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An Analytical Study of the Impact of Macroeconomic Variables on the Performance of the Indian Stock Market with Special Reference to NSE and BSE

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Abstract

The present study investigates the impact of macroeconomic variables on the Indian stock market returns using the ARIMA model. The study of four macroeconomic variables, namely FDI, FIIs, exchange rate, and foreign exchange reserve has been undertaken; the macroeconomic variables and stock market price was taken for the period 2017-18 to 2021-22 on monthly data. The study reveals that all the variables are stationary at first order difference, except FDI and FIIs, which are stationary at level. The correlogram defines that the autocorrelation (q) and partial autocorrelation (p) are not more than the significance level, either in BSE or in NSE. With the help of the correlogram, lag values of p and q are selected; so, the model (0,1,0) and (0,1,0) have been selected for further analysis. The estimation of the ARIMA model parameters found that FDI and exchange rate have a negative relation with the Indian stock market, whereas FIIs and foreign exchange reserve are positively related to BSE and NSE, and the p-values (0.0321 and 0.0368, respectively) are less than 0.05, which defines the significant impact of FIIs on the Indian stock market returns. We can say that FIIs play a major role in the growth of the Indian stock market, compared to other variables. Based on the experiment's results, the best ARIMA model can predict market prices effectively. Investors could use that information to make successful investment decisions.

Keywords: Macroeconomic Variables, NSE, BSE, ADF Unit Root Test, ARIMA Model

Introduction

India has a developing market economy. The Indian economy is the sixth-largest in the world in terms of nominal Gross Domestic Product (GDP) The country reported a GDP of USD2.6 trillion for 2020 and is ranked the third largest in terms of GDP purchasing power parity (PPP) (USD8.9 trillion). As per the International Monetary Fund (IMF) data and reports published in 2021, the Indian economy ranked 148th by GDP (Nominal) and 128th by GDP (PPP) on per capita income. According to the Ministry of Commerce and Industry (India), India's exports are USD497.90 billion and imports are USD547.1 billion in the financial year 2021-22. According to NITI Aayog, India's current nominal growth is 11.1% and it needs a growth rate of 12.5% to achieve a target of USD5 trillion GDP by 2024. India has developed rapidly over the years due to its ever-increasing economy.

The concept of macroeconomics refers to the analysis of a country's economy as a whole. In macroeconomics, macroeconomic variables refer to cyclical movements in an economy, such as gross domestic product,

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unemployment, inflation, money supply, budget deficits, international trade, and exchange rates. Appreciation of the Indian currency will benefit firms operating in any industry. Other macroeconomic variables include investment, exports, and imports.

Researchers accepted that macroeconomic variables are of utmost importance and governments cannot make policies, rules, and regulations without considering them. As a result, macroeconomic variables are the most important indicators of the economy's trends.

The present study uses four major macroeconomic variables.

Exchange Rate: Financial transactions between countries are mediated by the exchange rate. Any country's entire import and export process depends on its currency exchange rate. An increase in import value and a decrease in export value are immediately caused by a depreciation in the country's currency. When the domestic currency is stronger, export-oriented companies are adversely affected, and import-oriented companies benefit. Whenever the domestic currency value appreciates, the stock market benefits.

Foreign Exchange Reserve: The central financial institution and other monetary policy authorities keep the reserve of a variety of currencies like the US Dollar, Euro, Pound Sterling, and Japanese Yen, and use it to repay its liability. A stable forex rate is used to influence the exchange rate and economic policy. It has a tremendous relationship with the stock market. The traders would like to make investments greater if the function of a country is enhanced in foreign exchange reserves. More reserves mean more faith in a financial system, which continuously leads in the direction of more investment in the stock market.

Foreign Institutional Investors: The FIIs are a crucial part of the Indian economy. An international investor makes a short-term investment in it. The returns on other financial markets, such as the money market, stock market, and foreign exchange market, are causally related to the returns of the foreign exchange market. FII is meaningful for an emerging economy because it exerts a greater impact in the short run on the domestic financial markets and has a lasting effect in the long run. As per NSDL, foreign institutional investors invested USD428.03 billion in India in FY2021-22.

Foreign Direct Investment: FDI is an investment from one country into a business in a different country to create a lasting relationship. FDI requires 10% ownership in the foreign companies' voting stock. Compared to the foreign portfolio investments that passively hold securities of foreign companies, FDI has a lasting interest. India received USD83.57 billion in FDI in FY2021-22, making it the country receiving the highest FDI. FDI inflows to India have increased 20 times in the last 20 years, as it rapidly emerges as a preferred investment destination. As a result of economic reforms, India is expected to attract USD100 billion in FDI in FY2022-23. The Indian economy depends heavily on foreign direct investment.

ARIMA Structure (Box-Jenkins Methodology)

There are four steps involved in obtaining the ARIMA structure of the stationary variable:

- *Identification*: The values of p, d, and q must be determined appropriately; the correlogram and partial correlogram can be helpful in this process.

  The ARIMA model (p, d, q) consists of the following:

  - p is the number of autoregressive terms;
  - d is the number of differences; and
  - q is the number of moving averages.
- *Estimation:* The estimation of the parameters of the autoregressive and moving average terms in the model follows the identification of the appropriate p and q values.
- *Diagnostic Checking:* One must determine if a selected ARIMA model fits the data reasonably well after estimating its parameters, since other ARIMA models may be equally effective. Because of this, Box-Jenkins ARIMA modelling is more of an art form than a science.
- *Forecasting:* The success of ARIMA models in forecasting is one of the main reasons for its popularity. This method can produce forecasts that are more accurate than those based on traditional econometric models, especially for short-term forecasts.

Review of Literature

- Sudhamathi (2021) examined the forecasting of BSE Sensex movement using ARIMA modelling, from 1 January 2020 to 31 December 2020, and using GDP, inflation, exchange rate, unemployment rate, and statistical tools Box Jenkins ARIMA model for testing the hypothesis. The study concludes that ARIMA (ar (5) ma (6) ma (7)) is the best model for forecasting the future movement of the stock market.

- Radha and Gopinathan (2019) examined the impact of macroeconomic determinants on Nifty and banking sector stocks from May 2009 to July 2018, using monthly returns of macroeconomic variables, Nifty, Johansen's co-integration, and Granger causality tests. The result of the study supports the previous conclusion that there is a positive impact of macroeconomic determinants on Nifty and banking sector stocks.
- Gautam, Singh and Fouzdar (2019) investigated the relationship between Indian stock market returns and macroeconomic variables from 2000 to 2017. For the investigation, macroeconomic variables, i.e. consumer price index (CPI), index of industrial production (IIP), exchange rate (ER), foreign exchange reserve (FER), and Nifty 50, and statistical tools like Augmented Dickey-Fuller test and OLS have been used. The result concludes that there is a significant impact of Nifty returns on macroeconomic variables; further, a unidirectional relation between them was established.
- Kinslin and Velmurugan (2018), in their study, used correlation analysis and multiple regression analysis for investigating the impact of identifying variables like foreign direct investment, exchange rate, oil price, interest rate, inflation rate, and gold price on the stock market indices' performances, namely BSE Sensex and NSE Nifty of the Indian stock market. The result reveals that security exchange lists are significantly affected by macroeconomic variables.
- Garg and Kalra (2018) studied the relationship between macroeconomic factors and Indian stock markets using Pearson correlation. In this, Sensex was taken as the dependent variable and unemployment rate, exchange rate, average inflation rate, gold price rate, foreign exchange rate, and GDP were considered the independent variables. Data from 1997 to 2017 was used and revealed that there is a positive relationship between macroeconomic factors and Sensex, except for average inflation and unemployment rate.
- Mohamed and Senthamarai (2017) forecast the Nifty bank sectors stock price using ARIMA model, from July 2016 to June 2017, using the bank sector of Nifty daily closing market price to predict the fluctuation of the stock market. The study found that the private bank sector has a minimum risk of investors for an upcoming trade.
- Chal (2017) attempted to test the relationship between macroeconomic variables and the Indian stock market using unit root test, correlation, and granger causality test; the study reveals that there is no cause-and-effect relation between the Indian stock market and macroeconomic variables; however, there is a positive correlation between them.
- Alam (2017) analysed the impact of select macroeconomic variables on the stock price in India using Johansen cointegration test, OLS, and GARCH model, and concluded that there exists a long-term heteroscedastic relationship between stock price and macroeconomic variables.
- Gurloveleen and Bhatia (2016) investigated the impact of macroeconomic variables on the functioning of the Indian stock market using the Augmented Dickey-Fuller test, multiple regression, and granger causality test, and revealed that the Indian stock market has a weak form efficiency, because there is no significant relationship found between them.

Need for the Study

Macroeconomic variables have been playing a crucial role in the performance of the Indian economy. It has great significance because it helps mitigate various challenges in the country. Previous literature review reveal that many studies have been conducted on the impact of macroeconomic variables on the functioning of the Indian stock market, forecasting nifty bank sectors' stock price using the ARIMA model, and the analysis of the impact of select macroeconomic variables on the Indian stock market – a heteroscedastic cointegration approach. The results of these have not been satisfactory and these studies have been conducted on either BSE Sensex or NSE Nifty. The proposed study undertaken highlights both the NSE Nifty and BSE Sensex indices, to identify which is more affected by macroeconomic variables and to select the best model for the forecasting impact of macroeconomic variables on the Indian stock market; it also includes major macroeconomic variables which help to estimate the Indian stock market more accurately. Therefore, 'Impact of macroeconomic variables on the Indian stock market returns using ARIMA model has been taken into consideration.

Objectives of the Study

Following are the objectives of the study:

- To analyse the relationship between macroeconomic variables and Indian stock market returns.
- To study the impact of macroeconomic variables on Indian stock market returns.

Hypotheses of the Study

H_{01}: There is no significant impact of macroeconomic variables on NSE Nifty.

H_{02}: There is no significant impact of macroeconomic variables on BSE Sensex.

Research Methodology

The present study seeks to examine the impact of the macroeconomic variables on the Indian stock market returns, for which four macroeconomic variables, namely foreign direct investment, foreign institutional investment, foreign exchange reserve, and exchange rate have been taken as the independent variables. Monthly stock returns of NSE Nifty and BSE Sensex have been taken as the dependent variables. The study covers monthly data from 2017-18 to 2021-22 and data has been collected from various sources, namely the Reserve Bank of India, FDI statistics, the National Stock Exchange, the Bombay Stock Exchange, and NSDL for examining the impact of macroeconomic variables on the Indian stock market returns. Augmented Dickey-Fuller Model or Unit Root Tests (ADF) are used to check normality, and the ARIMA model is used to analyse the data. Statistical tools E-views version 8.0 and MS Excel are used.

Data Analysis and Interpretation

Augmented Dickey-Fuller Model or Unit Root Tests (ADF)

Table 1: ADF Unit Root Analysis at the Level

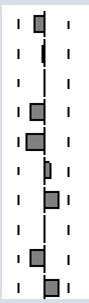
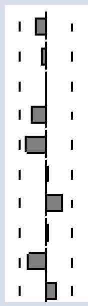
Sr. No.	*Variables*	*T-Statistic*	*ADF at Level*	*Critical Value at 1%*	*Critical Value at 5%*	*Critical Value at 10%*
1.	BSE	−0.713861	0.8361	−3.525618	−2.902953	−2.588902
2.	ER	−0.992663	0.7518	−3.525618	−2.902953	−2.588902
3.	FDI	−6.906927	0.0000	−3.525618	−2.902953	−2.588902
4.	FII	−7.289219	0.0000	−3.525618	−2.902953	−2.588902
5.	FOREX	0.464735	0.9843	−3.525618	−2.902953	−2.588902
6.	NSE	−0.732857	0.8312	−3.525618	−2.902953	−2.588902

Table 2: ADF Unit Root Analysis at 1^{st} Difference

Sr. No.	*Variables*	*T-Statistic*	*ADF at 1^{st} Difference*	*Critical Value at 1%*	*Critical Value at 5%*	*Critical Value at 10%*
1.	BSE	−8.989576	0.0000	−3.527045	−2.903566	−2.589227
2.	ER	−8.659876	0.0000	−3.527045	−2.903566	−2.589227
3.	FDI	−8.045772	0.0000	−3.527045	−2.903566	−2.589227
4.	FII	−9.122662	0.0000	−3.527045	−2.903566	−2.589227
5.	FOREX	−7.095586	0.0000	−3.527045	−2.903566	−2.589227
6.	NSE	−8.747563	0.0000	−3.527045	−2.903566	−2.589227

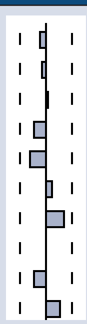
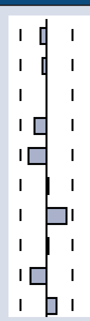
As per Table 1 and 2, the ADF test has been applied to check the stationarity of the data. All the variables have to be converted into log before applying the ADF test, because the original continuous data is not normalised. We therefore need to convert the data into log so that data becomes normally distributed and we get accurate or valid results from the data. Then, the ADF test is applied and it is found that BSE, ER, FOREX, and NSE are stationary at 1st difference, and FII and FDI are stationary at level.

Table 3: BSE Correlogram Test

Autocorrelation	*Partial Correlation*	*AC*	*PAC*	*Q-Stat*	*Prob*
		1 -0.086	-0.086	0.5430	0.461
		2 -0.021	-0.028	0.5751	0.750
		3 0.007	0.003	0.5788	0.901
		4 -0.119	-0.120	1.6787	0.795
		5 -0.160	-0.185	3.6996	0.593
		6 0.051	0.011	3.9065	0.689
		7 0.140	0.145	5.4871	0.601
		8 -0.005	0.011	5.4889	0.704
		9 -0.118	-0.170	6.6522	0.673
		10 0.135	0.094	8.2022	0.609

As seen in Table 3, the data taken for the study is stationary at d(1), which is the first difference. Hence, the series was generated for the same, and a correlogram test was performed to find the value of p and q. The result shows that there has been 0 lag autocorrelation, and partial autocorrelation spikes exceed the level of significance in BSE. Thus, the tentative ARIMA model to be considered for further analysis is ARIMA (0,1,0) for BSE.

Table 4: NSE Correlogram Test

Autocorrelation	*Partial Correlation*	*AC*	*PAC*	*Q-Stat*	*Prob*
		1 -0.059	-0.059	0.2552	0.613
		2 -0.029	-0.033	0.3185	0.853
		3 0.012	0.008	0.3291	0.954
		4 -0.111	-0.111	1.2804	0.865
		5 -0.155	-0.171	3.1697	0.674
		6 0.050	0.021	3.3691	0.761
		7 0.168	0.172	5.6634	0.580
		8 0.005	0.023	5.6657	0.685
		9 -0.109	-0.150	6.6570	0.673
		10 0.125	0.093	7.9779	0.631

As seen in Table 4, the data taken for the study is stationary at d(1), which is the first difference. Hence, the series was generated for the same, and the correlogram test was performed to find the value of p and q. The result shows that there has been 0 lag autocorrelation, and partial autocorrelation spikes exceed the standard error in NSE. Thus, the tentative ARIMA model to be considered for further analysis is ARIMA (0,1,0) for NSE.

Table 5: Coefficient of Different Models

	BSE	*NSE*
Significant coefficient	0	0
SIGNASQ	0.002635	-
Adjusted R-square	−0.018440	0.0000
AIC	−2.985872	−3.048786
BIC	−2.958397	−3.016917

The coefficient of different models is used to select the best model for the NSE and BSE. As per the selection criteria, certain indicators should be followed, like the fact that critical coefficient or SIGMASQ should be minimum or adjusted R square should be maximum; the AIC or BIC are selected based on the minimum value. The outcome shows that ten ARIMA models were estimated; out of the ten models, the best was selected as ARIMA for BSE (0,1,0), with the lowest AIC and BIC values of −2.985872 and −2.958397, and for NSE (0,1,0), with the lowest AIC and BIC values of −3.048786 and −3.016917.

Table 6: Adjusted ARIMA Estimated Parameters

		BSE (0,1,0)	*NSE (0,1,0)*
Constant		0.011447	0.011263
FDI	R square	−0.000771	−0.000726
	P value	0.0671	0.0763
FII	R square	0.016952	0.016622
	P value	0.0321	0.0368
Exchange rate	R square	−0.000359	−0.000299
	P value	0.0659	0.0749
Foreign exchange reserve	R square	0.000339	0.000379
	P value	0.0640	0.0728
Q significance		0.0000	0.0001
N		72	72

According to Table 6, adjusted ARIMA estimated parameters are used to examine the impact of macroeconomic variables on Indian stock market returns; it was found that R square reveals that FDI has a negative relation with BSE and NSE, with a value of −0.000771 and −0.000726, respectively. In addition, p-values of BSE (0.0671) and NSE (0.763) are greater than 0.05, which means we cannot reject the null hypothesis that ‘There is no significant impact of FDI on NSE and BSE’.

In analysing the impact of FII, one can say that R square defined the positive relation between FII and both the indices of the Indian stock market, with the values 0.016952 and 0.016622. The null hypothesis concerning FIIs and Indian stock market returns has been rejected, as the p-values of BSE and NSE are 0.0321 and 0.0368, respectively, which are less than 0.05. There is a significant impact of FII on Indian stock market returns.

R square shows that there is a negative (−0.000359, −0.000299) relation between exchange rate and Indian stock market returns. The null hypothesis concerning exchange rate and Indian stock market returns has been accepted, as the p-values of BSE (0.0659) and NSE (0.0749) are greater than 0.05 at 5% of the significance level. Therefore, this concludes that exchange rate and Indian stock market returns have independent growth and there is no significant impact of exchange rate on NSE and BSE.

From the result of foreign exchange reserve, it can be said that R square indicates a positive relation between foreign exchange reserve and Indian stock market returns, and the p-values i.e., (0.0640 and 0.0728, respectively) are greater than 0.05; this means we cannot reject the null hypothesis that ‘There is no significant impact of foreign exchange reserve and Indian stock market returns’.

Q significance reveals that models BSE (0,1,0) and NSE (0,1,0) are the best-fit models for the prediction of the impact of macroeconomic variables on Indian stock market returns, with a p-value of 0.000, which is less than the 5% significance level.

Conclusion

The macroeconomic variable is considered an important factor for investing in India. Through this study we examine the impact of macroeconomic variables on Indian stock market returns and determine which index is more affected by the macroeconomic variables.

This study utilised the autoregressive integrated moving average model to obtain the predictions of the impact of macroeconomic variables on Indian stock market returns. The results show that ARIMA has better forecasting results compared to other models. Moreover, the model using ARIMA gives importance to observations within a reasonable time frame. The study proposes the ARIMA (0,1,0) as the best model for predicting the impact of macroeconomic variables on Indian stock market returns. Additionally, the study was statistically tested, and validated the model for predictive power. In this way, this paper is useful for improving the decision-making ability of the Indian stock markets operating on investment strategies.

This study reveals an extensive method for developing the ARIMA model for the estimation of Indian stock market returns. With the use of the ARIMA model, the results found that FDI and exchange rate are negatively related to the Indian stock market returns, while FII and foreign exchange reserve have a positive relation with Indian stock market returns. In addition, it was found that among the macroeconomic variables only FIIs have a significant impact on Indian stock market returns.

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