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Impact of Interest Rates on the Stock Market

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ABSTRACT

With the objective to expand knowledge, the goal of this research was to establish and concentrate on the impact of interest rates on the stock markets, namely the National Stock Exchange (NSE) and the Bombay Stock Exchange (BSE). Various sets of variables were used to ascertain the relationship between interest rates and stock markets. This study is entirely dependent on secondary data, which was gathered over a five-year period from 2019 to 2023 from reputable exchanges. Interest data was also obtained from the Reserve Bank of India [RBI], which is where monthly and daily prices of various stock indices are gathered. A statistical tool called EViews 12 was used to analyze secondary data, and models called the Unit Root test, Johnsons Co-integration test, and ARCH model were used to estimate the results and estimate a long run positive and negative relationship between the variables. Stock prices, such as NIFTY, SENSEX, BSE AUTO, and NSE AUTO, are measured as dependent variables, and interest rates, such as Bank rate, Repo rate, and Reverse Repo rate, are measured as independent variables for this study. Financial managers, investors, and specialists in finance, among others, can benefit from this research.

Introduction

In many nations, stock markets are crucial to the economy. An investor can easily access stock markets worldwide thanks to the adoption of more flexible exchange rate arrangements in emerging and transitioning economies, the adoption of free and open economic policies, the development of new capital markets, and the progressive removal of restrictions on foreign exchange and capital inflows. The aforementioned developments have resulted in a substantial increase in risk associated with portfolio diversification and overall investment decisions, as well as a rise in the variety of investment opportunities and interest rate and exchange rate volatility. An economy's state is determined by stock market indices, which highlight the importance of stock Market. The stock market and interest rates typically have an inverse relationship. Share prices decrease as interest rates rise. Bonds gain in appeal. An increase in interest rates may make it more costly for a business to borrow money, which would reduce its ability to reinvest in the business and stabilize its cash flow, both of which would normally pressure share prices. For all of the above, the opposite is true when interest rates decrease.

The amount of interest owed on a loan, deposit, or borrowing amount expressed as a percentage of the principal sum is known as the interest rate. The principal amount, interest rate, frequency of compounding, and duration of loan, deposit, or borrowing all affect the total interest on the amount borrowed or lent. Interest is the price paid for utilizing someone else's funds. This is a scenario that landowners are well aware of. The bank's funds are intended to cover this privilege when they are utilized as a mortgage to purchase a house or a plot of land. When credit card holders borrow short-term loans to pay for goods and services, they also have to pay interest. It is defined as the percentage of the loan amount that the lender charges the borrower in interest; this percentage is typically expressed annually. It's the interest rate a bank or other lender charges on a loan, or the rate a bank gives its customers who maintain funds in an account.

Review of Literature

Jeongism Kim [2023] Using data from Korean firms, examines how a developing stock market reacts to increases in US interest rates in his study "Stock Market Reaction to United States Interest Rate Hike: Evidence from an Emerging Market." Models including OLS, Cross-sectional Regression, and Correlation were employed. They discovered that the Fed's sharp rate hike prompts investors to flee to emerging markets, and that determined companies with higher market capitalization, more export sales, and foreign ownership outperform during US interest rate hikes. They also discovered that financial flexibility is especially important for small cap companies during US interest rate hikes.

In their 2022 publication, "Interest rates and their Impact on the Stock Market: Evidence from Sweden," Felicia Anderson and Ribin Fogelberg examined the connection between short- and long-term interest rates. The Granger Casualty Test (GCR), OLS models, and Vector Autoregressive (VAR) were utilized in the analysis over the course of the 20-year study. The results indicated that there was no direct correlation between the long-term interest rate and the Swedish stock market and that the short-term interest rate had no effect on the market, while the OLS indicated a negative relationship between interest and the stock market.

Agyemang, Cai li, and Abredu Pearl [2021] investigated the impact of interest rates on the performance of the Ghana Stock Exchange [GSE] over a 20-year period. The GSE composite index served as the dependent variable, and the control variables were the interest rate, inflation rate, exchange rate, and money supply. The study tested the long-term relationship between interest rate and GSE index using Johnson's cointegration test. The results showed that long-term cointegration between the dependent and independent variables exists, and that interest rates have a significant impact on the GSE index (a 1% increase in interest rates would cause a 14.63% drag in the index).

In their research on the "Time Varying influence of Interest rates on Stock Market returns," Guangton Gu, Wenjie Zhu, and Chengjun Wang [2021] found that: Using data from China, a novel Bayesian time-varying regression model was used to analyze the relationship and effect of interest rates on stock market returns over time in that country. They found that while average interest rates typically have an abnormally positive effect on the market and have a negative impact on price returns, an increase in interest rates tends to stifle the growth in stock prices.

[2020] The effect of interest rates, inflation, and exchange rates on the Indian stock market For the study, Mahima and Tushar Jejani examined the effects of microeconomic variables on the Indian stock exchanges, Sensex 30 and Nifty 50, over a 29-year period. These variables included interest rates, inflation, and foreign exchange rates. The relationship between interest rates, inflation rates, and the stock market was found to be weak and inverse using ANOA and regression tests.

Research Gap

The relationship between interest rates and stock prices has been extensively researched. Many researchers used the SPSS software for study, and various models—such as correlation, regression, and ANOVA—were employed. As a result, the methods and instruments employed by different researchers also differ. It was discovered after reading through all of this material that the preceding statistical techniques did not produce conclusive proof on the connection between interest rates and stock markets. It was also discovered that interest rates and on stock markets were not homogeneous. In order to establish evidence of a relationship between the independent variables and dependent variables taken into consideration for the study, particularly in the Indian context, e-views is used as a tool in this study. Unit root test and Johnsons Cointegration test are applied and volatility has been checked by using ARCH Model which previous studies has not considered.

Objectives

- To analyse the long run causal relationship between stock prices with interest rates.
- To analyse the volatility in stock market for selected stock prices.
- To check the stationarity for the selected stock prices

Hypothesis

- H0: there is no stationarity in a given time series
- H1: there is a stationarity in the given time series
- H0: There is no long run relationship between stock prices and interest rates
- H1: There is a long run relationship between stock prices and interest rates
- H0: There is no ARCH effect
- H1: There is an ARCH effect

Limitations of the Study

- Precise results are impossible to attain because of the many other macroeconomic factors that also affect stock market returns.
- The study is also limited by the availability of data within the same interval.
- The goal of the study is to ascertain how interest rates, specifically bank and repo rates, relate to and affect the SENSEX and NIFTY, or the overall stock market index. However, neither an analysis nor consideration of the relationship with the remaining individual sectors is included in the study.

DATA AND METHODOLOGY

The data used for the present research work is principally secondary data. The data on stock prices are collected from BSE, NSE and the data on interest rates are collected from Reserve Bank of India (RBI), International Monetary Fund [IMF]. The study being quantitative in nature makes use of certain

statistical tools for analysing the data. Some of the tools and models which are used for this study are Unit root test, Johnsons Cointegration test and ARCH Model are used wherever necessary to illustrate the theory and findings

Period of the Study

Type of Research: Analytical.

Sampling: The Nifty 50 stock market indices are examined In order to compare the outcomes over the long terms, SENSEX is also researched for 5 years Since they collectively reflect the behaviour of Indian stock markets, a selection of major Indian stock market indices is examined and contrasted. Nifty 50 and SENSEX are studied from 2019 to 2023, CNX AUTO are studied from 2019 to 2023 and similarly S&P BSE AUTO are studied from 2019 to 2023. Monthly Stock prices are observed for estimating long run relationship and daily prices for Estimating ARCH effect. The data for the Bank Rates and Repo Rates has been collected from the database of the RBI.

ANALYSIS OF DATA:

Model 1: ADF unit root Test on First Difference of Sensex

Null Hypothesis: D(LN_SENSEX) has a unit root
Exogenous: None
Lag Length: 0 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-7.741897	0.0000
Test critical values:	1% level	-2.605442	
	5% level	-1.946549	
	10% level	-1.613181	

The series is stationary since there are no unit roots in the ADF test for the Sensex series in the first difference, the test calculated value (7.741897) is greater than the tabulated value (1.946549) at the 5% level of significance, and the probability value is 0.000. As a result, the log Sensex series' order of integration is 1.

ADF unit root Test on First Difference of BSE_Auto

Null Hypothesis: D(BSE_AUTO) has a unit root
Exogenous: None
Lag Length: 0 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-7.107654	0.0000
Test critical values:	1% level	-2.605442	
	5% level	-1.946549	
	10% level	-1.613181	

Since there are no unit roots in the ADF test for the series BSE_Auto in the first difference and the test calculated value (7.107654) is greater than the tabulated value (1.946549) at the 5% level of significance, the series is stationary. The probability value for the series is 0.000. As a result, the log Bse_Auto series' order of integration is 1.

ADF unit root Test on First Difference of Nifty 50

Null Hypothesis: D(LN_NIFTY) has a unit root
Exogenous: None
Lag Length: 0 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-7.571687	0.0000
Test critical values:	1% level	-2.605442	
	5% level	-1.946549	
	10% level	-1.613181	

The ADF test for the Nifty 50 series in the first difference reveals that there are no unit roots, indicating that the series is stationary because the test calculated value (7.571687) is greater than the tabulated value (1.946549) at the 5% level of significance and the probability value is 0.000. As a result, the log Nifty 50 series' order of integration is 1.

ADF unit root Test on First Difference of CNX Auto

Null Hypothesis: D(LN_CNX_AUTO) has a unit root
Exogenous: None
Lag Length: 0 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-7.271102	0.0000
Test critical values:	1% level	-2.605442	
	5% level	-1.946549	
	10% level	-1.613181	

The series is stationary since there are no unit roots in the ADF test for the CNX Auto series in the first difference, the test calculated value (7.271102) is greater than the tabulated value (1.946549) at the 5% level of significance, and the probability value is 0.000. As a result, the log CNX_Auto series' integration order is 1.

Model 2: Johnson's Cointegration Test for Sensex and Interest Rate

Date: 02/03/24 Time: 18:20
Sample (adjusted): 4 60
Included observations: 57 after adjustments
Trend assumption: Linear deterministic trend
Series: SENSEX BANK RATE REPO REVERSE REPO
Lags interval (in first differences): 1 to 2

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.527526	71.06145	47.85613	0.0001
At most 1	0.227444	28.32445	29.79707	0.0732
At most 2	0.195757	13.61554	15.49471	0.0941
At most 3	0.020797	1.197907	3.841465	0.2737

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.527526	42.73700	27.58434	0.0003
At most 1	0.227444	14.70891	21.13162	0.3098
At most 2	0.195757	12.41763	14.26460	0.0959
At most 3	0.020797	1.197907	3.841465	0.2737

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

The Max Eigenvalue statistic and the Trace statistic are two significant statistics that were revealed by the Johnsons Co Integration Test results in eViews. We are interested in the values of the Max Eigen and Trace statistics as well as the estimated number of the Cointegration equation in the above table. As the value of the Trace statistic (71.06145) for the None* null hypothesis is higher than the critical value at the 5% level of significance (47.85613), we can reject the null hypothesis. The output table contains three CEs, namely At most 1, At most 2, and None*. The null hypothesis is rejected and the alternative hypothesis is accepted because the probability value (0.0001) of none* is less than 0.05. This leads us to the conclusion that the series are cointegrated, related, and show a long run relationship. In the long run, the Sensex was positively and significantly impacted by bank rates and reverse repo rates; therefore, a percentage increase in these rates will result in an increase in Sensex prices. Conversely, there was a negative relationship and significant impact with repo rates; an increase in these rates will cause the Sensex to decline, and vice versa.

Johnsons Cointegration Test for Bse_Auto and Interest Rates

Date: 02/03/24 Time: 18:36
Sample (adjusted): 4 60
Included observations: 57 after adjustments
Trend assumption: Linear deterministic trend
Series: BSE AUTO BANK RATE REPO REVERSE REPO
Lags interval (in first differences): 1 to 2

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.510810	75.00985	47.85613	0.0000
At most 1 *	0.317189	34.25459	29.79707	0.0144
At most 2	0.186830	12.50699	15.49471	0.1342
At most 3	0.012527	0.718538	3.841465	0.3966

Trace test indicates 2 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.510810	40.75526	27.58434	0.0006
At most 1 *	0.317189	21.74760	21.13162	0.0409
At most 2	0.186830	11.78845	14.26460	0.1188
At most 3	0.012527	0.718538	3.841465	0.3966

Max-eigenvalue test indicates 2 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

The Max Eigenvalue statistic and the Trace statistic are two significant statistics that were revealed by the Johnsons Co Integration Test results in eViews. We are interested in the values of the Max Eigen and Trace statistics as well as the estimated number of the Cointegration equation in the above table. As the value of the Trace statistic (75.00985) for the None* null hypothesis is higher than the critical value at the 5% level of significance (47.85613), we can reject the null hypothesis. The output table contains three CEs, namely At most 1, At most 2, and None*. The null hypothesis is rejected and the alternative hypothesis is accepted because the probability value (0.0001) of none* is less than 0.05. This leads us to the conclusion that the series are cointegrated, related, and show a long run relationship. We can reject the null hypothesis because the value, At most 1*, is 34.25459, which is greater than the critical value at the 5% level of significance (29.79707). The likelihood of none* (0.0001) is less than 0.05 and maximum* (0.0144). As a result, the null hypothesis is rejected and the alternative is accepted. We draw the conclusion that there are two cointegrations between the interest rates and Bse_Auto, and that these cointegrations show long-term relationships. While bank rates and reverse repo had a long-term, negative, and significant impact on BSE auto prices, a percentage increase in these rates will result in a decline in BSE auto prices. Conversely, for repo, there was a positive, significant relationship; an increase in repo rates will result in a rise in BSE auto prices.

Johnson's Cointegration Test for Nifty 50 and Interest Rates

Date: 02/03/24 Time: 19:02
Sample (adjusted): 4 60
Included observations: 57 after adjustments
Trend assumption: Linear deterministic trend
Series: NIFTY_50 BANK RATE REPO REVERSE REPO
Lags interval (in first differences): 1 to 2

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.534078	72.05918	47.85613	0.0001
At most 1	0.239389	28.52612	29.79707	0.0695
At most 2	0.185327	12.92902	15.49471	0.1174
At most 3	0.021620	1.245839	3.841465	0.2643

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.534078	43.53306	27.58434	0.0002
At most 1	0.239389	15.59710	21.13162	0.2493
At most 2	0.185327	11.68318	14.26460	0.1231
At most 3	0.021620	1.245839	3.841465	0.2643

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

We are interested in the values of the Max Eigen and Trace statistics as well as the estimated number of the Cointegration equation in the above table. As the value of the Trace statistic (72.05918) for the None* null hypothesis is higher than the critical value at the 5% level of significance (47.85613), we can reject the null hypothesis. The output table contains three CEs, namely At most 1, At most 2, and None*. The null hypothesis is rejected and the alternative hypothesis is accepted because the probability value (0.0001) of none* is less than 0.05. This leads us to the conclusion that the series are cointegrated, related, and show a long-term relationship. In the case of repo, there was a negative relationship and significant impact; an increase in repo rate would result in a decline in nifty, and vice versa. In the long run, bank rate and reverse repo had a positive and significant impact on nifty. As a percentage, these rates will lead to an increase in nifty prices.

Johnsons Cointegration Test for CNX_Auto and Interest Rates

Date: 02/03/24 Time: 19:26
Sample (adjusted): 4 60
Included observations: 57 after adjustments
Trend assumption: Linear deterministic trend
Series: NSE_AUTO BANK_RATE REPO REVERSE_REPO
Lags interval (in first differences): 1 to 2

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.507837	73.43244	47.85613	0.0000
At most 1 *	0.304381	33.02255	29.79707	0.0205
At most 2	0.184615	12.33422	15.49471	0.1416
At most 3	0.012219	0.700797	3.841465	0.4025

Trace test indicates 2 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.507837	40.40989	27.58434	0.0007
At most 1	0.304381	20.68833	21.13162	0.0576
At most 2	0.184615	11.63343	14.26460	0.1252
At most 3	0.012219	0.700797	3.841465	0.4025

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

We are interested in the values of the Max Eigen and Trace statistics as well as the estimated number of the Cointegration equation in the above table. The output table contains three CEs: None*, At most 1*, and At most 2. For the None* null hypothesis, the Trace statistic value (73.43244) is greater than the critical value at the 5% significance level (47.85613), and for the At most 1* hypothesis, the value (33.02255) is greater than the critical value at the 5% significance level (29.79707). As a result, the null hypothesis can be rejected. The null hypothesis is rejected and the alternative hypothesis is accepted because the probability value (0.0000) of none* is less than 0.05 and at most* (0.0205). This leads us to the conclusion that the series are cointegrated and that there are two cointegrations between CNX_Auto and Interest Rates that show long-term relationships. While bank rates and reverse repo had a long-term, negative, and significant impact on CNX auto, a percentage increase in either of these rates will result in a decline in CNX auto prices; in the case of repo, however, there was a positive, significant relationship; an increase in repo rate will result in a rise in CNX auto prices.

Model 3: ARCH Estimation of SENSEX

Heteroskedasticity Test: ARCH

F-statistic	34.39733	Prob. F(1,1235)	0.0000
Obs*R-squared	33.51945	Prob. Chi-Square(1)	0.0000

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 02/08/24 Time: 15:20
Sample (adjusted): 1/03/2019 12/29/2023
Included observations: 1237 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	228521.6	22810.08	10.01845	0.0000
RESID^2(-1)	0.164618	0.028068	5.864924	0.0000

R-squared	0.027097	Mean dependent var	273572.0
Adjusted R-squared	0.026310	S.D. dependent var	765534.3
S.E. of regression	755396.7	Akaike info criterion	29.90949
Sum squared resid	7.05E+14	Schwarz criterion	29.91777
Log likelihood	-18497.02	Hannan-Quinn criter.	29.91260
F-statistic	34.39733	Durbin-Watson stat	2.085368
Prob(F-statistic)	0.000000		

It is determined that the observed R-squared value is 33.51945, with a probability Chi-Square (1) of 0.0000. The presence of ARCH Effects in the series is accepted as the alternative hypothesis, and the null hypothesis of no ARCH Effects is rejected because the p-value of 0.0000 is less than 0.05 at the 5% level of significance. Therefore, it is safe to say that the Sensex closing prices exhibit volatility and that the given series exhibits ARCH Effects. Additionally, the Table shows that, at the 5% level of significance, the value of b1 = 0.164 is statistically significant.

Dependent Variable: CLOSE
Method: ML ARCH - Normal distribution (BFGS / Marquardt steps)
Date: 02/08/24 Time: 15:35
Sample (adjusted): 1/02/2019 12/29/2023
Included observations: 1238 after adjustments
Convergence achieved after 15 iterations
Coefficient covariance computed using outer product of gradients
Presample variance: backcast (parameter = 0.7)
GARCH = C(3) + C(4)*RESID(-1)^2

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	30.24395	52.55684	0.575452	0.5650
CLOSE(-1)	1.000083	0.001080	926.4209	0.0000
Variance Equation				
C	190498.4	5456.006	34.91536	0.0000
RESID(-1)^2	0.323901	0.030972	10.45781	0.0000

R-squared	0.997739	Mean dependent var	50301.83
Adjusted R-squared	0.997737	S.D. dependent var	11002.27
S.E. of regression	523.4087	Akaike info criterion	15.27001
Sum squared resid	3.39E+08	Schwarz criterion	15.28656
Log likelihood	-9448.139	Hannan-Quinn criter.	15.27624
Durbin-Watson stat	1.972591		

Two parts make up the above table. The ARCH model's variance equation was the subject of the lower section, while the mean equation was the main emphasis of the upper part. The beta coefficients for the constant c and the SENSEX one-period lag are found in the upper portion of the mean equation. The beta coefficient of 0.030972 indicates the mean value of the Sensex. Given that the given series is stationary and the parameters b0 and b1 lie in the range of 0 to 1, with a probability value of 0.000 for each, the ARCH model is statistically significant.

ARCH Estimation of BSE_Auto

Heteroskedasticity Test: ARCH

F-statistic	14.42862	Prob. F(1,1235)	0.0002
Obs*R-squared	14.28509	Prob. Chi-Square(1)	0.0002

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 02/09/24 Time: 11:29
Sample (adjusted): 1/03/2019 12/29/2023
Included observations: 1237 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	85365.69	6371.271	13.39853	0.0000
RESID^2(-1)	0.107374	0.028267	3.798502	0.0002

R-squared	0.011548	Mean dependent var	95654.74
Adjusted R-squared	0.010748	S.D. dependent var	203923.0
S.E. of regression	202824.1	Akaike info criterion	27.27968
Sum squared resid	5.08E+13	Schwarz criterion	27.28796
Log likelihood	-16870.48	Hannan-Quinn criter.	27.28280
F-statistic	14.42862	Durbin-Watson stat	2.014711
Prob(F-statistic)	0.000153		

The observed R-squared value is 14.28509 , and the probability Chi-Square (1) is 0.0000. The alternative hypothesis—that there are ARCH Effects in the series—is accepted and the null hypothesis—that there are no ARCH Effects—is rejected because the p-value of 0.0002 is less than 0.05 at the 5% level of significance. Therefore, it is safe to say that the Bse_Auto closing prices are volatile and that the given series exhibits ARCH Effects. Additionally, the Table shows that, at the 5% level of significance, the value of b1 = 0.1073 is statistically significant.

Dependent Variable: BSE AUTO
Method: ML ARCH - Normal distribution (BFGS / Marquardt steps)
Date: 02/09/24 Time: 11:30
Sample (adjusted): 1/02/2019 12/29/2023
Included observations: 1238 after adjustments
Convergence achieved after 14 iterations
Coefficient covariance computed using outer product of gradients
Presample variance: backcast (parameter = 0.7)
GARCH = C(3) + C(4)*RESID(-1)^2

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-37.21947	28.02432	-1.328113	0.1841
BSE AUTO(-1)	1.002364	0.001178	850.6645	0.0000
Variance Equation				
C	79090.40	2817.802	28.06812	0.0000
RESID(-1)^2	0.189104	0.035382	5.344564	0.0000

R-squared	0.997901	Mean dependent var	23841.02
Adjusted R-squared	0.997899	S.D. dependent var	6762.785
S.E. of regression	309.9550	Akaike info criterion	14.28811
Sum squared resid	1.19E+08	Schwarz criterion	14.30466
Log likelihood	-8840.340	Hannan-Quinn criter.	14.29433
Durbin-Watson stat	1.895755		

Two parts make up the above table. The ARCH model's variance equation was the subject of the lower section, while the mean equation was the main emphasis of the upper part. The beta coefficients of the constant c and the one-period lag of the Bse auto are found in the upper part of the mean equation. The beta coefficient of 0.035382 yields the mean value of BSE_Auto. Given that the value of b0 is positive and b1 is between 0 and 1, with a probability value of 0.000 for both b0 and b1, the ARCH model is statistically significant and the given series is stationary.

ARCH Estimation of NIFTY 50

Heteroskedasticity Test: ARCH

F-statistic	34.80716	Prob. F(1,1224)	0.0000
Obs*R-squared	33.90001	Prob. Chi-Square(1)	0.0000

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 02/09/24 Time: 14:53
Sample (adjusted): 1/04/2019 12/29/2023
Included observations: 1226 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	19708.75	1945.370	10.13111	0.0000
RESID^2(-1)	0.166295	0.028187	5.899759	0.0000

R-squared	0.027651	Mean dependent var	23642.95
Adjusted R-squared	0.026857	S.D. dependent var	64865.86
S.E. of regression	63988.90	Akaike info criterion	24.97244
Sum squared resid	5.01E+12	Schwarz criterion	24.98078
Log likelihood	-15306.10	Hannan-Quinn criter.	24.97557
F-statistic	34.80716	Durbin-Watson stat	2.083198
Prob(F-statistic)	0.000000		

The observed R-squared value is 33.90001 is the observed R-squared value, and the probability Chi-Square (1) is 0.0000. The presence of ARCH Effects in the series is accepted as the alternative hypothesis, and the null hypothesis of no ARCH Effects is rejected because the p-value of 0.0000 is less than 0.05 at the 5% level of significance. Therefore, it is safe to say that the NIFTY 50 closing prices exhibit volatility and that the given series exhibits ARCH Effects. Additionally, the Table shows that, at the 5% level of significance, the value of b1 = 0.166 is statistically significant.

Dependent Variable: NIFTY
Method: ML ARCH - Normal distribution (BFGS / Marquardt steps)
Date: 02/10/24 Time: 15:47
Sample (adjusted): 1/03/2019 12/29/2023
Included observations: 1231 after adjustments
Convergence achieved after 16 iterations
Coefficient covariance computed using outer product of gradients
Presample variance: backcast (parameter = 0.7)
GARCH = C(3) + C(4)*RESID(-1)^2

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	7.586342	15.31170	0.495461	0.6203
NIFTY(-1)	1.000189	0.001059	944.2092	0.0000
Variance Equation				
C	16577.79	470.0932	35.26491	0.0000
RESID(-1)^2	0.316820	0.031809	9.959927	0.0000

R-squared	0.997832	Mean dependent var	14959.91
Adjusted R-squared	0.997830	S.D. dependent var	3301.621
S.E. of regression	153.7982	Akaike info criterion	12.82472
Sum squared resid	29070639	Schwarz criterion	12.84135
Log likelihood	-7889.617	Hannan-Quinn criter.	12.83098
Durbin-Watson stat	1.970279		

Two parts make up the above table. The ARCH model's variance equation was the subject of the lower section, while the mean equation was the main emphasis of the upper part. The beta coefficients of the constant c and the one-period lag of the Nifty 50 are found in the upper part of the mean equation. The beta coefficient of 0.031809 yields the mean value of NIFTY 50. Given that the value of b0 is positive and b1 is between 0 and 1, with a probability value of 0.000 for both b0 and b1, the ARCH model is statistically significant and the given series is stationary.

ARCH Estimation of CX_AUTO

Heteroskedasticity Test: ARCH

F-statistic	13.89192	Prob. F(1,1218)	0.0002
Obs*R-squared	13.75781	Prob. Chi-Square(1)	0.0002

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 02/09/24 Time: 15:51
Sample (adjusted): 1/03/2019 12/29/2023
Included observations: 1220 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	17432.81	1311.672	13.29053	0.0000
RESID^2(-1)	0.106103	0.028467	3.727186	0.0002

R-squared	0.011277	Mean dependent var	19506.56
Adjusted R-squared	0.010465	S.D. dependent var	41707.64
S.E. of regression	41488.82	Akaike info criterion	24.10587
Sum squared resid	2.10E+12	Schwarz criterion	24.11425
Log likelihood	-14702.58	Hannan-Quinn criter.	24.10902
F-statistic	13.89192	Durbin-Watson stat	2.014242
Prob(F-statistic)	0.000203		

The observed R-squared value is 13.75781 and the probability Chi-Square (1) is 0.0002. The presence of ARCH Effects in the series is accepted as the alternative hypothesis, and the null hypothesis of no ARCH Effects is rejected because the p-value of 0.0002 is less than 0.05 at the 5% level of significance. Thus, it is reasonable to conclude that there is volatility in the CNX_Auto closing prices and that the given series exhibits ARCH Effects. Additionally, the Table shows that, at the 5% level of significance, the value of b1 = 0.106 is statistically significant.

Dependent Variable: NIFTY_AUTO
Method: ML ARCH - Normal distribution (BFGS / Marquardt steps)
Date: 02/09/24 Time: 15:51
Sample (adjusted): 1/02/2019 12/29/2023
Included observations: 1221 after adjustments
Convergence achieved after 15 iterations
Coefficient covariance computed using outer product of gradients
Presample variance: backcast (parameter = 0.7)
GARCH = C(3) + C(4)*RESID(-1)^2

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-16.27754	12.95806	-1.256171	0.2091
NIFTY_AUTO(-1)	1.002347	0.001245	805.2400	0.0000
Variance Equation				
C	16278.02	576.2649	28.24746	0.0000
RESID(-1)^2	0.179548	0.035818	5.012785	0.0000

R-squared	0.997725	Mean dependent var	10509.86
Adjusted R-squared	0.997723	S.D. dependent var	2933.261
S.E. of regression	139.9684	Akaike info criterion	12.69959
Sum squared resid	23881599	Schwarz criterion	12.71632
Log likelihood	-7749.097	Hannan-Quinn criter.	12.70588
Durbin-Watson stat	1.904141		

Two parts make up the above table. The ARCH model's variance equation was the subject of the lower section, while the mean equation was the main emphasis of the upper part. The beta coefficients of the constant c and the one-period lag of CNX Aut0 are found in the upper part of the mean equation. The beta coefficient of 0.035818 provides the mean value of CNX_AUTO. Given that both b0 and b1 have values between 0 and 1, and that the probability value for each parameter is 0.000, the ARCH model is statistically significant and the given series is stationary.

Findings and Conclusion:

Economists and financial analysts have researched the intricate and varied relationship between interest rates and the stock market in great detail. Throughout this research paper, we have explored dimensions of this relationship, including the theoretical foundations, empirical evidence, and practical implications. The results of this study are in the favour of the objectives of this Paper We discovered that there was a long-term relationship, or cointegration, between interest rates (bank rate, repo rate, reverse repo rate) and stock prices, or SENSEX, NIFTY 50, BSE_AUTO, and CNX_AUTO. When cointegration is present, a stable and equilibrium relationship is found, meaning that stock prices and interest rates move in tandem over time. This suggests that, should the variables deviate from their long-term equilibrium relationship, there will be forces that pull them back in that direction. Regarding interest rates and the stock market performance, this means that any deviations from their long-run relationship are likely to be temporary, with the variables eventually converging back to their equilibrium levels where we found a positive and as well as negative relationship was found, along

with that there was presence of ARCH effect. Any change in policy the investors, participants need to be very careful and adjust their portfolios in accordance with their financial goals and hedge and mitigate the risk.

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