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Impact of Select Macroeconomic Variables on Volatility in Indian Stock Market in the Post-Liberalisation Era: A Study

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Abstract:

The movement of the index of stocks is very illuminating to changes in the underlying economic structure as well as changes in predictions for the future. It is assumed that domestic economic fundamentals control the stock market's performance. However, domestic economic factors are also subject to change in the globally connected economy because of the policies implement or to be implementing by other nations, as well as some external occurrences. The present study attempts to find out the instability caused by the chosen macroeconomic indicators of the Indian share market between the years of the research from1 April 1991 till 30 July 2023 using ARCH family model.

Keywords: India, Stock Market, ARCH, Price of crude oil, exchange rate, gold price, and yield on US bonds.

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Introduction

In the current global economy, the capital market is essential as a source of financial development. An efficiently organized stock market plays a pivotal role in gathering savings and facilitating investment ventures, thereby stimulating economic activity within a nation. It collects deposits from a variety of individual individuals and allocates the money to useful and lucrative investment opportunities. The stock market provides national and international, individual and institutional investors with multiple investment alternatives in order to maximise their return and wealth (Nijam et al., 2015). On the one hand, the stock market mobilises money for the business sector. The interaction of supply and demand in the stock market is influenced by multiple factors, which, as is the case in any open market, impact stock prices. According to Chen et al. (1986), daily experience appears to corroborate the idea that different unplanned occurrences have different effects on asset values and that certain situations have an increasingly pervasive impact than others. The share price movements are also said to be influenced by numerous macroeconomic variables such as national and worldwide social, economic, or political developments; market perceptions or expectations of upcoming economic growth, monetary or fiscal policy pronouncements, or so on (Moskalenko, 2005). In that case inquiry may clearly begin, how can the impact of macroeconomic factors on stock prices be assessed?

Stock index movement is very attentive to shifts changes in both the fundamentals of the economy and alterations in forecasts for future outcomes. It is believed that domestic economic fundamentals control the stock market's performance. However, domestic economic factors are also susceptible to change in the globally connected economy because of the policies implemented or anticipated to be implemented by other nations, as well as some external occurrences. The economy's oil price, the value of US bonds, the value of gold, and the exchange rates are frequent external factors that affect stock return. For instance, changes in interest rates by major economies throughout the world affect capital inflows and outflows as well as local interest rates. But recently, a huge number of international participants closely monitor and assess the behaviour of the Indian stock market. Policymakers, traders, and investors may find it valuable to comprehend the macro dynamics India's stock market. Results might indicate whether changes in stock prices are the result of other factors or one of the factors driving changes in other macroeconomic variables. The study seeks to investigate if stock market movement is influenced by macroeconomic factors or not. In many areas of investing and finance, it is crucial to understand how sensitive the stock market is to the macroeconomic behaviour of key factors and vice versa. The following parts make up the way the paper is organized. Section 2 reviews some of the literature regarding the cause-and-effect connection between the stock market and macroeconomic factors. In Section 3, we present the data and describe the methods for detecting unexpected changes in the suggested state variables. The results and their interpretation are reported in Section 4. There are conclusions in Section 5.

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Literature Review

Ample study has been established to assess the lively connections between macroeconomic factors and the share market of developed nations. There are so many studies on hand that talk about a number of the significant commentary linking to the area. Bhunia and Ganguly (2020) studied the influence of crude oil prices and stock market volatility, FIIs, Exchange rates and selected stock price indexes (Sensex) in India using secondary source time series data gathered from January 31, 2020 to March 29, 2020, using the ARCH, GARCH, and ADF unit root tests. GARCH as well as ARCH results shows that the Indian share market is volatile under study. Nijam et al. (2012) used a linear- log, log- a log model, an Ordinary Least Square (OLS) model, a Durbin-Watson statistics model, regression test to observe the interdependencies across the Sri Lankan stock market using data between 1980 and 2012. Using the Correlations, Regression model, Kitati et al. (2012) found a negative relation between Nairobi Securities Exchange with one spanning the months of January 2008 and December 2012. In this study by Chen et al. (2012), the macroeconomic factors observed consistent impact the stock market return. The researchers used vector autoregressive models to analyze the data in between 1958 to 1983 in this study. Singh (2010) confirmed the existence of a causal relationship between macroeconomic conditions and the stock market by utilizing data gathered for all variables, including the BSE Sensex, the wholesale price index, industrial production index, and the exchange rate, between April 1995 and March 2009. The result confirms that selected macroeconomic factors impinge on Indian stock market pricing. The Conrad and Loch (2012) considered the long-term connection among stocks price as well as macroeconomic factors of employing secondary time series data from 1969 (January) to 2012 (December) from the US Stock Exchange and the GARCH-MIDAS model. These empirical conclusions demonstrated substantial evidence in favor of the long-term stock market volatility's countercyclical nature. Darrat (2014) investigated the effects of earlier financial and monetary actions regards stock returns based on secondary quarterly data from a time range of 14 years periods between January 1960 and December 1984 with the use of fiscal econometrics. Empirical findings established that between this fiscal measure and current stock return, there is a large lag. Oriwo (2010) observed how the Nairobi Stock Exchange index and macroeconomic factors are related secondary data in between March 2008 to March 2012 were used but negative relation was discovered in this study. Huy et al. (2020) suggested constructing an economic model to study how certain factors affect stock price based on supplementary information for the time in between December 2014 to June 2019 using the regression model. The regression equation and evaluation quantitative results show both positive and negative impacts on Sacombank (STB) as well as economic variables. The main goal of investigation of Saqib and Aggarwa (2017) is to determine how the Indian stock market's Nifty 50 index is affected by changes in specific macroeconomic variables in India. The tests are performed using monthly data, and the time frame under consideration is 2001–2016, based on the result of strong impact stock values.

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Above studies give an overview of the empirical work done earlier on the topic of volatility caused in the stock market of different economies due to different macroeconomic variables. And the present study attempts to find out the volatility caused by the selected macroeconomic variables on the stock exchange in India.

Data and Methodology

An effort has been made to find out why the Indian market is so turbulent due to the shock of select macroeconomic fundamentals such as currency rate, gold price, crude oil price, and US bond yield. This study considered daily time series data ranging from the period from April 1, 1991 till July 30 of 2023. To be able to analyze these data, the ARCH family models were considered using in EViews 9 software.

Analysis and Discussion

Descriptive Statistics

The descriptive statistics of the study is given in the table 1. The result of descriptive statistics confirms high standard deviation of the Sensex followed by crude oil and gold price indicating volatility associated with such variables. The Jarque Bera statics with probability conforms the non-normality that the data item.

Table-1: Descriptive Statistics

	Sensex	Crude Oil	Exchange Rate	Gold Price	US Bond Rate
Mean	9.101003	7.474225	3.807471	9.039656	1.432518
Median	9.140589	7.612246	3.815512	8.698445	1.481605
Std. Dev.	0.945078	0.895208	0.263849	0.822635	0.432600
Skewness	0.016258	-0.108871	-0.290069	0.332747	-0.397605
Jarque-Bera	618.8164	585.8207	108.4076	819.0273	271.6650
Probability	0.000000	0.000000	0.000000	0.000000	0.000000
Observations	7050	7050	7050	7050	7050

Correlation Statistics

In table 2 the correlation of Sensex's with the select macroeconomic indicators such as crude oil, gold, bonds, and the exchange rate are exhibits. The result of correlation confirms the high positive correlation of the selected variables (other than US Bond Rate) with the Sensex and there shows high negative correlation of US Bond Rate with the Sensex.

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Table-2: Correlation Statistics

	Sensex	Crude Oil	Exchange Rate	Gold Price	US Bond Rate
Sensex	1.00				
Crude Oil	0.90	1.00			
Exchange Rate	0.83	0.79	1.00		
Gold Price	0.96	0.91	0.83	1.00	
US Bond Rate	-0.88	-0.83	-0.81	-0.89	1.00

Unit Root Test

In table 3 the unit root test result are discussed. All the variables initially tested at level and found only exchange rate as stationary data and rest all the variables as non stationary. Then all the selected data set were tested at 1st difference and found that all of the data are stationary.

Table-3: ADF Unit Root Test Results

	At Level				At 1st Difference			
	t-stat	C.V. @ 5%	Prob.	Remarks	t-stat	C.V. @ 5%	Prob.	Remarks
Sensex	-2.89	-3.41	0.16	NS	-78.09	-3.41	0.00	S
Crude Oil	-2.34	-3.41	0.41	NS	-81.52	-3.41	0.00	S
Exchange Rate	-4.00	-3.41	0.00	S	-55.37	-3.41	0.00	S
Gold Price	-1.68	-3.41	0.76	NS	-86.01	-3.41	0.00	S
US Bond Rate	-2.38	-3.41	0.39	NS	-27.04	-3.41	0.00	S
C.V. = Critical Value; NS = Non-Stationary; S = Stationary								

OLS Result (DV: SENSEX)

The relationship between the dependent variable and the independent variables is taken into consideration when we estimate a relationship using the OLS (Ordinary Least Square) method. The outcomes are displayed in Table 4. As we can see, the influence of the US Bond rate on the Sensex is non-linear. Crude oil price and gold price have a linear influence on the Sensex in addition to the exchange rate.

Table - 4: Ordinary Least Square

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.413687	0.108789	3.802649	0.0001
Crude Oil	0.158861	0.008365	18.99126	0.0000
Exchange Rate	0.326516	0.021917	14.89762	0.0000

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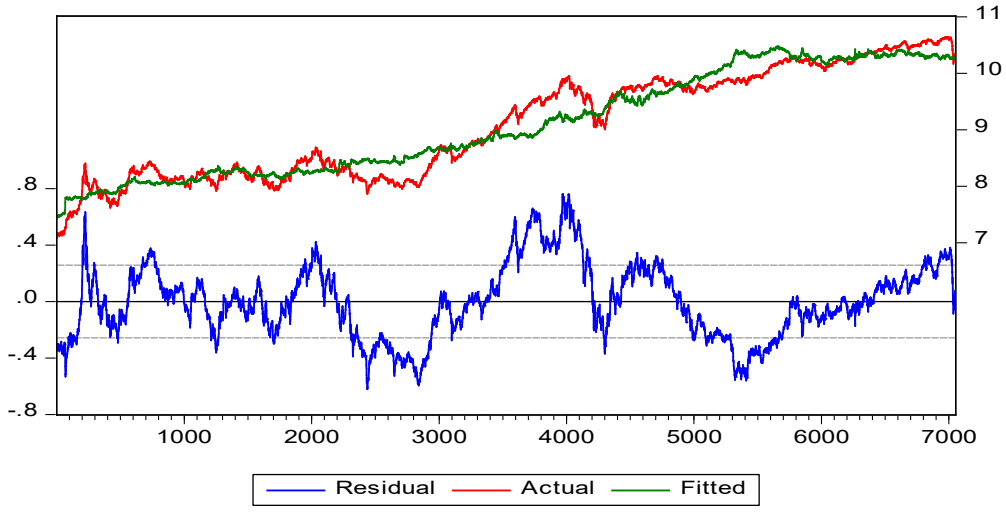
Variable	Coefficient	Std. Error	t-Statistic	Prob.
Gold Price	0.733108	0.011180	65.57022	0.0000
US Bond Rate	-0.258484	0.016028	-16.12726	0.0000
R-squared	0.925579	Akaike info criterion		0.128155
Adjusted R-squared	0.925537	Schwarz criterion		0.133021
F-statistic	21904.92	Durbin-Watson stat		0.005182
Prob(F-statistic)	0.000000			

Residual Test of the OLS:

The following figure (Figure 1) shows that there exists a huge fluctuation in the data set during the course of the investigation. The outcome of residual confirms that existence of the volatility in the model and with the intention to identify the volatility Auto Regressive Heteroskedasticity family Model has been used in the study.

Figure - 1: Residual Test of the OLS



Again in the table 5 the heteroskedasticity test of the residual has been carried out with the goal of determining whether or not there is a heteroskedasticity issue. The following hypothesis has been assigned for the test:

H_0: There is no ARCH effect

H_1: An ARCH effect exists.

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Table - 5: Heteroskedasticity Test of Residual

F-statistic	543823.5	Prob. F (1,7047)	0.0000
ObsR-squared	6958.826	Prob. Chi-Square (1)	0.0000

Table 5 result confirms the disproved null hypothesis as the likelihood of the observed R-squared has the equivalent value of 0.00 and accepts the alternative hypothesis that there exists volatility in the residuals. The result also indicates that ARCH family model test should be carried on to find out the volatility in the model.

Volatility Model

The stock market's volatility is caused by arbitrage, structural changes to any current trading strategy, and both internal and external macroeconomic news. The volatility aids in predicting the uncertainty brought on by any modifications to specific variables. For assessing volatility, both the Generalised Autoregressive Conditional Heteroskedasticity (GARCH) and Autoregressive Conditional Heteroskedasticity (ARCH) models were used.

ARCH Model

Table 6 demonstrates the overall short-run volatility of the Sensex and a subset of variables as well as their statistical 5% level of significance for significance. This outcome demonstrates that the Sensex increases by 16.63% for every 1% shift in crude oil, indicating that crude oil is positively volatile. Exchange prices are also extremely volatile, and a 1% move in one currency increases the other by 26.70%, increasing the Sensex. Again, the Gold price is also favourably volatile, and the Sensex is boosted by 73% for every 1% change in the price of gold under consideration. US Bond rate is likewise very volatile, and a 1% change in US Bond Rate causes a 26% drop in the Sensex. This suggests that because of the market's short-term volatility, the shareholder risk is higher in this one.

Table –6: ARCH Test of Volatility

Variable	Coefficient	Std. Error	z-Statistic	Prob.
Crude Oil	0.166265	0.010829	15.35356	0.0000
Exchange Rate	0.267955	0.023883	11.21961	0.0000
Gold Price	0.732283	0.011021	66.44489	0.0000
US Bond Rate	-0.264307	0.025204	-10.48680	0.0000
Sensex (C)	0.596578	0.137149	4.349864	0.0000
Variance Equation				

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C	0.000768	0.000496	1.547335	0.1218
GARCH (-1)	0.988234	0.007576	130.4445	0.0000

GARCH Model

As a total, the outcome (as shown in Table 7) demonstrates that Sensex and a few chosen factors are volatile over the long term and statistically significant at a 5% significance level. The outcome demonstrates that crude oil is positively volatile and that for every 1% change in price, the Sensex rises by 1.4%. A change of 1% in the exchange rate causes the Sensex to rise by 45%. The exchange rate is also positively volatile under study. Once more, the price of gold is positively inconsistent, and a shift of 1% in the price of gold causes the Sensex to rise by 70.81%. Also adversely volatile is the US Bond rate, which causes a 35% drop in the Sensex with every 1% shift. This suggests that because of the long-term volatility in this market, shareholder risk is also higher.

Table –7: GARCH (1,1) Test of Volatility

Variable	Coefficient	Std. Error	z-Statistic	Prob.
Crude Oil	0.013961	0.001511	9.238392	0.0000
Exchange Rate	0.453159	0.004259	106.4025	0.0000
Gold Price	0.708178	0.002186	323.9404	0.0000
US Bond Rate	-0.355567	0.002834	-125.4813	0.0000
C	1.347916	0.019915	67.68399	0.0000
Variance Equation				
C	0.000178	1.92E-05	9.267437	0.0000
RESID(-1)^2	0.964225	0.065107	14.80985	0.0000
GARCH(-1)	0.049866	0.026590	1.875343	0.0607

Residual Test of the GARCH Model

Normality Test

The goal of the normality test is to determine if the model that was created is normally distributed or not. The following hypotheses are selected and the histogram approach is used to test for normality:

H_0: Normal distribution of residuals

H_1: The distribution of residuals is abnormal

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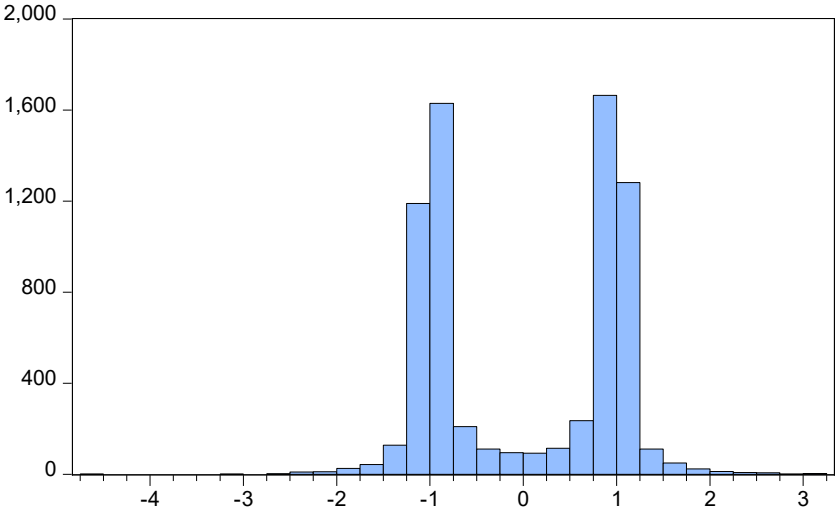
Figure - 2: Normality Test (Histogram)



In the histogram test, the probability of Jarque-Bera (0.00) rejects the invalid hypothesis and confirms that the residuals do not follow a normal distribution.

ARCH LM Test (Heteroskedasticity Test)

Evaluation for heteroskedastic issues within the framework comes after ensuring that the residuals are normal. The ARCH LM test has been used to determine the heteroskedastic issue, and the following hypotheses have been selected:

H_0: No ARCH impact exists.

H_1: An ARCH effect exists.

Table - 8: Heteroskedasticity Test of GARCH Model

F-statistic	31.68668	Prob. F(1,7047)	0.0000
ObsR-squared	31.55379	Prob. Chi-Square(1)	0.0000

The calculated value of the R-squared with probability confirms the rejection of the null hypothesis and proves that there exists no heteroskedasticity problem in the model.

Conclusion

The study aims to learn about the unpredictable movements of the Indian equity market because of the effect of select macroeconomic factors such as currency rate, gold price, crude oil price, and US bond yield. This descriptive statistics result indicates that the standard deviation of Sensex is significantly much greater than that for the other variables, indicating that its values are highly volatile during the study period. In almost all of the variables in the following correlation matrix are highly positive correlated with one another, with the exception of the US Bond Rate, which have highly negative correlation. Unit Root Test findings demonstrate that at the level only exchange rate is stationary and despite the fact that certain variables are not stationary, all

of the data remain stationary at first difference. ARCH and GARCH result confirms that only US Bond rate negatively volatile Sensex and the other entire macroeconomic indicator positively volatile under the investigation, both for the short run and the long run. So, it can be seen that shareholders risk exists because of market volatility, this happens in the Indian share market.

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