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IMPACT OF INTEREST RATE MOVEMENT ON INDIAN STOCK MARKET INDICES

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ABSTRACT
This research looks at how interest rates (10-year T-bill rate) affect the Indian stock market Index. This study's time frame is the underlying series is tested as quasi at the level but stationary in the first difference using the Augmented Dickey-Fuller unit root test. Bidirectional links are shown using the Granger causality test. Interest rates and the stock market index are causally related in both directions (Nifty 50 and Nifty Midcap 100). As a result, it is now feasible to estimate stock prices using changes in interest rates, which may help with economic forecasting, planning, and growth. The main finding of this research is that interest rate effects must be taken into consideration while analysing the dynamics of Nigeria's stock market behaviour. In order to encourage the expansion of the Indian stock market, we advise the implementation of suitable macroeconomic policies that are supportive of the stock market index (a proxy for stock prices).
Keywords: *Stock Market Index, Interest rate, Granger Causality Test*
JEL Code Classification*: G0, E43, C58*

Introduction
India is a country that is developing at a faster pace as compared to other developing countries. The reasons associated with this are many such as development in the real estate market, growth in the number of MNC's, Foreign investments, better utilization of resources, development of stock exchanges, capital market reforms, reforms in the banking sector, development of MSME's, improved political interferences, etc. All the reasons likely helped in some or the other way in the development of the economy as a whole. The idea behind the entire development process is to improve the quality of life and well-being of the individuals, generation of employment opportunities, better standard of living, growth in GDP(Gross Domestic Product), improved balance of payments, increase in per capita income and many more. All the variables leading to economic developments are interconnected and interlinked with each other, the effect on one variable may impact the other variables too in some or the other way. The interest rate is the amount charged on principal by the lender in return for the use of its money. One among the most prominent factor that affects stock prices is the earning that is expected by investing in stock and this is directly influenced by the interest rate. Every company for its ongoing business activities is dependent on some kind of borrowing in its balance sheet. One of the sources of the company's finances is commercial banks. If the repo rate moves upward, the bank will likely raise its interest rate. This will increase the borrowing rate for companies. This rising rate cause's reduction in Net profits which is directly reflected

in its stock prices and returns associated. Likewise, when this interest rate is linked with equities they have a unidirectional relationship. When the interest rate goes up the return on equities increases and when interest rate falls the returns on equity investment declines. Thus the relation between stock market operations and interest rate are interconnected and influence each other activities. Thus this research paper studies the influence of interest rate on the Indian stock market.

Review of Literature

Asai and Shiba (1995) studied has connection between their financial exchange other than large scale monetary factors into Japan. For study vector auto regressions (VAR) model was used. The data was time series in nature and the variables used as macro-economic variables were inflation rate, interest rate, industrial production index, and the stock market. The results explained that there exists a positive relationship between "macro-economic variables and stock market returns. Thus macro-economic factors boost the stock market of Japan. While the effect of the stock market on economic growth was found to be inconclusive". Levine and Zervos (1996) worked taking place into connection among standard market expansion besides economic progress. The selected macro-economic variables are "the consumer price index, the money supply, and the Treasury bill rate". The results disclosed in solid positive relationship between's the securities exchange improvement, then since quite a while ago run financial exchange record, besides chose monetary factors. The Vector Error Correction Model was utilized aimed at examination. That is likely to be into its examination taking place financial exchange was essentially affected through macroeconomic factors. The connection between the financial exchange behavior of five Asian nations i.e. Malaysia, Philippines, Thailand, Singapore, and Indonesia, and macro-economic indicators were studied by Wongbampo and Sharma (2002). The selected macro-economic indicators "were GNP, inflation, money supply, interest rates, and exchange rates". The result of the analysis finds that all five-nation stock market prices are positively influenced by growth in the output and negative towards the total price level while it is seen in Malaysia and Indonesia stock prices and interest rates are positively related which is not so in Singapore, Thailand, and in the Philippines. Maghayereh (2003) analyzed the relationship between selected macro-economic variables and Jordanian stock market prices. The selected macro-economic factors were loan fee, trades, unfamiliar stores, swelling, in addition modern creation. Monthly data was used "for the period from January 1987 to December 2000.For study multivariate cointegration analysis and vector error correction model (VECM) were used". The results associated described that all the selected macro-economic variables were reflected by the Jordanian stock market and also influence the stock prices and returns. Ray and Vani (2003) also study stock market movement and macro-economic variables. The selected macro-economic variables were factors were financing cost, sends out, unfamiliar stores, swelling, and mechanical creation, foreign investment, and fiscal deficit. The methodology used was artificial neural network (ANN) and Vector autoregressive (VAR) model. The monthly data collected was from April 1994 to March 2003. As per the results cash gracefully, modern creation, conversion scale, loan cost, besides swelling rate influence the stock market prices and significantly influence the stock market. But foreign investment and fiscal deficit are not explaining a relationship and are not significant towards stock market movements. "Ray and Vani (2003) examined the association between the stock

market returns and real economic variables". Their study used the VAR model and was conducted on that Indian financial exchange. The macroeconomic factors were loan cost, mechanical creation, cash gracefully, expansion rate, and conversion standard. The outcomes found that financing cost, mechanical creation, cash gracefully, expansion rate, and swapping scale significantly affect Indian securities exchange returns. Likely, Short-run and since quite a while ago run connections between financing cost, expansion rate, swapping scale, and the modern efficiency of the Kualalumpur Stock Exchange (KLSE) Composite Index were inspected by Islam (2003). The outcomes discovered both short just as since a long time ago run connection between all the chose macroeconomic markers (loan cost, expansion rate, conversion scale, and the mechanical efficiency) and the stock returns. "Mayasmi et al., (2004) broke down the connection between full scale monetary factors with Singapore's composite stock list, SES All-S Equities Hotel Index, and SES All-S Equities Finance Index, just as SES All-S Equities Property Index. He applied Johansen's cointegration VECM. The month to month information considered for the investigation was from January 1989 to December 2001.The chose full scale financial factors were loan fee, expansion, conversion scale, mechanical creation, and cash flexibly. The outcomes demonstrated that the Singapore securities exchange and the SES All-S Equities Property Index are related with chosen macroeconomic factors. Then again, the SES All-S Equities Hotel Index and the SES All-S Equities Finance Index demonstrated a cozy relationship with hardly any macroeconomic factors. Esen et al., (2005) contemplated the impacts of macroeconomic factors elements. The examination was identified with the Turkish securities exchange. The GARCH model was utilized with macroeconomics factors specifically unfamiliar conversion scale, modern creation, cash flexibly, mechanical creation, and loan cost". The data was weekly between 1991 to 2000.The results were that the financial slowdown in 1994 and subsequent recovery helped the structural changes in the dynamics. Gan et al., (2006) studied the New Zealand stock market and macro-economic factors using cointegration and Granger causality test for the data set from January 1990 to January 2003. The results said that the stock market index was not a significant indicator of macro-economic growth. Ologunde et al., (2006) examined the Nigerian market; he studied the relationship interest rate and stock market capitalization rate. Their findings said that the prevailing interest rate is influenced positively by the stock market capitalization rate. Thus interest rate and stock market return are closely associated with each other. Similarly, Abugri (2006) analyzed macroeconomic indicators and stock market returns in Latin American countries. The chosen macroeconomic pointers were trade rates, loan fees, modern creation, in addition cash flexibly. The results drawn showed that macro-economic factors are impacting significantly towards prices of stocks of selected Latin American countries. Chuang et al., (2007) examined the impact of macro-economic fundamentals on "stock prices in Taiwan, Hong Kong, Singapore, and South Korea". The selected macro-economic variables were money supply and budget deficit. The study revealed the long-run relation between selected variables and stock prices of four countries. Padhan (2007) researched towards examine their association amid its Indian standard marketplace besides real economic activities. The Cointegration and causality model was used from 1991 to 2005.The study results were that there exists a long-run relationship among the two and that causality exists between real economic activities and the Indian stock market. Ahmed (2008) explored the causal relationship between selected key macro-economic variables and Indian stock market prices.

For the Indian stock market, both Nifty and Sensex were taken as a proxy to the dependent variable. The selected key macro-economic variables were Index for Industrial production, Foreign direct investments, exports, money supply, exchange rate, interest rate. Granger causality, BVAR modeling, and impulse response function were applied to find empirical results. The study showed that from among all the selected macro-economic variables only interest rate was influencing stock market prices in India. "Kyereboah-Coleman & Agyire-Tettey (2008) studies the relationship between macro-economic variables and the stock market in Ghana". Their data collected was quarterly for the period 2005 to 2020.All the share indexes represented stock market performance while selected macro-economic variables were inflation, Treasury bill rate, real exchange rate, and interest rate. The results showed a positive relationship between the exchange rate and stock market performance while the lending rate and inflation have a negative relation with that of the stock market. Rashid (2008) conducted a study to understand the dynamics of the stock market in Pakistan and macro-economic variables. The methodology used was Granger causality tests and cointegration tests. The selected macro-economic variables were consumer price, exchange rate, industrial production, and the market rate of interest. The results showed a bi-directional and long term causal relationship among exchange rate, industrial production, and the market rate of interest. But consumer prices and stock market performance was found to be unidirectional. Adam and Tweneboah (2008) studied their effect of macroeconomic factors on the Ghanaian securities exchange. The chose large scale monetary factors were loan cost, swelling, foreign direct investment, and the exchange rate. Databank Stock Index was taken as a proxy to the Ghanaian stock market index. A cointegration test was used. The results concluded that the Ghana stock market was significantly influenced by macroeconomic factors i.e. the interest rate, inflation, foreign direct investment, and the exchange rate while the results of the cointegration test showed that interest rate had a negative but significant relation to stock price returns, while foreign direct investment had a positive and significant relationship. Unlikely to above, Inflation and exchange rates have a negative but insignificant relationship to stock market returns in Ghana. Rahman et al., (2009) explained the relationship between stock prices in Malaysia and macroeconomic variables. The monthly data was collected from January 1998 to March 2008.The model used was VAR. The macroeconomic variables used for the study were "interest rate, money supply, reserves, industrial production index, and exchange rate". These answers remained in there is a cointegrating relation between these variables and the stock market. It was seen that the mechanical creation list, financing costs, besides saves were emphatically related while cash gracefully and exchange rate are negatively related. Chinzara (2010) studied macro-economic variables and stock market volatility with the use of Vector autoregression and the GARCH framework for the Nigerian stock market. The results showed Exchange rate and short term interest rate play a crucial role in influencing volatility in the stock market while inflation, gold, and oil prices are insignificant in affecting volatility in the Nigerian standard sooq. "Xiufang Wang (2010) analyzed the time-series relationship between macro-economic variables volatility and stock market volatility in China. The lag-augmented VAR (LA-VAR) models and exponential generalized autoregressive conditional heteroskedasticity (EGARCH) were used". It was seen that bilateral relations exist between inflation and china stock market while interest rate unidirectional relationship was found with china stock market. But real GDP's relation with stock prices was seen insignificant.

Adaramola (2011) examined the effect of macro-economic factors on Nigerian stock prices. Ordinary least square technique was used for the quarterly data from 1985 to 2009.the selected macro-economic indicators were interest rate, exchange rate, broad money, inflation, oil prices, and gross domestic product. The results disclosed the fact that among all the selected macro-economic variables only inflation and money supply do not have a significant impact on the Nigerian stock market. Oseni et al., (2011) examined the volatility of their "stock market and macro-economic variables in Nigeria by using EGARCH (exponential generalized autoregressive conditional heteroskedasticity) model and lag – augmented VAR (LA - VAR) models". The data for the study was from 1986 to 2010. The macroeconomic factors were the genuine GDP, shopper value list, the expansion rate, transient loan fee. As per the findings, the bi – causal relationship was found between stock market volatility and real gross domestic product. On the other hand, a causal relationship was found between the volatility of the stock market and the volatility of interest rate and exchange rate. Srinivasan (2011) researched to find out the long term relationship between share price and macro-economic variables in India. For share price NSE-Nifty share price Index was taken and the selected macro-economic factors were record of mechanical creation, shopper value file, financing cost, cash flexibly, conversion standard, besides US stock value file. Both long-run and short-run relationships among share price and macro-economic variables were studied. Johansen and Juselius (1990) multivariate cointegration technique was applied to determine the long-run relationships and "VECM (Vector Error Correction Model) was used to analyze the short-run causality between" their share price and macroeconomic variables. The findings were that positively significant long term relation was found between cash gracefully, loan cost, file of modern creation, in addition the US financial exchange file however a huge negative relationship was found between share cost besides conversion scale into India. It was also seen strong unidirectional causal between interest rate and stock market return and the US "stock market return to NSE stock market return". The short-run causality relationship was found in the cash flexibly and loan fee, expansion, and cash gracefully, and the US securities exchange and conversion scale. Khan et al., (2011) used a vector autoregressive (VAR) model to study stock returns and macro-economic variables. The information for the investigation was from June 2004 to December 2009.The macroeconomic factors for the examination were cash gracefully, conversion scale, swelling, Treasury charge rate, and loan fee. All these are independent variables and the dependent variable was stock market returns. The analyses revealed that only the money supply has a significant impact on stock returns from among all the selected variables. Khan et al., (2012) also conducted his study on the macroeconomic variable and its effect on Pakistan stock exchange for the period 2001 to 2010.The variables selected for the study were the exchange rate, inflation, and interest rate. The methodology used for analysis was multilinear regression, results of their study uncovered their the swapping scale significantly affects financial exchange returns while the other two variables i.e. interest rate and inflation have an insignificant impact on the returns of their standard sooq. "Osisanwa and Atanda (2012) investigated the determinants of the stock market in Nigeria. He employed the OLS" technique by using annual data from 1984 to 2010.The macroeconomic variables for the study were shopper value list, conversion scale, expansive cash, loan fee, in addition genuine per capita pay. The results were that the conversion scale, financing cost, cash gracefully, besides past stock return levels are the essential determinants of stock returns in Nigeria. Hussain et al.,

(2012) studied the impact of macro-economic variables on stock prices. "Augmented dickey-fuller (ADF) and Kwiatkowski-Phillips-shin (KPSS) unit root test, Johanson co-integration test, vector correction model (VECM), and Granger causality test" was employed to draw results for the analyses. The period of study was from January 2001 to December 2010.The selected macro-economic variables were swapping scale, unfamiliar trade save, mechanical creation record, loan fee, import, cash gracefully, discount value file, besides fare. As per the results Foreign exchange rate, interest rate, money supply, and wholesale price index showed a positive and significant relation between stock prices. But imports and export showed a negative relation. As per the results of Granger causality, wholesale price index and money supply have bi-directional relation and foreign exchange rate, export rate, and money supply have unidirectional relation with stock prices. But interest rate, industrial production rate, and import do not have any causal relation with stock prices. "Osamwonyi et al., (2012) investigated the relationship of macro-economic variables and stock market index in Nigeria". Their vector error connection model was applied for the period from 1975 to 2005.The selected macro-economic factors for the were loan costs, swelling rates, trade rates, monetary stores, GDP, besides cash gracefully. The results of the study revealed the fact that the selected macro-economic factors affect the stock market returns in Nigeria. Shah et al., (2012) analyzed the long and short-run relationship between macro-economic variables and the Karachi stock market. The selected macro-economic variables were inflation, exchange rate, and interest rate. The data was collected from January 2003 to April 2009.The results found that long, as well as short-run relation, exists between selected macro-economic variables and standard marketplace revenues. "Zakaria et al., (2012) studied the relationship between macro-economic variable volatilities and stock market volatility in Malaysia". Their selected macro-economic variables were inflation, gross domestic product, money supply, exchange rate, interest rate. The monthly data collected was from January 2000 to June 2012.The methodology used was GARCH (generalized autoregressive conditional heteroskedasticity) and VAR (vector autoregressive) model. The results showed very little support towards the macroeconomic factors volatility and stock market volatility. Regression analysis was also conducted and the results were there solitary currency source unpredictability has meaningfully connected towards standard marketplace unpredictability from among all the selected macro-economic variables. Attari and Safdar (2013) considered the connection between financial elements in addition the securities exchange. Exponential Summed up Autoregressive Restrictive Heteroskedasticity (EGARCH) model was utilized. The macroeconomic pointers were the total national output, swelling, in addition loan fee besides the information gathered was since December 1991 towards August 2012, the results revealed that all the selected macroeconomic indicators have a significant effect on the stock market prices and the stock market is one prominent indicator of the growth of the economy. Naik (2013) examined the macroeconomic variables and stock market returns behavior in India. The chosen macro-economic variables were the industrial production index, inflation, money supply, exchange rate, and short-term interest rates. The period of study was from 1994 to 2011 and the data were collected quarterly. The methodology used was the Vector error correction model and Johansen cointegration to study long term relation between selected macro-economic indicators and the stock market. The results discovered a long-run association between macro-economic variables and the stock market. It was found that positive long-run relation existed between money supply and

industrial production index and negative relation between stock return and inflation. “But interest rate and exchange rate results found to be insignificant. Abdullah et al., (2014)” investigated the causality between macro-economic variables and the stock market index in Malaysia. He adopted time series techniques and Wavelet analysis. The variables were the Kuala-Lumpur Composite Index “consumer price index, exchange rate, short-term interest rate, export, and government bond yield. Data was collected for the period from January 1996 to September 2013”.The results were that among all the variables short term interest is having maximum casual relation with the Malaysian stock market and it was also seen that government bonds, short-term interest rates, and KLC are exogenous variables. Hunjra et al., (2014) used cointegration and Granger Causality to find the effect of macro-economic indicators on Pakistan's stock price. Macro-economic indicators that are selected are the conversion scale, expansion rate, Total national output, and financing cost. Month to month information from first January 2001 to 31st December 2011 was collected. “The result of the analysis was that in the short run there is no relation between the Pakistan stock market. But in the long run, it is found a strong relationship between stock” market returns in Pakistan and chosen macro-economic variables. Khan (2014) studied the impact of macro-economic factors on KSE-100i.e. Pakistan stock return. “The macroeconomic factors were the gross domestic product, exchange rate, interest rate, and inflation. The tests applied were Multiple Regression and Pearson’s correlations. The analysis showed that total national output, swapping scale, besides swelling were emphatically identified with the stock costs while interest rates negatively impact on stock prices. Sikalao-lekobane et al., (2014) examined macroeconomic fundamentals' impact on the domestic stock market in an emerging market. Quarterly data gathered was from 1998 to 2012. The selected macroeconomic variables were 10 years US government bond yield, long and short term interest rates, gross domestic product, money supply, diamond price index, inflation, exchange rate, and foreign reserves, and the US share price index”. A vector error correction was employed. The results said their the stock cost and macroeconomic factors are cointegrated and since quite a while ago run balance connections existed between them. Ibrahim and Musah (2014) examined large scale financial factors' effect on the securities exchange in Ghana. “The chose full scale financial factors were conversion scale, swelling, wide cash flexibly, record of mechanical creation, and loan cost. The vector blunder remedy model and the Johansen multivariate co coordination approach were applied”. The monthly data was collected for the period “from September 2000 to September 2010.The results found that a long-run relationship exists between stock market returns and macro-economic fundamentals selected. The results also revealed that inflation and money supply have significant positive relation while interest rate, exchange rate, and industrial production” have a negative relation with Stock returns in Ghana. Ilahi et al., (2015) researched the interconnection between macroeconomic factors on financial exchange returns in Pakistan. The macroeconomic factors were expansion rate, swapping scale, besides loan cost. The Pakistan Karachi stock trade 100 File was chosen as illustrative of the securities exchange returns. Data were collected from January 2007 to December 2012. The methodology applied for data analysis was Multiple Linear Regression. “The results of the study showed that there is a weak connection between selected macroeconomic variables and stock market returns in Pakistan”.

3. Data and Methodology

3.1 Objective and hypothesis

The objective of the research conducted is to study the relationship between the interest rate (10-year T-bill rate) and its impact on Indian stock market indices including nifty 50 and midcap. The null hypothesis of the research study is that there no significant relationship between the interest rate (10-year T-bill rate) and the Indian stock market.

3.2. Data Description and Sources

The study makes use of monthly time series data to analyze the long-term behavior of interest rate movements and stock indices of India. The interest rate of 10-year T-bills is considered in the study. The fluctuations in the interest rates have a significant impact on the economy especially on the demand for loans, consumer products, real estate, etc. The monthly data of interest rate of 10-year T-bills and the stock indices are collected from Bloomberg software for the period 2007 to 2020.

3.3. Estimation Technique

In attempting to establish the relationship between Interest rates and stock market index in Indian Stock Market, the study employed descriptive statistics and econometric techniques such as; VAR (Vector auto regression) model and Grangers causality test., this enables us to understand and establish a directional relationship i.e. unidirectional or bidirectional relationship exist between the Interest rate and stock market index or not.

4.0 Data Analysis and Interpretation

4.1 Descriptive statistics

In the descriptive analysis the average price, maximum and minimum price, standard deviation, skewness, kurtosis, and the density population are observed. The results of the descriptive analysis are shown below in the table:

Table 1: Descriptive analysis: 10-year T Bills interest rates

Descriptives	10-year T Bills interest rates
Mean	7.719120
Median	7.786000
Maximum	9.319000
Minimum	5.262000
Std. Dev.	0.673173
Skewness	-0.522088
Kurtosis	3.478278
Jarque-Bera	9.178421
Probability	0.010161
Sum	1289.093
Observations	167

The results of the descriptive analysis indicate that the average 10 years T-bill rate during the selected period is 7.72 %. The minimum rate was found to be 5.26 % and the maximum it went to 9.32 %. During the selected period from 2005 to 2018, the 10-year T Bills rate moved in the narrow range of 7.71 and 9.31 %. The skewness of the distribution is found to be very low but negative and kurtosis is highly leptokurtic. The Jarque-Bera test is applied to check the normal

distribution of 10-year T-bill rates. The probability value of Jarque Bera statistics for the 10-year T Bill series is found to be less than the 5% level of significance. Thus the time series of 10-year T bills rate is not normally distributed.

4.2 Unit Root Test

The paper employed the Augmented Dickey-Fuller (ADF) unit root test to determine whether the series is stationary or not. The results before transformation showed that the p-value of the ADF statistic is found to be greater than 0.05(significance level 5%). Hence it can be concluded that the ten-year T-bill rate series is a random walk and contains the unit root. Since the series is found to be non-stationary it was transformed into a stationary series. The results of the transformed series are shown below:

Table 2: Unit root test

Null Hypothesis: 10 Year T-Bills Interest growth rate has a unit root			
Exogenous: Constant			
Lag Length: 3 (Automatic - based on SIC, maxlag=13)			
		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-8.161	0.000
Test critical values:	1% level	-3.471719	
	5% level	-2.879610	
	10% level	-2.576484	
*MacKinnon (1996) one-sided p-values.			

The results of Table 2 of the ADF unit root test on the log differenced transformed series of interest rates indicate that the probability value of ADF statistic is found less than 0.05. Hence it can be concluded that the log difference transformation applied to the Interest rate makes the series stationary. Here the transformed series which is also known as return on the interest rate can be further used in econometric analysis.

4.3 Correlation between interest rate fluctuations and Indian stock indices

The correlation between the interest rate fluctuations and Indian stock indices (Nifty 50 returns and Nifty Midcap 100 returns) is estimated in the study. The null hypothesis assumes that there exists no significant correlation between the interest rate fluctuations and Nifty 50 returns and Nifty Midcap 100 returns. The Pearson correlation is estimated in the study. The result of the correlation analysis is shown below:

Table 3: Covariance and correlation analysis

Covariance	Nifty Midcap 100 return	Nifty 50 return	10 – year T Bills interest rates
Nifty Midcap 100 return	1.000000		
Nifty 50 return	0.853368	1.000000	
10 – year T Bills interest rates	-0.095865	-0.095771	1.000000

4.4 Causality analysis: the selection of the optimum lag

Table 4 indicates the results of the VAR Lag Order Selection Criteria to select the optimum lag for the analysis.

Table 4: VAR Lag Order Selection Criteria

VAR Lag Order Selection Criteria Endogenous variables: RET_NIFTY RET_NIFTYMIDCAP RET_TENYEAR						
Lag	**LogL**	**LR**	**FPE**	**AIC**	**SC**	**HQ**
0	728.5024	NA	1.18e-08	-9.738288	-9.677805*	-9.713715
1	744.1066	30.37050	1.08e-08	-9.826934	-9.585005	-9.728642
2	758.2011	26.86482	1.01e-08	-9.895317	-9.471942	-9.723307
3	775.6911	32.63235	9.03e-09	-10.00928	-9.404456	-9.763548*
4	788.2340	22.89699	8.62e-09	-10.05683	-9.270564	-9.737384
5	794.3541	10.92578	8.97e-09	-10.01818	-9.050461	-9.625009
6	813.3674	33.17764*	7.86e-09*	-10.15258	-9.003422	-9.685698
7	822.5350	15.62806	7.86e-09	-10.15483*	-8.824226	-9.614229
8	827.8514	8.848748	8.28e-09	-10.10539	-8.593335	-9.491066
* indicates lag order selected by the criterion LR: sequential modified LR test statistic (each test at 5% level) FPE: Final prediction error AIC: Akaike information criterion SC: Schwarz information criterion HQ: Hannan-Quinn information criterion						

The optimum lag decided in the study is three as suggested by HQ criteria in the study. Hence in the research study, the multivariate causality is analyzed considering lag 3 for further analysis. In the VAR methodology, the pairwise Granger's causality test provides the causal relationship between the two variables at a time, whereas the VAR model can consider many variables at a time. If one variable "Granger causes" other variables the coefficients of the lagged values of the former must be significant in VAR.

4.5 Causality relationship between the ten-year treasury interest rates and the Indian stock market indices

The lead-lag relationship between the log difference transformed ten-year treasury interest rates series and Nifty 50 returns and Nifty Midcap 100 returns are analyzed using Grangers causality test. The granger's causality test assumes the null hypothesis that there exists no significant lead-lag relationship between the ten-year treasury interest rates series and Nifty 50 returns and Nifty Midcap 100 returns. The result of the Grangers causality test is shown below:

Table 5: Pairwise Granger Causality Tests

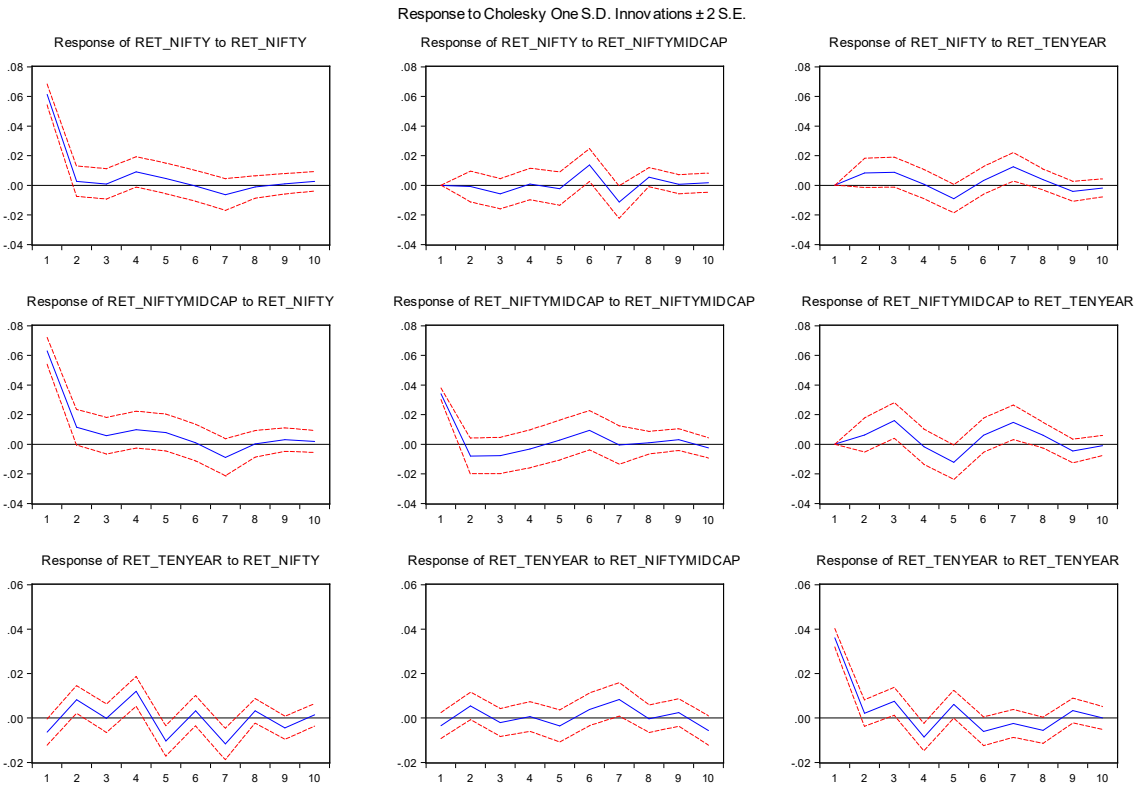
Null Hypothesis:	**Obs**	**F-Statistic**	**Prob.**
NIFTY Midcap return does not Granger Cause NIFTY return	161	1.71646	0.1209
The NIFTY return does not Granger Cause NIFTY Midcap return		1.16985	0.3255
The interest rate does not Granger Cause NIFTY return	***153***	***2.62283***	***0.0193***

The NIFTY return does not Granger Cause Interest rate		***4.69644***	***0.0002***
The interest rate does not Granger Cause NIFTY Midcap return	***153***	***3.06902***	***0.0075***
The NIFTY Midcap return does not Granger Cause Interest rate		***4.04426***	***0.0009***

The results indicate that the p-value of F statistics is found to be less than the 5% level of significance between the ten-year treasury interest rates series and both of the Indian stock indices. Hence with a nifty five percent confidence level, the null hypothesis of no significant causal relationship between the ten-year treasury interest rates series and Indian stock indices cannot be rejected. Therefore, it can be concluded that there exists a significant lead-lag relationship between ten-year treasury interest rates series and both of the Indian stock indices namely Nifty 50 returns and Nifty Midcap 100 returns. There seems to exist bidirectional causality between the interest rates and the stock market. This can be concluded that movements of interest rates in India have a significant impact on stock market movements.

4.6 Impulse response analyses

The impulse response analyses the responsiveness of the endogenous variable in the VAR to shocks to each of the exogenous variables. Thus, for each endogenous variable in the system, a unit shock is applied to the error, and the effects upon the VAR system over time are noted. In the study, the interest rate, nifty 50, and nifty midcap series are considered as endogenous variables. The impulse response graphs of the causality analysis are shown below:



The above figure indicates the significant impact of interest rates on the stock market indices are observed. Bidirectional causality between the interest rate and nifty stock indices is observed in the study.

Discussion and Conclusion

The macroeconomic factor plays a very significant role in the stock market movement. It was found that the relationship between the interest rate (10-year T-bill rate) and its impact on Indian stock market indices including nifty 50 and midcap for descriptive analysis indicated that the fluctuations in the interest rates have a significant impact on the economy especially on the demand of loans, consumer products, real estate, etc. The results between the interest rate (10-year T-bill rate) and its impact on Indian stock market indices including nifty 50 and midcap in case of descriptive statistics explained that long term behavior of interest rate significantly influences Nifty 50 and Nifty 100 midcap index. The Pearson Correlation between interest rate fluctuations and Indian stock concluded found that negative correlation exists between the crude oil with both the indicators of the Indian stock market i.e. Nifty 50 and Nifty 100 midcap index. The correlation between the interest rate fluctuations and Indian stock indices (Nifty 50 returns and Nifty Midcap 100 returns) found to have a negative correlation. It can be concluded that there exists a significant lead-lag relationship between ten-year treasury interest rates series and both of the Indian stock indices namely Nifty 50 returns and Nifty Midcap 100 returns. There seems to exist bidirectional causality between the interest rates and the stock market. So it can be concluded that movements of interest rates in India have a significant impact on stock market movements. The impulse response test found a significant impact of interest rates on the stock market indices. Bidirectional causality between the interest rate and nifty stock indices was observed in the study.

It can be concluded that the selected macro-economic variable namely interest rate impacts the Indian stock market indices Nifty 50 and Nifty midcap. We, therefore, recommend the adoption of appropriate macroeconomic policies related to the interest rate that is favorable to the stock market index (a proxy for stock prices), and this in turn will stimulate the growth of the stock market in India. Thus, the Indian stock market and macroeconomic variables are closely related to each other, and thus economists, financial analysts, and traders while making decisions related to the Indian stock market must appropriately examine macro-economic variables and its influence on the Indian stock market.

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