**Indian Stock Market Developments & Interest Rates: An Association Assessment**

**Abstract:** In this research paper, the objective was to map the influence interest rates have on Indian stock market. Monthly frequency data of weighted average of call money (interest rates), closing prices of BSE indices and NSE indices from April, 1991 to March, 2023 are employed for the analysis. Granger Causality proved inconclusive in respect of finding any relationship between variables. In further establishing relationship VAR models are run. Evidence of lead-lag causal relationship from interest rates to the indices, both BSE and NSE exist. The conclusions establish that interest rates do have the capability to drive the Indian stock market movements. Further, analysis can help establish in which direction the interest rates can initiate the Indian stock market progress.

**Keywords:** Macroeconomic Announcements, Interest Rates, Indian Stock Market, Augmented Dickey Fuller, Granger Causality, Vector Auto-regression Model.

**JEL Codes:** E44

1. **Introduction**

The reforms introduced in India through Economic Policy, 1991 liberalized the economy by exceptional increase in foreign investments. Soon after which the Indian financial markets got recognized as the most progressive and dynamic on an international level. A stable framework of macroeconomic announcements, although not the only factor, is indispensable when trying to achieve balanced economic growth. So, macroeconomic announcements can be said to have a stable framework when fiscal policy is well balanced, a competitive yet predictable exchange rates, a sustainable condition of balance of payments, low and probable inflation, appropriate interest rates. Interest rates evidently as part of this macroeconomic announcement framework has been effective in altering economic environment of a country. Fluctuations in interest rates have been linked to alterations in investment pattern which paint a visible picture over the financial markets.

Reserve Bank of India, vested with the responsibility of deciding the interest rates, maintains a continuous release of new information in an effort to keep the stakeholders informed in a routinely fashion. Causing ripples by means of financial institutions that provide loans to firms and consumers across an economy. Variability in interest rates causes an inverse development in aggregate demand. High interest rates cause a decline in demand as cost of borrowing increases. Contractionary state instigates in the economy, discouraging firms and individuals expenditure which means a plunge in capital flow. While low interest rates trigger expansionary state in the economy, easy availability of loans encouraging firms and individuals to spend more insinuating more capital flow. All these activities around rising and declining of interest rates raises transposed movements in the financial markets.

India is seeing an exhaustive injection of investments from foreign and domestic levels. An upward slope in the market assures a constant inflow of investments while a downward slope in the market results in withdrawal or decline in investments. The financial market serves as a common ground for both firms, eyeing to cultivate capital and individuals, making efforts to augment their savings. Monetary policies are defined by RBI to build exchange rate and price stability. Regulation of interest rates from time to time to make amends in the economy affects the thrust of money, motivation enough to question the empirical validity of inverse relationship existence among Indian stock market development and interest rate.

1. **Literature Review**

A broad literature of studies undertaken in Indian purview was reviewed for maximising the effectiveness of aforesaid research. Traditional theories insinuates for the usage of borrowed capital a cost is incurred in the form of interest rates, which when raised for strict monetary policy takes the stock market for a dive although the central banks deny any attempts to affect the stock markets (Gu et al., 2022).

(BREEN et al., 1989) attempted to establish the importance of interest rates in envisaging the variations in stock market prices, also returns. (Mok, 1993) found stock market returns and interest rates are both independent of each other. (Lee, 1997) study of establishing connection from interest rates to stock prices proved inconsistent, suggesting change of causality direction among variables from time to time also from negative to positives over unequal time periods. Similarly, (Harasty & Roulet, 2000) established long run affiliation amongst interest rates and stock market. (Arango et al., 2002) shows indications of non-linear and reverse relationship between interest rates and share market prices. (Hsing, 2004) also shows evidence of converse relationship among interest rates and stock market prices, also returns. (Rigobon & Sack, 2004) empirical examination suggests negative impact of short term interest rates on stock market prices. (Wong et al., 2005) demonstrated a long run capability of stock market to adjust the monetary policies. (Alam & Uddin, 2009) reveal negative yet significant relationship from interest rates to stock market prices in many developing countries. (Farsio & Fazel, 2010) study showed lack of any causality relationship among interest rates and stock market prices. (D. Muktadir-Al-Mukit, 2013) through cointegration technique established a negative causality relationship from interest rate to the market returns. (R et al., 2016) establishes significant evidence of influencing of Nifty 50 and many sectoral indices by interest rates while (Prakasam Chellaswamy et al., 2020) recorded no such impact. (Mayur, 2017) registered SENSEX to have association with short term interest rates, negatively and long term interest rates, positively.

This survey of previous literature exemplifies the many attempts required been undertaken to explain the affiliation between interest rates and stock market movements either in their prices or their returns. The previous examinations have a disagreement of similar results. There are fewer studies linking interest rates and stock market in Indian environment. Thus the former researches give the purpose to contribute further to the literature of study of developments caused in Indian stock market due to interest rates.

1. **Research Objectives**

For the study “Indian Stock Market Developments & Interest rates”, the research objectives setup is:

1. To examine the association of interest rates with BSE 100 index.
2. To examine the association of interest rates with Nifty 50 index.
3. **Empirical Research Methodology**
	1. **Augmented Dickey-Fuller (ADF)**

In a time series analysis, it is a necessity to check for unit root existence which signifies non-stationarity. Presence of stationarity describes the statistical characteristics of a time series i.e. mean, variance and autocorrelation unchanged over the period under study making it convenient to analyse. Occurrence of non-stationarity leads to failure to make significant forecasts and reveal indecisive conclusions.

The ADF analysis for testing unit root is an improved variety of the Dickey-Fuller test capable of handling more complex arrays of data which may have lagged differentiation. Also, appropriate for time series with non-stationarity exhibiting trends. A regression model is specified for the purpose of testing unit root in the time series. The ADF analysis aids in determination for requirement of differencing for data stationarity and whether inclusion of moving average or autoregressive in time series is needed. The (Dickey & Fuller, 1979) ADF regression model is as follows:

**∆yt = α + β t + γ yt-1 + δ1∆yt-1 + δ2∆yt-2 +.....+ δp∆yt-p + εt eq1**

(Dickey & Fuller, 1979)

Given in the equation above:

* **∆yt**­ denotes differences in values at **t** time and at **t-1** time.
* **α** denotes intercept term
* **β** denotes variable of time trend coefficient.
* **γ** denotes lagged level coefficient of time series, **γt-1**.
* **δ1, δ2,....., δp** denote lagged 1st differences coefficient of time series, **∆yt-1, ∆yt-2, ……. , ∆yt-p.**
* **εt** denotes error term (white noise)

Where, for testing unit root hypothesis, α = p-1.

Null hypothesis H0: α=0; time series is unit root.

Alternate hypothesis H1: α<1; time series is stationary.

By using t-ratio, the augmented equation is then applied to assess the given hypotheses, MacKinnon critical values are utilized in ADF analysis. Given the sensitivity of ADF analysis for lag length selection, Schwarz Information Criterion directs determination of applicable lag length.

* 1. **Granger Causality Test**

In researches involving time series, assessment of causal relationships amongst two or multiple variables, (Granger, 1969) Granger Causality is employed, to conclude whether time series x, predictor variable, Granger cause time series y, response variable. The test implies, on the basis of available data, predictive causality of the historical values of predictor variables in conjecturing response variable. The test can most likely Granger cause one another as it does not encapsulate direction of causal relationship among variables.

A simple bivariate test equation for Granger Causality from predictor variable, x to response variable, y is broken down as follows:

**y(t) = a + b1 \* y(t-1) + b2 \* y(t-2) + b3\*y(t-3) +... + bn \* y(t-n) + c1 \* x(t-1) + c2 \* x(t-2) + c3\*x(t-3)... + cn \* x(t-n) + ε(t) eq2**

Where:

* **y(t)** denotes response variable y at t time.
* **a, b1, b2, b3, …., bn** denote estimated coefficients from available data.
* **c1, c2, c3, …., cn** denote lagged value coefficients for predictor variable **x**.
* **x(t-1), x(t-2), x(t-3), …., x(t-n)** denote predictor variable **x** lag values.
* **ε(t)** denotes the error term.

Through the test, significance of lag values of predictor variable x in forecasting response variable y is assessed. Hypothesis stated in mathematical form is as follows:

Null hypothesis H0: c1 = c2 = c3 = …. = cn = 0; x does not granger cause y.

Alternate hypothesis H1: At least one or more ci ≠ 0, given i = 1, 2, 3, …., n; x granger cause y.

* 1. **Vector Auto-regression (VAR) Model**

VAR model are the statistical models used to analyse time series that are interconnected and attempts to hypothesise the course of association among these series over a given time frame, dynamically. Forecasting through VAR model is made by repeatedly calculating each variable value regressed on all past variable values in multiple time series. The VAR mathematical equation for p time series for the ith variable in the data is generalised as follows:

**Yi(t)=ci+Φi,1Yi(t-1)+Φi,2Yi(t-2)+Φi,3Yi(t-3)+…+Φi,pYi(t-p)+Σnj=1Σpk=1θi,j,kYj(t-k)+εi(t) eq3**

Where:

* **Yi(t)** denotes **ith** variable at **t** time in model.
* **ci** denotes constant term in the **ith** equation
* **Φi,1, Φi,2, Φi,3,…, Φi,p** denote lag coefficient of **ith**variable
* **Σnj=1** denotes summation of **n** variables in the multiple time series
* **Σpk=1** denotes summation of all lag values of **1** to **p** time series
* **θi,j,k** denotes summarizing coefficients describing influential relationship among all variables **j** with **ith**variable at lag **k** in the model.
* **εi(t)** denotes error term
1. **Data Interpretation & Empirical Results**

An inclusive data of monthly frequency from April, 1991 to March, 2023 is employed in the present study which augments accurate empirical results. Data on weighted average call money (interest rates) of monthly frequency for India was gathered from database on Indian Economy made available by Reserve Bank of India. Monthly closing prices of BSE & NSE indices were acquired from official websites, separately. All the statistical analysis was executed, with the purpose of achieving symmetry in data and valid results there on, on data variables converted into natural logarithm.

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| --- | --- | --- | --- |
| **Descriptive Statistics** | **Interest Rates** | **NSE Indices** | **BSE Indices** |
| Mean | 1.904 | 8.031 | 9.231 |
| Median | 1.883 | 8.181 | 9.413 |
| Maximum | 3.564 | 9.839 | 11.052 |
| Minimum | -0.315 | 5.964 | 7.119 |
| Standard Deviation | 0.458 | 1.039 | 1.042 |
| Skewness | 0.279 | 0.039 | 0.047 |
| Kurtosis | 5.868 | 1.617 | 1.614 |
| Jarque-Bera | 136.593 | 30.723 | 30.878 |
| Probability | 0.000 | 0.000 | 0.000 |
| Observations | 384 | 384 | 384 |

Table I Descriptive Summary

Table I displays descriptive brief of the study variables indicating all the time series to have a positive mean score. Evident from the results that time series for interest rates, BSE indices and NSE indices are all positively skewed depicting mean scores influenced by extreme values. While kurtosis scores indicate interest rate series to be a leptokurtic distribution and the market indices, BSE and NSE, being a platykurtic distribution. In any given normally distributed series data, skewness score equals ‘0’ and kurtosis score equals ‘3’, any other scores obtained during analysis suggest the time series data not of normally distributed nature. Jarque-Bera test for normality also supports the observation by rejecting the null hypothesis of normality.

|  |  |  |  |
| --- | --- | --- | --- |
| **Study Variables** | **Interest Rates** | **NSE Indices** | **BSE Indices** |
| Interest Rates | 1.00 | 0.999 | -0.452 |
| NSE Indices | 0.999 | 1.00 | -0.458 |
| BSE Indices | -0.452 | -0.458 | 1.00 |

Table II Correlation Matrices

Table II offers an understanding of the nature of association between two given variables presented in each cell of the matrix. Evident from the correlation results, interest rate has a strong and positive correlation to NSE Indices, indicating movements of interest rates and NSE Indices values in the similar direction. On other side, interest rates and BSE Indices have an opposite relationship.

|  |  |  |
| --- | --- | --- |
| **Variables** | **Level** | **1st differences** |
| **Intercept** | **Trend & Intercept** | **Intercept** | **Trend & Intercept** |
| Interest Rates | -4.68\* | -5.08\* | -19.08\* | -19.08\* |
| NSE Indices | -1.13 | -3.11 | -18.05\* | -18.03\* |
| BSE Indices | -1.16 | -2.94 | -17.89\* | -17.88\* |

Table III Augmented Dickey Fuller Test result

Table III displays t-statistic for ADF test assessing the hypothesis for unit root. The t-statistics is assessed at level as well as 1st differences considering intercept and also trend with intercept in different equations. From the above ADF results, interest rates reject the unit root hypothesis at level, variance factor included and excluded. While the other two series of BSE Indices and NSE Indices accept the null hypothesis of stationarity. Thus, interest rates are stationary at level while the indices, BSE and NSE, are non-stationary at level. ADF test executed at 1st differences for all three variables depicts rejection of null hypothesis. Interest rates, BSE Indices and NSE Indices are all stationary at 1st differenced results trend variance included and excluded.

|  |  |  |  |
| --- | --- | --- | --- |
| **Null (H0) Hypothesis** | **Lags** | **F-statistic** | **Probability** |
| Interest rates do not Granger Cause BSE Indices | 3 | 1.202 | 0.309 |
| BSE Indices do not Granger Cause Interest rates | 3 | 1.56421 | 0.27534 |
| Interest Rates do not Granger Cause NSE Indices | 3 | 1.243 | 0.294 |
| NSE Indices do not Granger Cause Interest rates | 3 | 1.53871 | 0.26078 |

Table IV Granger Causality Test Result

Table IV illustrates test results for Granger Causality among time series variables. The Granger Causal assessment is undertaken on stationary time series variables at level for interest rates and first differenced for indices, BSE and NSE. Akaike Information Criterion (AIC) is considered for appropriate selection of lag length. The empirical results exemplify a non significant Granger causal relationship among time series variables. This indicates the null (H0) hypothesis acceptance that interest rates do not Granger Cause BSE indices or NSE indices. Also, BSE indices or NSE indices do not Granger Cause interest rates.

|  |  |  |  |
| --- | --- | --- | --- |
| **Variables** | **Interest Rates** | **BSE Indices** | **NSE Indices** |
| Interest Rates(-1) | (0.052)[13.509]\*\*\* | (0.016)[-0.572] | (0.016)[-0.637] |
| Interest Rates-2) | (0.051)[2.836]\*\*\* | (0.015)[-0.045] | (0.015)[-0.016] |
| BSE Indices(-1) | (1.242)[2.144]\*\* | (0.373)[-1.298] | (0.374)[-0.654] |
| BSE Indices(-2) | (1.229)[-0.086] | (0.369)[0.208] | (0.370)[0.339] |
| NSE Indices(-1) | (1.235)[-2.009]\*\* | (0.371)[1.529] | (0.372)[0.838] |
| NSE Indices(-2) | (1.232)[-0.190] | (0.370)[-0.141] | (0.371)[-0.345] |
| Constant | (0.059)[4.909]\*\*\* | (0.018)[1.550] | (0.018)[1.623] |
| R-squared | 0.690 | 0.018 | 0.011 |
| F-statistic | 138.496 | 1.128 | 0.703 |

Table V VAR test results with () standard errors & [] t-statistic

**Significant at \*1%, \*\*5% & \*\*\*10%.**

VAR test results are demonstrated in Table V. The analysis is taken on stationary time series of the variables. A tri-variate model of VAR test is estimated in the study. Test result depict lag values of interest rates are significant at 1% and 5% level for BSE and NSE indices. Further, suggesting a causal relationship from interest rates to BSE indices and NSE indices with no evidence of reverse causality among them. This interprets as almost immediate incorporation of new information from interest rates to both indices, BSE and NSE.

1. **Conclusion**

In the particular research study we examine the developments in Indian stock market owing to interest rates. Monthly frequency data of weighted average of call money (interest rates), closing prices of BSE indices and NSE indices from April, 1991 to March, 2023 are employed for the analysis. For obtaining symmetrical results, all time series data were transformed into natural logarithms of variables. ADF test results exemplify interest rates stationary at level while BSE and NSE indices at 1st differenced. Testing for Granger Cause we found none kind of relationship from interest rates to BSE and NSE indices. While consecutively VAR test show evidence of lead-lag interaction in observed variables. The results suggesting causality from interest rates lag values to BSE and NSE indices at 5% significance level. Empirical statistics indicate alignment with previous literature. From the results, we gain the insight of interest rates causing movements in Indian stock market indices, BSE and NSE.

The results in gist prove crucial for various stakeholders operating in stock market ranging from investors to policymakers. The results make study of kinds of developments brought by interest rates decisive and implicate to multiple stakeholders vigilant about market fluctuations and economic fundamentals. Investors should have a keen eye for the injection of new interest rates information as it causes changes in Indian stock market, thus, information can be used efficiently in predicting the market movements. Retail investors can employ the timing of interest rates announcements to their trading advantage. The attitude of the announcements influences retail investors expectations of market price variation. A positive natured announcement stimulates purchase of additional stock while negative natured announcement stimulates selling existing stocks. Similarly for sustainability in Indian stock market, interest rates demonstrate ability in aiding development and implementation of suitable measures by government, policymakers and organizations. Monitoring of macroeconomic announcements by market regulators is imperative to prevent retail investors from misinformation and irrational decision actions. Policy makers awareness to the macroeconomic announcement stimulation on market prices is favorable for efficient and detailed policy decisions. Further studies encompassing other macroeconomic announcements should also be encouraged.

Disclaimer (Artificial intelligence)

Option 1:

Author(s) hereby declares that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

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