BSE Sensex and a number of other macroeconomic indicators. They discovered that factors such as the foreign exchange rate, foreign exchange reserves, and money supply did not have a long-term co-integrated relationship with the BSE Sensex. For the year 2020, Anuradha Saha and her colleagues conducted an analysis of the linkages between nine main macroeconomic indicators. Their findings demonstrated that there is evidence of long-term co-integration between these factors and the Sensex. Using regression modelling using RStudio, Bhupender Kumar Som and Himanshu Goel (2020) evaluated the impact of macroeconomic factors on the BSE Sensex. They discovered that long-term interest rates, the CPI, and the MSCI index were important contributors. A further investigation on the influence of macroeconomic indicators on the Indian stock market was carried out by Dr. M. Jegadeeshwaran and M. Basuvaraj (2020). They came to the conclusion that macroeconomic variables have a substantial role in determining the performance of the stock market.

4. METHODOLOGY

The purpose of this study is to investigate the link between macroeconomic parameters and the BSE Index by utilizing empirical data obtained from the websites of the RBI, the World Bank, and the BSE. Between the months of June 2022 and March 2024, data was collected. In order to evaluate the influence that the GDP, gold prices, inflation rate, unemployment rate, and exchange rate have on the SENSEX, descriptive statistics, correlation analysis, and stationarity tests were considered. These factors are essential for gaining a knowledge of the vitality and dynamism of a nation's economy, since they offer a comprehensive perspective on the manner in which an economy functions. Numerous macroeconomic factors have been included in the majority of studies; nonetheless, there has been a dearth of study on the effects of certain variables. Through the incorporation of these components into the inquiry, the study intends to address this gap in knowledge.

5. CONCEPTUAL FRAMEWORK

Figure 1



6. PERIOD OF THE STUDY

The data was gathered from June 2022 to March 2024.The span encompasses a crucial period, comprising the conclusion of the COVID-19 epidemic and the initial phases of economic recovery. The research encompasses phases of volatility and recovery, which is beneficial for comprehending the index's response to economic disruptions and the subsequent recovery phase. The research concentrated on short-term effects and trends.

7. RESULTS AND DISCUSSION

1) Descriptive Statistics

The statistical metrics of the sample variables were computed. Descriptive statistics offer historical context for the behaviour of sample variables, including GDP, Gold, Inflation, Unemployment, Exchange Rate, and Sensex utilized in the research. The distribution of data normalcy is analysed. The table indicates that the mean GDP is 81%. The standard deviation of the Sensex is 36%, whereas that of unemployment is 2.6%. Table 1 reveals that the majority of the sample variables had Kurtosis values over three, with corresponding Jarque-Bera values likewise surpassing three. The sample variables have a normal distribution.

Table 1

Table 1 Descriptive Statistics						
	GDP	GOLD	INFL	SENSEX	UNEMP	XR
Mean	0.810073	4.229075	0.760215	4.234546	0.746096	1.687938
Std. Dev.	0.130891	0.344200	0.175887	0.361066	0.026741	0.219941
Skewness	-1.176556	-0.396116	0.390432	-0.523598	3.091671	-3.109301
Kurtosis	3.197393	1.774241	1.799446	2.532092	12.72080	13.44116
Jarque-Bera	4.879088	1.863852	1.794694	1.151113	116.1367	129.2278
Observations	21	21	21	21	21	21

Unit Root Test

H0: Unit root exist

The analysis begins by assessing the stationarity of time series data for chosen variables to ensure the use of appropriate econometric techniques and avoid deceptive conclusions. The ADF test was applied to all variables within the mean equation, including GDP, gold prices, inflation rate, BSE Sensex, unemployment rate, and exchange rate. The test was conducted at 1%, 5%, and 10% significance levels to examine stationarity characteristics.

The findings showed that GDP, inflation, and exchange rate were stagnant at level, indicating no trend over an extended period. The Sensex became stationarity after the first differencing, while gold prices and unemployment rate required a second differencing for stationarity. This led to the rejection of the null hypothesis, indicating that these variables reached a stable state at various phases, justifying their inclusion in further econometric modelling. The findings provide evidence that these variables reach a stable state at various phases, justifying their inclusion in further econometric modelling.

Table 2

Table 2 Stationarity Test						
Variable	**At level**		**First difference**		**Second difference**	
	t-statistic	**Prob.**	**t-statistic**	**Prob.**	**t-statistic**	**Prob.**
GDP	-4.499	0.0023				
GOLD	-1.04532	0.7145	-2.51773	0.1271	-4.05507	0.0067
INFL	-4.86177	0.0017				
SENSEX	-1.4319	0.5461	-4.56801	0.0024		
UNEMP	-1.71462	0.4084	0.079973	0.9551	-3.67855	0.0143
XR	-4.47655	0.0024				

Table 3

Table 3 ADF Unit Root Test Analysis	
Test Critical Values	
1% Level	-3.80855
5% Level	-3.02069
10% Level	-2.65041

Correlation

The Sensex does not show significant correlations with other economic factors, indicating each variable is distinct. The correlation between the Sensex and gold is strong, while the correlation between the Sensex and inflation is weak. A positive correlation coefficient indicates a direct relationship, while a negative correlation indicates an inverse relationship. However, correlation does not necessarily indicate causality, as other factors may influence both variables, making the association potentially misleading.

Table 4

Table 4 Correlation						
	GDP	GOLD	INFL	SENSEX	UNEMP	XR
GDP	1.000000					
GOLD	0.113971	1.000000				
INFL	0.030874	0.285324	1.000000			
SENSEX	0.310419	0.931938	0.182676	1.000000		
UNEMP	0.254290	0.164611	0.053391	0.236600	1.000000	
XR	-0.146271	0.177376	-0.013479	0.195755	0.231292	1.000000

Pairwise Granger Causality Test

H0: Sensex does not Granger cause (GC) macroeconomic variables

Table 5

Table 5			
Null Hypothesis	**F-Statistic**	**Prob.**	**Result**
SENSEX does not (GC) GDP	0.43674	0.6546	Accept H0
GDP does not (GC) SENSEX	1.4553	0.2666	Accept H0
SENSEX does not (GC) GOLD	3.33168	0.0455	Reject H0
GOLD does not (GC) SENSEX	0.02854	0.9719	Accept H0
SENSEX does not (GC) INFL	0.06126	0.9408	Accept H0
INFL does not (GC) SENSEX	1.41777	0.275	Accept H0
UNEMP does not (GC) SENSEX	0.85987	0.4444	Accept H0
SENSEX does not (GC) UNEMP	1.26414	0.3128	Accept H0
XR does not (GC) SENSEX	0.2102	0.8129	Accept H0
SENSEX does not (GC) XR	3.95467	0.0435	Reject H0

The GC test reveals that Sensex does not GC Gold, therefore the null hypothesis about Sensex and XR is rejected; nevertheless, all other null hypotheses are supported. This suggests that the Sensex may be utilized to predict Gold prices and exchange rates. It indicates that the variables lack a causal relationship, and one variable cannot be utilized to forecast the other.

The connection and GC require further verification for long-term fluctuations between the Sensex and economic factors using the co-integration test.

Co-integration

H0: No co-integration between Sensex and Macroeconomic variables

Table 6

Table 6 Co-integration				
Hypothesized		Trace	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.989841	230.9078	95.75366	0.0000
At most 1 *	0.967213	143.7095	69.81889	0.0000
At most 2 *	0.819984	78.77262	47.85613	0.0000
At most 3 *	0.697417	46.19317	29.79707	0.0003
At most 4 *	0.576751	23.48055	15.49471	0.0025
At most 5 *	0.313415	7.144473	3.841466	0.0075
UCR Test (Maximum Eigenvalue)				

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.989841	87.19826	40.07757	0.0000
At most 1 *	0.967213	64.93687	33.87687	0.0000
At most 2 *	0.819984	32.57944	27.58434	0.0105
At most 3 *	0.697417	22.71262	21.13162	0.0297
At most 4 *	0.576751	16.33608	14.26460	0.0232
At most 5 *	0.313415	7.144473	3.841466	0.0075

It reveals six co-integration equations at 0.05 significance levels, indicating a long-term link between the Sensex and macroeconomic factors such as GDP, Gold Price, Inflation Rate, Unemployment Rate, and Exchange Rate. This helps investors and analysts make informed investment decisions, highlighting the long-term influence of these variables on stock market performance.

Ordinary Least Square

H0: Significant relationship exists between Sensex and macroeconomic variables

The OLS regression measures the influence of macroeconomic variables on stock market performance, focusing on factors like coefficient estimates, statistical significance, and model goodness of fit, with a positive coefficient indicating a positive influence.

Table 7

Table 7 Ordinary Least Square

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.568743	0.753941	-0.754361	0.4623
GDP	0.581656	0.211525	2.749821	0.0149
GOLD	0.963626	0.081227	11.86330	0.0000
INFL	-0.177370	0.154455	-1.148362	0.2688
UNEMP	0.312802	1.050793	0.297682	0.7700
XR	0.093795	0.126433	0.741851	0.4696

The table above presents the results of the ordinary least squares approach. The factors Gold and GDP have a substantial link with the Sensex. The p-value for Gold and GDP is below 0.05. The variables of inflation, unemployment, and exchange rate do not exhibit a significant association with the dependent variable, Sensex. Consequently, we accept the null hypothesis, indicating no meaningful association between the Sensex and macroeconomic indicators such as inflation, unemployment, and exchange rate over the specified time.

8. LIMITATIONS OF THE STUDY

1) The study examines the correlation between certain economic indicators and the BSE Sensex, acknowledging the multitude of micro and macroeconomic factors that affect the stock market.
2) Results reflect conditions of the study period and may not be applicable to other periods or future conditions.

9. CONCLUSION

The study reveals a normal distribution of variables, with significant correlations between Sensex and selected variables, particularly gold. Sensex can predict gold prices and exchange rates using the Granger causality test. The Johansen's integration confirms the long-term association. The least squares approach shows a substantial correlation between GDP and Sensex. However, no significant link exists between Sensex and inflation, unemployment, or exchange rate. Further research is needed to incorporate supplementary macroeconomic variables and account for local and foreign issues.

CONFLICT OF INTERESTS

None.

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