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Long Run Cointegration Relationship between Nifty Returns Distribution to Changes in the Level and Volatility of Interest Rate

Richa Sinha, PhD Scholar , ACCF, Amity University, UP
Dr Seshanwita Das, Associate Professor, Amity University
Dr Tapas Das, Associate Professor, Christ University

Abstract:

At this economic crisis, Government is taking steps to revive the economy which was held back due to pandemic in 2020. This research paper intends to give inputs to the Government for taking major decision in terms of changes in interest rate. The paper examines the impact of interest rate on Nifty returns on long run. Various theories and models were examined to explain the long run and short run relationships and forecasting of above stated variables. The period of study isfrom January 2008 - January 2021.The interest rate taken is G-sec10-year yield and Nifty return from RBI and NSE website. Before conducting the empirical analysis, data was made as continuous time series, normality test conducted and unit root test was applied to test the stability of the data. Lagged length was determined by VAR model and long run relationship was tested by the Johansen - JuseliusCointegration test. It is observed that there is no relationship between the G-sec yield and Nifty in long run. This inference from the research can be used by economists, Government, Portfolio managers and others to take some vital decisions.

Keywords: Interest rate, Nifty, Unit root test, Johansen - JuseliusCointegration test

1. Introduction:

India is the fastest growing Asian economy after China and world's 5th largest in terms of GDP.Indian economy depends on country's macroeconomics factors, private consumption, global trade policies, monetary transmission i.e lending rate, tax regime etc. Year 2020 will be considered as poor economic year wherein the economic growth lagged behind. There are various measures been taken by the Government i.e Ministry of Finance to get back India into leading economy. India's GDP to be at 7.7% in FY 2020-21 (source: national Statistical Office). The all-possible ways to revive and grow the economy is been taken care of. The MoF needs more industry and academic research on various aspects of economic growth to frame policies and devise plans for revival. The role of a researcher becomes prominent here to provide MoF with all relevant data, analysis, implications, causal relationships which can help in growing economy. Presently widespread vaccine deployment and effective government measures can help in keeping ahead of the estimated GDP in current year.

Theories speaks stock market as barometer/indicator of country's economic growth. If the stock market is growing means more money to be poured in the listed companies, companies getting money for their operation, innovations and diversification in turn increases production which ultimately lead to consumption. There were many researches done to establish relationship between stock market and economic growth. Palamalai and Prakasam (2014) studied the data from 1991 to 2013 and by using cointegration and causality tests concluded that stock market development indicators have a positive influence on the economic growth in India. Inversely, Singh (1997) based his research work on the period from 1980 and 1990 and concluded that there is no long run impact of stock market on the economic growth of developing countries. *In recent time it has been observed that the Indian economy is not growing but the stock market is booming and touching new higher benchmarks. Is stock market really an indicator of economic growth? India need research on latest data on factors which impact economic growth of country.*

One of the macroeconomic factors which influences a country's economic growth is interest rates (lending rate, monetary policy, external commercial borrowing rate). RBI cuts rates resulting in more cash with banks and decreased lending rates. This benefit is been transmitted to the industry and households, who get loans at a cheaper rate. Cheaper loans increased investment from the private sector, as well as more demand for goods and services by households. Excess money also encourages savings and investments. On the other hand, if RBI increase rates, results in less money in hands of banks, companies and household declining the consumption rate. This way the economic cycle of production, consumption and investment perpetuates. Pill (1997) concluded that in an average country, raising real interest rate from .025 % to 5% will increase real annual GDP growth to 2%.

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Most of the research papers agree on one hypothesis i.e Interest rates are negatively correlated with economic growth.Lee and Werner (2018) examined 3 months and 10 year benchmark rates and nominal GDP for a period of 50 years in 4 out of 5 largest economies. They concluded that the interest rates follow GDP growth and are consistently positively correlated with growth. We have both thought on the relationship between interest rate and economic growth.*It has been observed that in April 2020 there was rate cut by RBI to infuse money in the economy but the GDP declined. And after that the interest rate was kept constant and the GDP starts increasing. Is GDP becoming immune to interest rates?*

Stock market and interest rate both has positive or negative relationship with economic growth of the country as per the studies carried out in different time zone and economic situations.Both stock market and interest rates have also positive or negative relationship with each other and it is important to understand the level and extent of their relationship. Their relationship will help to identify and define the parameters affecting economic growth. At present, more researches on latest data needs attention.*MoF has taken various measures to fight with year 2020 economic crisis like cutting repo and reverse rate to discourage Banks to park funds with it and more cash availability in the market. Stimulus packages, OMO operations, softening of Gsec yields were carried out to have credit creation and funds available for production in the country. GDP growth in that time was reported 1.9% (IMF report).RBI decided to remain unchanged on the rate cut in MPC Dec 2020, but the stock market is booming and scaling new heights. Is stock market is becoming immune to the interest rate changes levels?*

RBI needs to suggest on more economic measures to the MoF stating which factors are dynamically impacting economic growth and levels also. They need fresh and updated researches to rely on and backed there upcoming decisions. A few questions which needs closure are as below:
RBI need to understand whether to keep rates unchanged, increase or decrease.
How will it impact in short run as well as long run-on stock market?
Is this economic crisis can overcome by short term measures or they need long term visions?
Will different interest rates have different relationships on stock market?
Is stock market becoming immune to the interest rates?
How much the level in changes of interest rate will impact the stock market now?

This study is trying to answer few above stated problem statements.

Interest rates:
Below are few important interest rates prevalent in India are :

Repo rate – The rate at which central bank of a country (RBI) lends money to commercial bank in the event of any shortfall. Repo rate is also used to control inflation in a country. Monetary policy committee (MPC) is been scheduled every quarter to study the demand and supply of money in the country. Last MPC was held in 1st week od Dec 2020 and it was decided to remain unchanged at 4%. The changes in repo rate results in the expansion and contraction of money supply in the market.

91 days T-Bill yield – Treasury Bills popularly known as T-Bills are money market instruments issued by RBI on behalf of the Government of India as a promissory note with guaranteed repayment at a later date. Funds collected through it is been used to meet short term requirement of the Government. It is of duration 91 days, 184 days and 364 days.The yield of the same is calculated as the difference in the discounted issue price and redeemed on par value. Current yield of 91 days T bill is 3.35%

G-sec yield – G-sec, referred as Government securities are debt instruments issued by the Government to borrow moneyfor long term instruments, which mature anywhere between 5 years and 10 years. These are long dated maturities and pay interest twice in a year. Current yield of 10-year G-sec is 5.96% reported on January 2021.

Stock market –Stock exchange is a financial intermediary which facilitates investments in various companies enabling buying and selling of shares. India has two major stock exchange i.e National Stock Exchange (market cap - $2.27 Trillion, no of companies listed is 1952) and Bombay stock exchange (market cap - $ 2.8 trillion, no of companies listed is 5439). Nifty 50 is the NSE indices representing weighted average of 50 of largest Indian companies listed on NSE.

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2. Literature Review:

It has been a matter of discussion about the important factors which impact the stock market movement. In India RBI led rates are of much concern and affecting various economic growth factors. The long term as well as short term interest rates have different impacts on the stock market returns.

FAMA(1981) has examined the relationship between inflation and stock market and found negative correlation between stock market returns and expected inflation. The long run interest rate has a direct impact on the stock market returns.

A regression analysis was done to study the impact of interest rate and stock prices as stated by Zhou (1996). The study revealed that long run interest rate has a direct impact on the stock prices, long term bond yields and also accounted for forecasts of discount rates.

Mahamudul and Ghazi (2009) investigated the long term interest rate and stock price relationship of 15 different countries and found that changes in interest rate has a direct impact on changes of share price.

Uddin and Alam (2009) has studied the monthly data of interest rate and share price from January 1988 to March 2003 of 15 developed and developing nation. They used time series and panel regression. They concluded all 15 countries have negative relationship between interest rate and share price. Further they have concluded that in 6 countries changes in interest rate has significant negative relationship with changes in share prices.

Faff, Hodgson and Kremmer (2005) had analysed the Australian financial stock market to study the dual impact of interest rate and interest rate volatility on it. They used multivariate GARCH- M model to analyse the impact of deregulation in the financial sector. They concluded that there is a consistent inter temporal tradeoff between risk and return. Additionally it was concluded that financial companies are highly sensitive to new shocks in the financial market. The news of deregulation had highly increased the risk for smaller financial institutions.

Kyereboah-Coleman, A., &Agyire-Tettey, K. F. (2008). The study was on quarterly time series from the period 1991-2005. They used Cointegration and the error correction model techniques to study short run as well as long run impact of interest rate on stock market. They concluded that the lending rates has an adverse effect on stock market performance. Inflation has too negative effect on stock market performances.

Uddin and Alam (2010) has studied monthly data from 1992 to 2004 of Bangladesh stock index i.e Dhaka Stock Exchange (DSE) and interest rate. They first tested the stationarity of market return and found thet it is not efficient in weak form means that it doesn't follow random walk model.They conclude their study stating that interest rate has significant negative relationship with growth of share price. They have used ordinary least - square (OLS) regression.

Ahmad, M. I., Rehman, R., &Raoof, A. (2010). They have studied the relationship between interest rate, stock market and exchange rate in the Pakistan economy for the period of 1998-2009. Short term interest rate, US exchange rate and stock market returns (KSE-100). They applied multiple regression model and concluded that change in interest rate as well as change in exchange rate has a significant impact on the stock return for the given time period.

Senthil Kumar (2013) has investigated the long-term effects of repo rate issued by RBI on the seven public sector banks and 6 private sector banks. He has used the linear regression model to explain the relationship between commercial bank and the repo rate. He concluded that any increase in yhe interest rate adversely affects the bank stock returns.

Addo, A., &Sunzuoye, F. (2013). The paper examined joint impact of both the interest rate and T-bill yield on the Ghana stock market from the period 1995-2011.They used E-view 7 for their Johansen's multivariate cointegration model and vector error correction model to establish the long run relationship. They concluded that T-Bill rate and interest rate both have negative relationship with stock market returns but are not significant. So they have weak predictive power on stock market.

Toraman and Basir (2014) have studied the long run interest rate relationship with the stock market capitalization with the help of the VAR model. They did a cointegration method and found there is a significant relationship between these two important economic growth factors.

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Muthukumaran and Somasundaram (2014) has studied the empirical relationship between interest rate and stock return by using causal relationship effect. The econometric model applied was Granger Causality test and it concluded that there exists short term relationship between interest rate and stock index but has no relationship found for long term.

Chavannavar, Patil, Simoes (2016) studied effect of selected monetary instruments changes on Nifty 50 and other sectoral indices and found a strong linear relationship. It effects in long-run, while in short run there is no such effect.

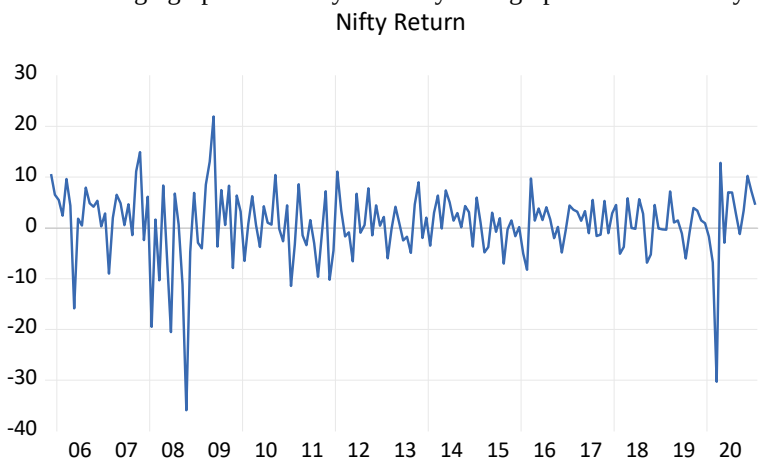
Kumuda, Komala, Sirisha (2016) studied the relationship between interest rate and stock prices in Indian context to forecast future price based on Karl's Pearson coefficient of correlation and linear regression. Their study was based on 11 sectoral indices and rates published by RBI for a 10-year period from 2005 to 2014. It concludes 6 sectors were significantly impacted by interest rate.

Suhag, M. S., & Mehta, Y. (2020). They studied the causal relationship between interest rate and stock market indices in India. The study is spread over the period of 2005-2018. The 10 yeat T-bill i.e G-sec yield has been considered as the interest rate and stock indices as Nifty 50 as well as Nifty midcap 100. They checked the stationary of the data by using Augmented Dickey-Fuller unit root test and found data not be stationary. The data was made stationary at the first difference. The Granger causality test reveals bidirectional relationships. They concluded that predicting the future index value is possible by the changes in the interest rates.

3. Data, Model & Methodology

This research paper is set to study the long run relationship between interest rates prevalent in India and the stock market indices i.e. Nifty 50. Three rates of Indiai.e10 Year T bill (G-sec) yield, 91 Days T-bills yield and Repo rate issued by RBI were considered and taken from RBI website. Nifty 50 index data was taken from the nifty website. Monthly closing price was taken into consideration. The data collected is from Jan 2008 - Jan 2021 in monthwise. Interest rate was taken as independent variable and Nifty monthly closing price is been taken as dependent variable. The paper studies the impact of independent variable on the dependent variable.

Continuous time series were computed and considered. Monthly Nifty returns have been calculated by taking the natural logarithm of the monthly close price relatives i.e. P = ln P(t)/P(t-1), Where P_t is the index price at time t and $P_{(t-1)}$ is the index price at time t-1.
Similarly, all three rates are also first differentiated and then compounded continuously.
Rate Return =$(R_{t-1}-R_t)/R_t$
Nifty return is been checked though graph to identify volatility. The graph shows volatility in few intervals.



Graph 1: Nifty returns volatility
Source:E-views 11

The below hypotheses are framed after the review of literature to meet the objective of the study:
Hypothesis 1: Interest rate and Nifty returns are not normally distributed.
Hypothesis 2: Unit Root exits in both the series (both the series are non – stationary)
Hypothesis 3: Correlation exists between both the independent and dependent variable.
Hypothesis 4: No causality exists between these two variables.

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Below tests and models are used to examine the above stated hypothesis and for drawing inferences between the variables. All the tests are conducted through E-views software version 11.

a. Principal Component Analysis (PCA): Rao, C. R. (1964). PCA is a dimensionality reduction method and used to reduce the dimension of large data set. It transforms large set of data set into smaller ones that still contains most of the information in the large set. The test can be conducted on the software and it gives two plots i.e eigenvalue & %cumulative of data. Eigenvalues >1.0 were considered as significant and subsequently varimax factors (VFs), which are the new groups of variables are generated. The VFs values which are greater than 0.75 (> 0.75) is considered as "strong", the values range from 0.50-0.75 (0.50 ≥ factor loading ≥ 0.75) is considered as "moderate", and the values range from 0.30-0.49 (0.30 ≥ factor loading ≥ 0.49) is considered as "weak" factor loadings.

b. Factor Analysis: This is the technique for reduction of large number of variables into few number of factors. Each factor captures a certain amount of the overall variance in the observed variables and the factors tell how much variation they explain. The eigen value is a measure of how much of the variance of the observed variables a factor explains. Any factor with an eigen value >=1 explains more variance than a single observed variable.

c. Normality test: The Jarque-Bera (JB) test is used to test whether Nifty returns and Interest rates individually follow the normal probability distribution. The JB test of normality is an asymptotic, or large-sample, test. This test computes the skewness and kurtosis measures and uses the following test statistic:
JB = n [S2 /6 + (K-3)2 /24]
Where n = sample size, S = skewness coefficient, and K = kurtosis coefficient.

d. Unit Root test (Stationarity test): The empirical test assumes the time series data to be stationary. The data series is said to be stationary when its its mean and covariance are constant over time. It only to be depended on the lag length not the actual time. The data series has to made stationary for proceeding for cointegration approach. Stationary conditions can be checked by Augmented Dickey-Fuller (ADF) test and Philips – Perron (PP) method.

e. Augmented Dickey- Fuller (ADF) test - The ADF approach controls for higher-order correlation by adding lagged difference terms of the dependent variable to the right-hand side of the regression. The Augmented Dickey-Fuller test specification used here is as follows:

$\Delta Yt = b0 + \beta\ Yt\text{-}1 + \mu 1\ Yt\text{-}1 + \mu 2\ Yt\text{-}2 + \ldots.. + \mu pYt\text{-}p + et$

ΔYt = time series to be tested,

b0 = intercept term,

β = coefficient of interest in the unit root test,

μ = the parameter of the augmented lagged first difference of Yt to represent

P_{th} = order autoregressive process,

et = white noise error term.

f. Philips- Perron (PP) test – It ia type of unit test, used in time series analysis to test the null hypothesis that the time series in integrated of order 1.
P = 1 in $\Delta y_t = (\rho\text{-}1)y_{t\text{-}1} + \mu_t$
Where Δ is the first difference operator.

g. Johansen – Juseliuscointegration test - Johansen, S. (1991) is a process to test cointegration of many time series. The data should be in stationary form. This test allows more than one cointegration relationship. It is better than Engle-Granger test in the applicability. The test is done with trace or eigen value. The first pre condition of the test is to make the data series stationary. The second pre condition is to determine the lag length using Vector Auto Regression (VAR) model. If the variables are cointegrated then Vector error correcting model (VECM) to be constructed.
Var model is as below :
$X_t = \mu + \emptyset Dt + \cap pXt - p + \cdots \ldots \ldots \ldots \ldots \ldots + \cap 1Xt - 1 + \epsilon t$
t = 1, …….T

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4. Empirical results and analysis:

As stated in the methodology the analysis were carried and tried to infer the hypothesis framed.

a. Principal component analysis followed by the factor analysis was carried out to arrive at one interest rate which influences most. All three interest rate were analysed through above stated method to find out maximum contribution by one rate. Study reveals that GOI (10 year Gsec yield has the maximum component)

Table 1: PCA analysis

Rates	Eigen values
T Bills	58.86 %
G-Sec	83.09 %
Repo rate	68.82%

Source : E-views 11

b. PCA is not enough to state one interest rate whose component is maximum. Factor analysis is carried to validate the results of PCA. It has been observed that GOI (10- year G sec yield has maximum loading. So this yield has been taken into consideration for further analysis. Impact of this yield is been measured with the study of Nifty 50 for long run analysis.

Table 2: Factor Analysis

	F1	Communality	Uniqueness
G-Sec	0.820	0.673	0.326
Repo rate	0.957	0.917	0.082
T Bill	0.977	0.954	0.045

Source: E-views 11

c. Normality test:Jarque-Bera Test was conducted with the help of E-views and depicted in the table 3 along with other descriptive statistics of the two series. Skewness value 0 and kurtosis value 3 indicate that the variables are normally distributed. From the table the skewness value of Nifty% and G-sec % is found to be -0.37731 and -0.99687 respectively. Kutosis value is not found to be 3. This clearly indicated that the data is not normally distributed. Now the stationary needs to be analysed and examined.

Table 3: Descriptive Analysis

	Nifty return %	G-Sec %
Mean	0.007698	-0.0008
Median	0.0065	-0.003
Maximum	0.2807	0.1762
Minimum	-0.2641	-0.2571
Std. Dev.	0.064956	0.042215
Skewness	-0.37731	-0.99687
Kurtosis	6.9329	12.94233
Jarque-Bera	104.9097	672.647
Probability	0	0
Sum	1.2086	-0.1262
Sum Sq. Dev.	0.658211	0.278003

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Observations	157	157

Source: E-views 11

d. Unit root test - To determine its level of stationary , the stationarity of each variable were tested by unit root test. It was observed that stationarity of time series is a pre requisite in future estimations.Data with non stationarity may results in a deviation or good not pop up correct result. So the data has to made stationary by applying unit root tests of Augumented Dickey-Fuller (ADF), Philip -person (PP).Both the data was not found stationary as ADF and PP test conducted. These series become stationary only when their first level difference is taken.So they are first order integrated. Differenced data was used in analysis. Table below shows the data:

Table 4: Unit root test

Test	d(G- Sec)	d(NIFTY)
ADF	-13.3047	-11.8113
PP	-13.2769	-11.8113

Source: E-views 11

e. Johansen – Juseliuscointegrationtest -The above test reveals that the two components are stationary at first level, so they are considered as integrated. But in long run, stationarity can not give assurance that they behave similar. Similar behaviour means in one direction. Long run relationships in two stationary series can be determined by cointegration test. Prior to co-integartion test, VAR model was run through to determine the lagged ratio. Lagged ratio is taken as 4 as per AIC and FPE criteria. After checking the lagged ratio, Johansen cointegration test is been conducted. The null hypothesis here is There is no cointegration between the variables chosen. The details of the analysis is shown below:

Table 5 : Trace Test Result:

Hypothesized no of CEs	Eigen Value	Trace statistics	%5 Critic Value	Probability
None	0.065565	10.927	15.49	0.2160
At most 1	0.004070	0.6199	3.84	0.4311

Source: E-views 11

Table 6: Maximum Eigen value result

Hypothesized no of CEs	Eigen Value	Max Eigen statistics	%5 Critic Value	Probability
None	0.065565	10.307	14.26	0.1925
At most 1	0.004070	0.6199	3.841	0.4311

Source: Eviews 11

If the probability value =< 5%, reject Ho. The probability value is not less than 5 %, so we have to accept the null hypothesis i.e. There is no cointegration between variables.

So we can conclude that there is no long run relationship between the variables.

5. Conclusion and summary:

There were many researches done to establish long run relationship between the interest rate and Nifty returns in the past. This paper also tries to investigate the relationship but the period taken contains pandemic situation also. So this study is different from others as it has been done in that period where Government has to revive the economy. The empirical results shows that there is no long run relationship between-sec yield and Nifty returns.

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In other words it can be concluded that there us weak forecasting between these two varaibles. While change the G-sec yield, Governemnt can see no or nil impact on Nifty on long run. This study will help below to take major decisions.

a. Government –
b. Portfolio Manager
c. Companies
d. Fund Managers
e. Investors

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