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A Study on Granger Causal Relationship between Macroeconomic Variables and Stock Price Behavior: Evidence from India

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Abstract

In this study, we use multivariate stepwise regression analysis to examine how various macroeconomic factors have affected the Indian stock market. To investigate the underlying dynamic causal relationship between the variables,a Granger causality test was performed and Average monthly closing prices of BSE Sensex and S&P CNX Nifty are used as dependent variables, while industrial production (IIP), wholesale price index (WPI), money supply (M3), interest rates (IR), trade deficit (TD) and investment are institutional variables. Foreign exchange (FII), exchange rate (ER), crude oil price (CP), and gold price (GP) are used as independent variables (GP).Data from January 2020 through June 2022 was evaluated for this analysis. The empirical findings of this study feature the significance of macroeconomic factors in explaining the behavior of the Indian stock market. Investors' inclination for gold has to be tempered, and the government should instead encourage further participation in the stock market.

Keywords

Indian stock market, multivariate, regression, causality test, dynamic, wholesale, price index, metals.

Introduction

Incredible transformations have taken place in the Indian stock market during the last several decades. In recent years, the market has experienced extensive transformation. The market movement has been influenced by the global and national economic uncertainty. Investors and policymakers alike have long been interested in the manner in which the stock market is related to broad measures of economic health. Due to the country's unstable economy, the Indian stock market is volatile. The theory of arbitrage pricing describes how macroeconomic factors influence stock prices. The potential, direction, and health of the economy are all reflected in the stock markets and their corresponding indexes. The share price of a company may be affected by

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a wide range of macroeconomic factors. It is common to assume that the market would follow the economic growth rate of a nation. Investors' hopes have sprung up on the stock market in developing countries like India. The expansion of a nation's industrial sector may be gauged by looking at an indicator like the Industrial Production Index. Investing in gold has been a potentially rewarding option for many people in recent years. As one of the world's fastest-growing economies, India has a considerable power demand. As a result, the nation need crude oil to meet its energy demands. The situation has escalated to a state of emergency for one of the world's major crude oil importers.

Review of Literature

Many papers, both globally and locally, have examined the relationship between the stock market and macroeconomic factors, and their findings can be found in the literature. Causality Granger tests and Engle-Granger co-joining test executed in the vector blunder rectification model of Kwon and Shin (1999) demonstrated that financial factors, for example, yield, cash trade rates, exchange excess and cash supply are co-incorporated with Korean. Stock market index.

Moghereh (2003) utilized cointegration examination on month to month time series information starting in January 1987 and finishing off with December 2000 to analyze the long-run connection between's Jordanian stock costs and chose macroeconomic markers. The examination found that stock costs in the Jordanian capital market reflect macroeconomic factors, for example, trades, unfamiliar stores, loan fees, expansion and modern action.The research shows that stock price movements may be predicted with reasonable accuracy using macroeconomic indicators.

Erdogan and Ozlale (2005) on the effect of a few macroeconomic variables on Turkey's stock return uncovered a favourable correlation between industrial output and exchange rates. However, M1 money circulation did not significantly affect stock returns.

Gan, Lee, Yong, and Zhang (2006) analyzed the association between securities exchange values and macroeconomic markers in New Zealand. Financing costs (long haul and present moment), expansion, cash conversion standard, GDP, cash supply and the cost of oil sold at the pump in the United States are considered. According to their research, there appears to be a drawn out connection between's stock costs and some of New Zealand's significant records. In any case, Granger's causality trying shows that the New Zealand securities exchange isn't a reliable indicator of New Zealand's macroeconomic factors.

Naik and Padhi (2012) looked at the years 1994-2011 to determine the correlation between the BSE Sensex, the record of indian securities exchange, and numerous macroeconomic factors, for example, modern creation, discount cost changes, cash supply, depository bill rates, money trade rates. As displayed in the review there is for some time run harmony between macroeconomic

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factors and securities exchange list.According to the findings of this analysis, stock prices have a positive relationship with the growth of the money supply and industrial output, but a negative relationship with inflation. This shows that stock costs are not connected with changes in conversion standard or transient loan fee. While there is a one-way causal relationship from cash supply development to stock costs, from stock costs to expansion, and from loan fees to stock costs, there is a two-way causal connection between modern creation and stock costs.

Ray (2013), looked at how various macroeconomic factors affected stock values. Stock prices react to changes in predicted future cash flows, which industrial output provides as a gauge of a country's total economic activity. As a result, it stands to reason that a rise in the industrial output index would have a similarly beneficial effect on stock prices. Coverage ranges from 1990–91 to 2010–11, Zeroing in on the connection between modern creation and stock costs in India. One of the primary finishes of the review is that there is no huge connection between modern creation and stock costs in India. Relapse examination demonstrates a potential positive relationship between securities exchange esteem and genuine result in the assembling area.When manufacturing output rises, the stock market rises with it.

Sirisha (2013) used linear relapse to examine the effect of macroeconomic factors on the movements of Nifty index of Indian stocks, as well as the prices of gold and silver. Gold and silver prices were selected for consideration for their importance in the modern economy and their performance relative to the stock market. Correlation between endogenous variables and performance of stock returns, precious metals, and currencies is evident. Gold's return is heavily impacted by the money supply, whereas the GDP and inflation both have a significant impact on stocks' performance. There is areas of strength for a between the reliant variable and the exogenous element.

In 2016, Mishra and Gupta looked at what drives the ups and downs in the Indian stock market. For the years 2006-2012, we analysed the correlation between the Sensex and the IIP, WPI, Interest Rate, and the Morgan Stanley Capital International Index of India. Relationships between variables may be analysed using numerous methods, such as correlation and regression. Over the course of the study period, this research indicates an extremely substantial positive association between the sensex and macroeconomic indicators.

Kumar (2014) has conducted research on the effects of the conversion standard and unrefined petroleum costs on the Indian financial exchange by utilizing S&P CNX Nifty. Beneficial outcomes of the conversion scale and unrefined petroleum costs on the financial exchange are uncovered by the research. This study's finding of a positive correlation is a pleasant surprise.

Objectives of the Study

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1. To analyze the relationship among macroeconomic variables and Indian stock market.
2. To assess the impact of macroeconomic variables on Indian stock market.
3. To examine the causal relationship between macroeconomic variables and stock exchange market.

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Hypothesis

Ho: There is no significant impact of macroeconomic variables on Indian stock exchange market.

Ho: There is no any causal relationship among macroeconomic variables and stock exchange market.

Research Methodology

Granger's causality test, multivariate stepwise relapse examination and connection were utilized to analyze the information and reach determinations about the effect of macroeconomic factors on stock lists in BSE and NSE, addressed by Sensex and S&P CNX Nifty separately. Record of Industrial Production (IIP), Wholesale Price Index (WPI), Money Supply (M3), Interest Rates (IR), Trade Deficit (TD), Foreign Institutional Investment (FII), 91-Day Treasuries as a substitute for Exchange Rate (ER)) unrefined petroleum value (CP) and gold value (GP) are the free factors, and normal month to month shutting cost of CNX Nifty is the reliant variable (GP).January 2020 through June 2022 is the time frame for the research. The research makes better use of the data by using it on a monthly basis. The information comes from a variety of sources, including the Reserve Bank of India's website, an Indian economic database, and the RBI's own yearly reports. The following are some of the models considered for this research:

$BSESENSEX= \alpha 0 + \beta 1IIP + \beta 2\ WPI+ \beta 3M3 + \beta 4\ IR + \beta 5\ TD + \beta 6\ FII + \beta 7\ ER + \beta 8\ CP + \beta 9\ GP+ \epsilon$

$CNXNIFTY= \alpha 0 + \beta 1IIP + \beta 2\ WPI+ \beta 3M3 + \beta 4\ IR + \beta 5\ TD + \beta 6\ FII + \beta 7\ ER + \beta 8\ CP + \beta 9\ GP+ \epsilon$

$\alpha 0$ =Constant; ϵ = Error term

$\beta 1$, $\beta 2$, $\beta 3$, $\beta 4$, $\beta 5$, $\beta 6$, $\beta 7$, $\beta 8$ and $\beta 9$ are the coefficients of independent variables IIP, WPI, M3, IR, TD, FII, ER, CP and GP respectively.

Analysis and interpretation of the study

Relationship, multivariate stepwise relapse and Granger's causality test were utilized in this examination.

Statistical Analysis of Correlations

Pearson correlation analysis was used to inspect the connections between financial exchange and macroeconomic variables. The results of the correlation analysis across the entire study period show that the BSE Sensex's modern creation, discount cost list, cash supply, loan fee, unfamiliar institutional financial backers and unrefined petroleum cost are positively correlated, while trade

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deficit and gold price are negatively correlated.To contrast, the BSE Sensex and the WPI, M3, FII, and ER all have strong positive correlations. Therefore, these factors are significantly linked to the stock market. There is a connection framework between BSE Sensex and chose macroeconomic variables displayed in Table 1. As should be visible from the table, there is areas of strength for a connection among's IIP and FII (0.340).

Table 1 An Analysis of the Relationships Between the BSE Sensex and Some Macroeconomic Indicators

Variables	BSE Sensex	IIP	WPI	M3	IR	TD	FII	ER	CR	GP
BSE Sensex	1									
IIP	0.267	1								
WPI	0.673**	0.182	1							
M3	0.708**	0.239	0.884**	1						
IR	0.121	0.563	0.347**	0.597**	1					
TD	-0.293	-0.392	0.406	0.178	0.236	**1**				
FII	0.377*	0.450*	0.633*	0.590	0.195	0.341	**1**			
ER	0.562**	0.016	0.762**	0.844**	0547**	0.141	0.141	**1**		
CR	0.022	0.192	-0.317	-0.253	-0.191	0.909**	-0.914	0.401	**1**	
GP	-0.224	-0.164	0.984**	0.947**	0.409*	0.545*	0.842**	0.985*	-0.151	**1**

Source: Analysis via computation shows that (*) a correlation is significant at the 5% level and (**) a correlation is significant at the 1% level.

As such, there is serious areas of strength for a connection between cash supply and expansion rate (0.984). Cash supply and expansion rates are related as shown in the Fisher equation. Moreover, there is a strong positive relationship between inflation and interest rates (0.547). This relationship shows that increasing costs and loan fees in a nation go hand in hand.Inflation is closely correlated with the currency rate as well (0.962). Inflation in India rises when the Indian rupee loses value against the dollar. Furthermore, gold prices have a positive correlation with inflation (0.409). More demand for gold will lead to higher inflation since the country must import 8-10% of all of its gold needs.

In all time periods considered, the correlation between the money supply and interest rates, exchange rates, and gold prices is positive and statistically significant. Exchange rates, crude oil prices, and gold prices all move in tandem with the short-term interest rate. At 5% importance level, the relationship between's conversion standard and gold is 0.392, which is a strong correlation. Due to the appreciation of the dollar, the value of the Indian rupee has fallen.The result is a lower Indian rupee on the global currency exchange market, which is good for the country's gold prices.

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Numerous factors contribute to India's high demand for gold on the domestic market, making it the world's second-greatest shopper of the valuable metal after China. This commodity's high liquidity and substantial returns have made it a popular choice among investors. Due to India's status as a net importer of gold, a rise in the value of the dollar would drive up the price of the rupee, making imported gold more expensive. Multicollinearity among independent variables, which may lead to misleading findings when the variables are regressed together, is also shown by the correlation coefficient.

S&P CNX Nifty has a positive connection with IIP, WPI, M3, FII, and the exchange rate for the whole research period, as shown by the correlation analysis. Index has a weak but negative correlation with both TD and GP . There is major areas of strength for a connection between global venture and unfamiliar speculation. Cash supply, loan fee, unfamiliar financial backers, conversion scale and gold cost all have positive and statistically significant relationship with inflation rate and general level of prices. Short-term interest rate, exchange rate and gold prices are highly positively correlated with money supply. There is a positive and genuinely critical connection between the momentary loan cost and the value of the dollar, crude oil and gold. Gold has a positive relationship with trade imbalance. As shown in Table 2, there is a positive and measurably critical connection among FII and gold cost.

Table 2 The S&P CNX Nifty's Correlations to Key Macroeconomic Indicators

Variables	**CNX Nifty**	**IIP**	**WPI**	**M3**	**IR**	**TD**	**FII**	**ER**	**CR**	**GP**
CNX Nifty	1									
IIP	1.620*	1								
WPI	0.954*	1.182	1							
M3	1.799**	0.239	1.884**	1						
IR	1.159	1.363	1.447**	0.597**	1					
TD	0.281	1.192	0.206	0.178	0.436	1				
FII	1.574*	1.540*	1.433*	0.490	0.195	0.341	1			
ER	1.734*	1.676	1.762**	0.544**	0.658**	0.441	0.519	1		
CR	1.127	1.782	0.317	-0.552	0.709**	-0.214	0.101	-0.191	1	
GP	0.881	1.564	1.709**	0.547*	0.935*	0.742**	0.785*	0.792*	0.951	1

Source: Analyzed and calculated: * Significant correlation at the 5% level, ** Significant correlation at the 1% level.

Multivariate Stepwise Regression Analysis

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Regression analysis was used to analyze the effect of macroeconomic factors on the financial exchange. To dispense with the issue of multicollinearity among the illustrative variables, multivariate stepwise relapse investigation is utilized in this research because of the significant correlation between the independent variables.

BSE Sensex and Macroeconomic Variables

Gold prices and FII are two factors that are accounted for in the model in 2021. In this case, we just include those variables that meet our criteria and leave out the others. With an F-value of 26.89, which is very significant, the model is the best fit. Stock prices are negatively correlated with the gold price, demonstrating gold's negative effect on stock markets.

For the year 2021, the hypothesis was rejected for two variables (GP and FII) and accepted for the other four. Gold prices and the exchange rate in 2022 have become important independent variables, whereas all other factors have been eliminated from the analysis. A extremely significant F-value of 15.55 indicates that the model is the best match. An R2 index of 0.776 indicates that the model adequately explains 77.6% of the observed annual variation. In 2022, the hypothesis was rejected for GP and ER but was supported for the other variables.

In Table 3 you can see the outcome of the regression analysis. There is a negative relationship between's gold cost and swapping scale as estimated by BSE Sensex, indicating a negative market reaction to rising gold and currency exchange rates. As the year progresses and the value of the Indian rupee decreases due to an increase in the exchange rate, the market responds adversely. Because of high liquidity, security concerns and high return, gold has turned into a place of refuge for financial backers.In this way, capital would be reallocated from the stock market to this rare and valuable resource. An increase in gold imports will have a negative impact on the market as it will result in a widening trade imbalance.

Table 3 Outcomes of a Multivariate Regression Model using BSE Sensex and Macroeconomic Variables

Year	**R2**	**Adjusted R2**	**F**	**P**	**R2 change**	**Regression Models**
2021	0.957	0.725	36.89	<0.001	GP = 0.646 FII = 0.121	BSESENSEX = 35397.46 – 0.31 GP + 6.83 FII
2022	0.876	0.826	25.55	<0.001	GP = 0.757 ER = 0.319	BSESENSEX=8066.41 GP – 170.60 ER

In 2016, just one variable was shown to have a statistically significant effect on the S&P CNX Nifty, as revealed by a regression study. This finding is consistent with gold having a depressing influence on the index throughout the course of the year. If we look at the coefficient of determination, we can see that this variable accounts for 81.9% of the total variance in the index. Except for gold, all other factors are eliminated from the equation. While the null hypothesis is rejected for gold prices (GP), it is accepted for all other variables in the year 2021. The gold price, the exchange rate, and the money supply all play a major role in the year 2022. Gold and exchange rates are responsible for the negative influence, whereas the money supply has a

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notably positive one. If an R2 value of 92.4 is obtained for a model, it means that almost all of the observed variance in the index can be attributed to the presence of those factors. F is extremely significant (P 0.001), indicating that the regression models for both years are well-fit.
For the year 2021, the hypothesis was rejected for GP, ER, and M3, but was accepted for all other variables.
Research shows that specific macroeconomic factors significantly affect the Indian securities exchange.Table 4 shows the effect on the BSE and NSE stock indexes of the macroeconomic factors that have been deemed relevant.

Table 4 S&P CNX Nifty and Macroeconomic Variables Step-by-Step Regression Analysis Results

Year	**R2**	**Adjusted R2**	**F**	**P**	**R2 change**	**Regression Models**
2021	0.719	0.701	43.29	<0.001	GP = 0.719	CNXNIFTY = 1831.47 – 0.10 GP
2022	0.824	0.995	33.26	<0.001	JhGP = 0.380 M3 = 0.19 ER = 0.343	CNXNIFTY = 1364.30 - 0.05GP – 166.39 ER + 0.14 M3

The data's stationarity has been checked using the unit root test. Among the many available methods for determining whether or not a time series is stationary, the Augmented Dickey-Fuller (ADF) test has emerged as the gold standard in the academic community. Before proceeding to Granger's causality test, it is recommended to apply unit root test first.In spite of the way that every one of the picked factors are fixed across the underlying contrast, they are not all stationary throughout the level. Given that, I conclude that the series is integrated to order 1. (1). Granger causality test was used to look at the chance of directional connection between macroeconomic factors and stock records. It is likely that either the explained or the explanatory factors might have a role in this research because of the inclusion of both sets of data. An association between two variables might be unidirectional, bidirectional, or nonexistent.
Null hypothesis of no causal association between BSE Sensex and exchange rate or trade imbalance is rejected. Since there is only one way for a connection to go between a variable and the stock market, the hypothesis cannot hold for the exchange rate. If there is unidirectional causation from sensex to the variable, then the trade deficit null hypothesis should be rejected. For this reason, the Granger causality index is a function of the exchange rate. To forecast the BSE sensex, all that is needed is a change in the currency rate. As can be seen in Table 5, the link between macroeconomic factors and the BSE Sensex does not go in both directions. A second one-way connection exists between the index and the trade deficit.

Table 5 Results of a Granger Causality Test on Factors Influencing the BSE Sensex

Null Hypotheses	Observations	F-Statistic	Prob.
CP does not Granger Cause BSESENSEX	39	0.54497	0.4312
BSESENSEX does not Granger Cause CP		1.98353	0.2680

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ER does not Granger Cause BSESENSEX	39	4.47630	0.1427
BSESENSEX does not Granger Cause ER		2.78837	0.2831
FII does not Granger Cause BSESENSEX	39	2.28560	0.1900
BSESENSEX does not Granger Cause FII		0.33742	0.6900
GP does not Granger Cause BSESENSEX	39	0.33663	0.6906
BSESENSEX does not Granger Cause GP		3.28094	0.2181
IIP does not Granger Cause BSESENSEX	39	0.10855	0.5679
BSESENSEX does not Granger Cause IIP		0.67572	0.3260
IR does not Granger Cause BSESENSEX	39	0.44668	0.8096
BSESENSEX does not Granger Cause IR		0.20672	0.4379
M3 does not Granger Cause BSESENSEX	39	3.30577	0.3155
BSESENSEX does not Granger Cause M3		0.74661	0.8983
TD does not Granger Cause BSESENSEX	39	0.91953	0.3494
BSESENSEX does not Granger Cause TD		2.29235	0.2497
WPI does not Granger Cause BSESENSEX	39	4.73324	0.4797
BSESENSEX does not Granger Cause		0.97843	0.8247
WPI			

Table 6 displays the results of a Granger causality test indicating a causal link between the CNX Nifty and macroeconomic factors. Exchange rates cause Nifty to fluctuate and so does the quantity of money in circulation. The association between Nifty and FII is causal but only in one direction. There is no one-way or two-way interaction between the factors.

Table 6 Granger Causality Test Findings for Macroeconomic Variables and the S&P CNX Nifty

Null Hypotheses	Observations	F-Statistic	Prob.
CP does not Granger Cause CNXNIFTY	39	0.66745	0.7906
CNXNIFTY does not Granger Cause CP		0.48123	0.5566
ER does not Granger Cause CNXNIFTY	39	2.40140	0.2101
CNXNIFTY does not Granger Cause ER		5.10902	0.5419
FII does not Granger Cause CNXNIFTY	39	4.23132	0.2523
CNXNIFTY does not Granger Cause FII		6.93340	0.2294
GP does not Granger Cause CNXNIFTY	39	1.47393	0.8267
CNXNIFTY does not Granger Cause GP		2.73422	0.3922
IIP does not Granger Cause CNXNIFTY	39	2.12312	0.4846
CNXNIFTY does not Granger Cause IIP		1.88875	0.3208
IR does not Granger Cause CNXNIFTY	39	1.74483	0.6826

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CNXNIFTY does not Granger Cause IR		1.34645	0.3097
M3 does not Granger Cause CNXNIFTY	39	5.31843	0.2486
CNXNIFTY does not Granger Cause M3		3.86505	0.5708
TD does not Granger Cause CNXNIFTY	39	1.47310	0.7272
CNXNIFTY does not Granger Cause TD		5.87554	0.9706
WPI does not Granger Cause CNXNIFTY	39	3.40357	0.2061
CNXNIFTY does not Granger Cause WPI		1.05722	0.2445

Thus, we reject the invalid speculation that there is no causal connection between conversion scale and cash supply, and unfamiliar institutional venture and the financial exchange. It would appear the hypothesis holds true regardless of the other factors.

Conclusion

The stock market in India has been linked to broad economic trends. As the exact outcomes show, macroeconomic factors fundamentally affect the Indian securities exchange. Gold, cash supply, money rates and unfamiliar institutional financial backers essentially affect the securities exchange. Gold is adversely affecting the Indian financial exchange, as shown by the research, which indicates rising investor interest in the precious metal. Investors must maintain a close relationship with the financial exchange, which thusly requires the market to live up to the expectations of those who have money invested in it. Gold contributes for about 8 to 10 percent of India's import expenses, thus the country would be hit hard by the attractive investment opportunity in the precious metal. Investors are being drawn in by the apparent wealth to be made from this commodity, creating a negative trend in the market. The financial exchange is harmed by the swapping scale. The worth of the Indian rupee falls against the dollar on global currency markets when the dollar strengthens.

The Indian stock market is hampered by the widespread practise of using gold prices as an alternative investment. A Granger causality test indicates that the connection between's the swapping scale and the financial exchange is only one-way. This implies that the financial exchange responds to even little changes in the trade rate.Money supply is another variable that significantly affects the financial exchange as estimated by the S&P CNX Nifty. By virtue of the import/trade unevenness and new institutional monetary supporters, the heading of causation is from the file to the factors. The Indian government must take the initiative to boost investor trust in the stock market if it wants to wean investors off of gold and encourage them to put their money into the stock market instead.

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