Journal of Information & Optimization Sciences
ISSN 0252-2667 (Print), ISSN 2169-0103 (Online)
Vol. 45 (2024), No. 4, pp. 1073–1079
DOI : 10.47974/JIOS-1692

Estimating the opening stock price index for Indian market under the influence of varying crude oil and Dollar values through statistical time series analysis

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Abstract

The proposed effort is a research analysis of the effect of various macroeconomic determinants such as price of Oil, Gold price and rate of Exchange (USD to INR) over Indian stock exchange market (we took NSE catalog as a reference for Indian share market). In proposed study, we took recurrent data for time period of 14 years i.e. 2008 to 2022. In proposed work, first of all we established a correlation between various macroeconomic determinants (price of Gold, Oil price and US dollar exchange rate) with NSEI (National Stock Exchange of India). Once correlation is found between these entities, we formulated regression equations to forecast opening value of NSEI centered on historical values of macroeconomic determinants. Here we devised seven different models and concluded the best models amongst them. Then we tested the given results from regression analysis by providing a test data and comparing the results of actual value of NSEI with the predicted value. Finally, we proposed finest prototype to forecast the National Stock Exchange index.

Subject Classification: *62J05, 62M10, 97K40.*

Keywords: *Regression modeling, Correlation, Decomposition, Macroeconomic commodities.*

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1. Introduction

The role of financial market is very important in laying a strong foundation for a robust financial system. With the globalization and ease of doing business across the nations, the stock market of a country is hugely dependent on several international factors. These factors can be termed as Macroeconomic determinants. There are various commodities falls under this category such as Exchange rates, price of Silver, and price of Gold, Inflation, and Industrial production's Index etc. In proposed work a connection established among macroeconomic factors as well as share market. Our study used three macroeconomics variables and established a one to one and one to many relationships with the NSEI.

At first, we checked if there exist a correlation between the macroeconomics variables with that of National Stock Exchange index of India (opening value). With this study, we concluded that there exist a strong correlation between NSEI and these macroeconomics variables. This gave us a further confidence to go ahead and figure out the Regression equations to forecast opening price of NSEI centered on the historical data of macro-economic factors like prices of Oil, prices of Gold and Exchange duties of US dollars to Indian rupees. As we tested our prediction model against actual data, we realized that our model is able to predict the data quite correctly and hence we concluded that there is a strong impact of these variables over NSEI opening value. This model can be used by any investor to make clever decision about future investments and to gain maximum return out of it.

2. Literature Review

We went through various previous studies conducted on Macroeconomic factors affecting Stock Markets and found various interesting papers such as:-

In their study V Kapoor et. al [1], R. Maheshwari [12] recognize association and effect between several share index of world market. Chin Wen et. al [2] in research investigation study the impact of general election on share market. Subrat et. al [3] study various approach of share market prediction. Yang and Wang [4] in their study found that there exist a bivariate connection among RMB exchange as well as A- share in a short run but it is not there among RMB exchange as well as B-share share index. Agrawalla and Tuteja [5] established a long rum stable equilibrium between economic growth and stock market developments in India.

Ahmed [6] in their study summarized that share price value in India create the financial action with an exception that is movement in interest rates. It seems that interest rates keas the stock prices.

Debashish [7] found that with the introduction of future trading the instant price instability as well as trading productivity was condensed. Bansal and Pasricha [8] identify that the instability is expressively decreased with advent of FII in equity. Hosseini and Ahmad [9] in their study found linkage between macroeconomic variables such as price of crude oil, monetary supply, production of materials in industry as well as inflation rate and the stock markets of India and China. Buyuksalvarci [10] in their study the Turkish stock market is undesirably impacted by rate of interest, industrial production index, price of oil and foreign currencies whereas positively by money supply. Whereas gold price and inflation rate has no significant effect.

Srivastava [11] found that share markets are affected by local macroeconomic variables than the universal.

3. Data and Methodology

In our study, we have investigated the effect of macroeconomic factors i.e. prices of Oil, prices of Gold as well as Exchange rate over Nations stock exchange of India. Further, we devised a model to forecast opening price of NSEI based on those macroeconomic variables. We considered a time interval of January 2008 to April 2022 on a monthly basis. We collected the data for NSEI from yahoo finance whereas the data for macroeconomic variable are collected from investing.com.

First of all we will see the extent of correlation among the prices of Oil, prices of Gold and Exchange rate with NSEI. Here we took the opening value of all these commodities as well as NSEI and found a strong correlation between them as shown in the Table 1.

If the value of correlation between two entities are positive, it shows that there exist a strong correlation between them. The higher is the value the larger the extent of correlation is. From the figure above, we summarized that exchange rate as well as prices of Gold has the higher correlation than

Table 1

Correlation coefficient

Correlation between	Exchange rate (USD to INR)	Gold Prices	Oil prices
NSEI	0.834067	0.60045	0.179523

that of Oil prices. So from the table above we can conclude that the impact of Exchange rate (USD to INR) is highest on NSEI than the gold prices impact is also considerably high as it shows a higher value but the impact of oil prices is not as high as its counterparts but as its value is greater than zero we cannot deny its degree of impact hence we will take all these three variables in our regression modelling.

4. Regression Models

Regression analysis is basically statistics way to find the connection among depend variable (Z) as well as independent parameters (X). Regression can be of two types namely Simple linear regression and multiple linear regression. For simple regression, one to one relationship is established whereas in multiple regression one to many is established. Below are the equations for the same:-

- **Equation for Simple regression:** $Z = mX + c$
- **Equation for Multiple regression:** $Z = m_1X_1 + m_2X_2 + m_3X_3 + ... + m_tX_t + c$

Where:

- Z represents dependent variable
- X represents independent variable
- c represents Intercept.
- m is the slope.

4.1 *Simple Regression Models (influence of, prices of Gold, prices of Oil and Exchange rate on National Stock Exchange)*

Here we have calculated the influence of prices of Gold, prices of Oil, and Exchange rate individually on NSE. We have applied simple regression to do so and as a result of this we formulated three models i.e. First Model, Model – 1 (Exchange rate as independent and NSE will be dependent), Second Model, Model - 2(Gold prices as independent, NSE will be dependent), Third Model, Model-3(Oil prices as independent and NSE will be dependent)

4.2 *Multiple Linear Regression Models (influence of Exchange rate, prices of Gold and prices of Oil on NSE in combinations)*

Here we have calculated the influence of Exchange rate, prices of Gold as well as prices of Oil in blends (combination of two as well as all

three) on National Stock Exchange. We have devised four models i.e. Model - 4 (Exchange rate, Gold prices as independent as well as NSE as a dependent), Model - 5 (Gold prices, Oil prices as independent and NSE as a dependent), Model - 6 (Exchange rate, Oil prices as independent and NSE as a dependent), Model 7 (Exchange rate, prices of Gold, prices of Oil as independent and NSE as a dependent).

5. Results, Discussion and Conclusion

Here, we executed the regression analysis on different models we formed and found different equations as a outcome:-

Model 1 (Exchange rate on NSE)

Forecasted NSE= -8289+274.8429* Exchange rate

Model 2 (Gold price on NSE)

Forecasted NSE= -2095 + 7.436*Gold price

Model 3 (Oil price on NSE)

Forecasted NSE= 6062+ 0.523929* price of Crude Oil

Model 4 (price of Gold and Exchange rate on NSE)

Forecasted NSE= -9761.9 + 2.715* Gold price + 236.46*Exchange rate

Model 5 (Gold price and Crude oil price on NSE)

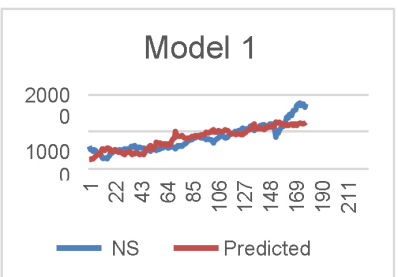
Forecasted NSE= -2308.78 + 7.3501*Gold price- 0.079223*Crude oil price

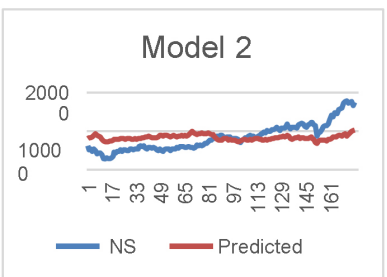
Model 6 (Crude oil price and Exchange rate on NSE) Forecasted NSE= -10510.2 + 0.526415* Crude oil price+ 274.90 * Exchange rate

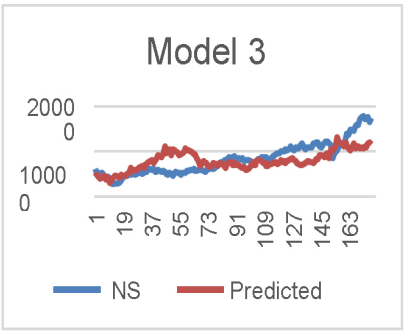
Model 7 (NYSE, LSE and All ord. on NSE)

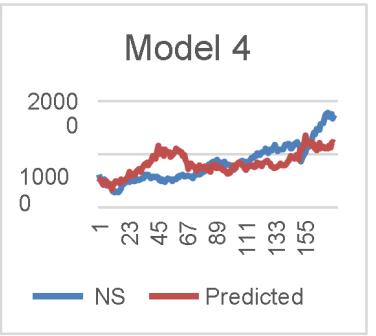
Forecasted NSE= -11114.2+ 0.3985* Crude oil +245.081*Exchange+2.1* Gold price

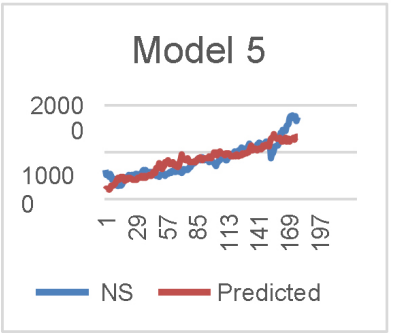
Here are different equations for 7 projected prototypes, we employed these equations to forecast the NSE and designed the predicted NSE vs Actual NSE and got following graphs:-

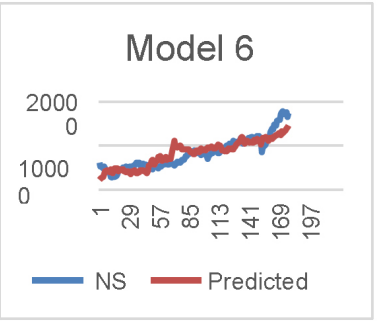


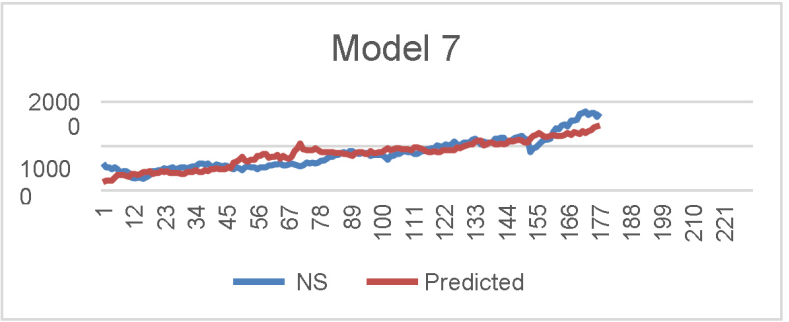












As shown from the graphs above we can see that Model 7 predicts the NSEI most accurately and hence we can conclude that this is the best fit model to forecast the price of NSEI based on historical value of macroeconomic factors i.e. price of Crude Oil, price of Gold and Exchange rate (USD to INR). Here we conclude our study with our final prediction model for investors to forecast the opening Price of NSEI. In future, more macroeconomic variables such as Silver price, Interest rates etc. can be clubbed together for better results.

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