

Dynamics of Indian Stock Indices with Macroeconomic Variables

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Abstract

The dynamics between the index price and its constituent sectors holds large significance from the sectoral growth to the aggregate economic growth of the country. Many theoretical and empirical exercises have been conducted on the same because of the large significance it holds. It has also been widely used as a key tool for predicting the financial trends by several analysts.

Keywords: Indian capital market, Indian Stock Indices, Industrial Production, Foreign Institutional Investment.

1. Introduction

Indian capital market has undergone tremendous changes since 1991, when the government has adopted liberalization and globalization policies. There has been a growing importance of the stock market from the aggregate economy point of view, ever since then. India is slowly shifting towards becoming a Market Based Economy, the Stock Market being the major driver. It is one of the major sources for raising resources for the corporate world, thereby enabling financial development and economic growth.

The dynamics between the index price and its constituent sectors holds large significance from the sectoral growth to the aggregate economic growth of the country. Many theoretical and empirical exercises have been conducted on the same because of the large significance it holds. It has also been widely used as a key tool for predicting the financial trends by several analysts.

2 Branson et al's (1997), portfolio-balance model suggested the incorporation of assets of portfolio in predicting the "stock-oriented" exchange rate movement. The National Stock Exchange (NIFTY 50) has been considered as a proxy of the Indian Stock Market and used to obtain a measure of market price movement of Indian securities since this index is comprehensive. The study consider macroeconomic variables as Index of Industrial production (IIP), wholesale price index (WPI), , Foreign Institutional Investment (FII), and National Stock Exchanges indices in the form of NSE - Nifty 50, Auto, PSU, Fast Moving Consumer Goods and Information Technology by using monthly data that span from January 2011 to December 2016 . More specifically, in the study we use ADF test, Correlation and Regression analysis to see the effect of macroeconomic variables on National Stock Exchange Indices and vice versa (by using granger causality test). The results would be very useful for the policy makers, traders, investors, and other concerned along with the future researchers.

The expectations of relative currency and the exchange rates largely influence the domestic and foreign interest rates. Any change in the interest rates would lead to a change in the value of the assets of the company. Thus it plays a considerable role in the movement of the stock prices.

In a similar way, the interest rate (or the 10-year government bond yield) directly influences the asset prices and therefore the stock movements.

FII's have a major impact on the volatility of the index. The Institutional Investors usually deal in high volume trades which in turn affects the volatility of the comprising sectors of the trade. This increases volatility in turn largely influences the returns generated by these sectors and which then influences the financial performance of the sector and thus the movement of the stock prices.

The Index of Industrial Production (IIP) is a short term indicator of how the industrial sector in the country is progressing. As India is getting more industrialized, the relative importance of the Index of Industrial Production is increasing. If the IIP is increasing it indicates a vibrant industrial environment (as the production is going up) and hence a positive sign for the economy and markets. A decreasing IIP indicates a sluggish production environment, hence a negative sign for the economy and markets.

The wholesale price index (WPI) is an index that measures and tracks the changes in the price of goods in the stages before the retail level. WPI shows the average price change of goods included in the index and is often expressed as a ratio or percentage, and the change is one indicator of a country's level of inflation. Although many countries and organizations use WPI, many other countries, including the United States, use the producer price index instead.

Result of this study help in exploring whether the movement of National Stock Exchanges indices is the result of some selected macroeconomic variables or it is one of the causes of movement in those variables of the Indian economy.

The rest of the study is organized as follow. Module 1 is a survey of the including empirical results on the nature of causal relationship between macroeconomic variables and stock prices is conducted. Module 2 is presents the data descriptions and variables undertaken for the study. Module 3 presents research methodology to be employed for investigation and analysis purposes. Module 4 reports the empirical results and discussions of descriptive statistics, ADF test, Correlation and Regression analysis and Granger Causality test which are followed by conclusion.

Statement Of Hypothesis

The hypothesis for this study has been stated below:

Null Hypothesis

H₀: There is no significant relation between Index of industrial production and NSE Nifty

H₀: There is no significant relation between USD Exchange rate and NSE Nifty

H₀ : There is no significant relation between 10 year govt bond yield and NSE Nifty

H₀: There is no significant relation between Foreign Institutional Investment and NSE Nifty

H₀: There is no significant relation between Wholesale price index and NSE Nifty

Alternate Hypothesis

H_a : There is significant relation between Index of industrial production and NSE Nifty

H_a: There is significant relation between USD Exchange rate and NSE Nifty

H_a : There is significant relation between 10 year govt bond yield and NSE Nifty

H_a : There is significant relation between Foreign Institutional Investment and NSE Nifty

H_a: There is significant relation between Wholesale price index and NSE Nifty

Null Hypothesis

H0: There is no significant relation between Index of industrial production and NSE FMCG

H0: There is no significant relation between USD Exchange rate and NSE FMCG

H0 : There is no significant relation between 10 year govt bond yield and NSE FMCG

H0: There is no significant relation between Foreign Institutional Investment and NSE FMCG

H0: There is no significant relation between Wholesale price index and NSE FMCG

Alternate Hypothesis

Ha : There is significant relation between Index of industrial production and NSE FMCG

Ha: There is significant relation between USD Exchange rate and NSE FMCG

Ha : There is significant relation between 10 year govt bond yield and NSE FMCG

Ha : There is significant relation between Foreign Institutional Investment and NSE FMCG

Ha: There is significant relation between Wholesale price index and NSE FMCG

Null Hypothesis

H0: There is no significant relation between Index of industrial production and NSE PSU

H0: There is no significant relation between USD Exchange rate and NSE PSU

H0 : There is no significant relation between 10 year govt bond yield and NSE PSU

H0: There is no significant relation between Foreign Institutional Investment and NSE PSU

H0: There is no significant relation between Wholesale price index and NSE PSU

Alternate Hypothesis

Ha : There is significant relation between Index of industrial production and NSE PSU

Ha: There is significant relation between USD Exchange rate and NSE PSU

Ha : There is significant relation between 10 year govt bond yield and NSE PSU

Ha : There is significant relation between Foreign Institutional Investment and NSE PSU

Ha: There is significant relation between Wholesale price index and NSE PSU

Null Hypothesis

H0: There is no significant relation between Index of industrial production and NSE IT

H0: There is no significant relation between USD Exchange rate and NSE IT

H0 : There is no significant relation between 10 year govt bond yield and NSE IT

H0: There is no significant relation between Foreign Institutional Investment and NSE IT

H0: There is no significant relation between Wholesale price index and NSE IT

Alternate Hypothesis

Ha : There is significant relation between Index of industrial production and NSE IT

Ha: There is significant relation between USD Exchange rate and NSE IT

Ha : There is significant relation between 10 year govt bond yield and NSE IT

Ha : There is significant relation between Foreign Institutional Investment and NSE IT

Ha: There is significant relation between Wholesale price index and NSE IT

Null Hypothesis

H0: There is no significant relation between Index of industrial production and NSE Auto

H0: There is no significant relation between USD Exchange rate and NSE Auto

H0 : There is no significant relation between 10 year govt bond yield and NSE Auto

H0: There is no significant relation between Foreign Institutional Investment and NSE Auto

H0: There is no significant relation between Wholesale price index and NSE Auto

Alternate Hypothesis

Ha : There is significant relation between Index of industrial production and NSE Auto

Ha: There is significant relation between USD Exchange rate and NSE Auto

Ha : There is significant relation between 10 year govt bond yield and NSE Auto

Ha : There is significant relation between Foreign Institutional Investment and NSE Auto

Ha: There is significant relation between Wholesale price index and NSE Auto

Note: First differencing of all the variables has been considered for testing the hypothesis.

Limitations of study

There are four limitations that need to be acknowledged and addressed regarding the present study. And these limitations are as follows:

❖ Reliability

This study is based on the analysis of the secondary data that has been collected. Secondary data is the data that is already available and has been used for analysis and thus might not be reliable.

❖ Accuracy

The result & conclusion of this study might not be accurate due to reliability of the secondary data & limitation on the variables selected and the time span considered.

❖ Time period

A time span of only 8 years has been considered for examining the relation between macroeconomic variables and Indian stock market.

❖ Limited variables

This study mainly focuses on selected seven independent variables which may not completely represent the macroeconomic variables.

Variable Selection and data source

This empirical analysis has used particular software like R programming, views and Excel and depends on both availability of data and established statistical criteria that are frequently used in the selection of variables.

To address the objective of this research 5 variables and 4 sectors namely Auto, IT, FMCG, PSU, have been considered. Wholesale price index has been used as a proxy to inflation in Indian economy, USD Foreign exchange reserves as a proxy of domestic interest rate affecting stock market, dollar price to show the effect of external world on Indian stock

market. To test the common perception that Foreign Institutional Investment has been a driver to stock market in India we have included FII as another crucial variable. Even after being a very important variable GDP growth rate was not included in the analysis because of unavailability of monthly data series of GDP growth rate (only quarterly series was available). Index of Industrial Production of all commodities is considered as a proxy to GDP growth rate.

The empirical investigation is carried out using monthly data from January 2011 to December 2016 which covers 72 monthly observations. The data of NSE Nifty 50 (including sector wise data) has been extracted from NSE website. Database of Index of Industrial Production has been extracted from the RBI. **RBI, Ministry of finance, industry.nic.in** has been referred for FII, USD Exchange rate data, WPI and interest rate.

Methodology

With a view to accomplish the pre-determined set of objectives of our research, different set of techniques and tests have been adopted. First and foremost, to fulfill the research objectives, descriptive statistics technique like mean, standard deviation, variance, etc are carried to show the nature and basic characteristics of the variables used in the analysis. ADF test is used to find the stationary or non stationary variables of data series. Inferential statistics technique is used to inference about the results by using different ways of inferential statistics like Correlation matrix analysis which finds any strength of association between National stock exchange indices (share price) and selected macroeconomic variables. Then the second type of inferential statistics is used that is linear regression analysis which create a mathematical model that can be used to predict the values of a stock price of National stock exchange indices based upon the values of a macroeconomic variables. In other words, we use the model to predict the value of Y when we know the value of X. Here, we used the sign-f to analysis the overall significance of the sample regressions and t- test and p-value to check the individual significance of the macroeconomic variables.

Inferential Statistics Technique

Inferential statistics is defined as the branch of statistics that is used to make inferences ,valid judgments about the characteristics of populations based on sample data. These statistics are ways of analyzing data that allow the researcher to make conclusions about whether a hypothesis was supported by the results.

A hypothesis is an educated guess about a trend, group difference or association believed to exist. A null hypothesis states that the results will be due to chance whereas an alternate hypothesis tells that the results are due to the manipulation of the independent variable. Here in our study, null hypothesis (H_0) is there is no relationship between National stock exchange indices and selected macroeconomics variables while alternate hypothesis (H_a) is that there is relationship between National stock exchange indices and selected macroeconomics variables. There are different ways to inference the results. Here, we used correlation matrix analysis and linear regression analysis (t- ratio, f-sign, and p- value, r-square) which allows us to make a conclusion related to our hypothesis. We have used 5% of level of significance and two tailed test so as to accept or reject our null hypothesis according. Regression analyses are typically done using MS Excel, R programming.

Correlation Matrix Analysis

Correlation is a term that refers to the strength of a relationship between two variables. A strong, or high, correlation means that two or more variables have a strong relationship with each other while a weak, or low, correlation means that

the variables are hardly related. Correlation coefficients can range from -1.00 to +1.00. The value of -1.00 represents a perfect negative correlation while a value of +1.00 represents a perfect positive correlation. A value of zero means that there is no relationship between two variables.

Here, the study used Karl Pearson r , type of correlation coefficient, which is also referred to as linear or product-moment correlation. This analysis assumes that the two variables being analyzed are measured on at least interval scales. The coefficient is calculated by taking the covariance of the two variables and dividing it by the product of their standard deviations. It is used to show the strength and the relationship between National stock exchange indices and macroeconomic variables.

Econometric Regression Model

The term regression was introduced by Francis Galton. Linear regression analysis is an inferential statistical technique that is used to learn more about the relationship between a independent variable (referred to as X) and dependent variable (referred to as Y) When there is only one independent variable, the prediction method is called simple regression. So, the regression equation $Y_i = \beta_0 + \beta_1 X_i + u_p$ where Y_i is the dependent variable, X_i is the independent variable, β_0 is the constant (or intercept), β_1 is the slope of the regression line which represent the strength and direction of the relationship between the independent and dependent variables and u_p is random error term. Here, in our study we carried out this method to see and interpret the effect of macroeconomic variables on stock exchange indices (share price).

Statistic test

R-square: also known as the coefficient of determination is commonly used to evaluate the model fit of a regression equation. That is, how good are all of your independent variables at predicting your dependent variable? The value of *R-square* ranges from 0.0 to 1.0 and can be multiplied by 100 to obtain a percentage of variance explained.

Sign-F: whether the model as a whole is significant. It tests whether *R-square* is significantly different from zero.

T-ratios: the reliability of our estimate of the individual beta. For that we can look at *p-values*.

Unit root test (Augmented Dickey –Fuller test): Empirical research in stock markets is based on time series data. And the stationary of a data series is a prerequisite for drawing meaningful inferences in a time series analysis and to enhance the accuracy and reliability of the models constructed. If the variable is not stationary estimation can obtain a very high R^2 , although there is no meaningful relationship between the variables. This situation reflects the problem of spurious regression between totally unrelated variables generated by a non-stationary process. Generally a data series is called a stationary series if its mean and variance are constant over a given period of time and the covariance between the two extreme time periods does not depend on the actual time at which it is computed but it depends only on lag amidst the two extreme time periods. One of the common methods to find whether a time series is stationary or not is the unit root test. There are numerous unit root tests. One of the most popular among them is the Augmented Dickey- Fuller (ADF) test. Augmented Dickey -Fuller (ADF) is an extension of Dickey -Fuller test. Following equation of ADF test checks the stationary of time series data, where Y_t is the variable in period t , T denotes a time trend, Δ is the difference operator, e^t is an error term disturbance with mean zero and variance σ^2 , and k represents the number of lags of the differences in the ADF equation. The ADF is restricted by its number of lags. It decreases the power of the test to reject the null of a unit root, because the increased number of lags necessitates the estimation of additional parameters and a loss of degree of freedom.

The test for a unit root is conducted on the coefficient of y_{t-1} in the regression. If the coefficient is significantly different from zero (less than zero) then the hypothesis that y contains a unit root is rejected. Rejection of the null hypothesis denotes stationary in the series.

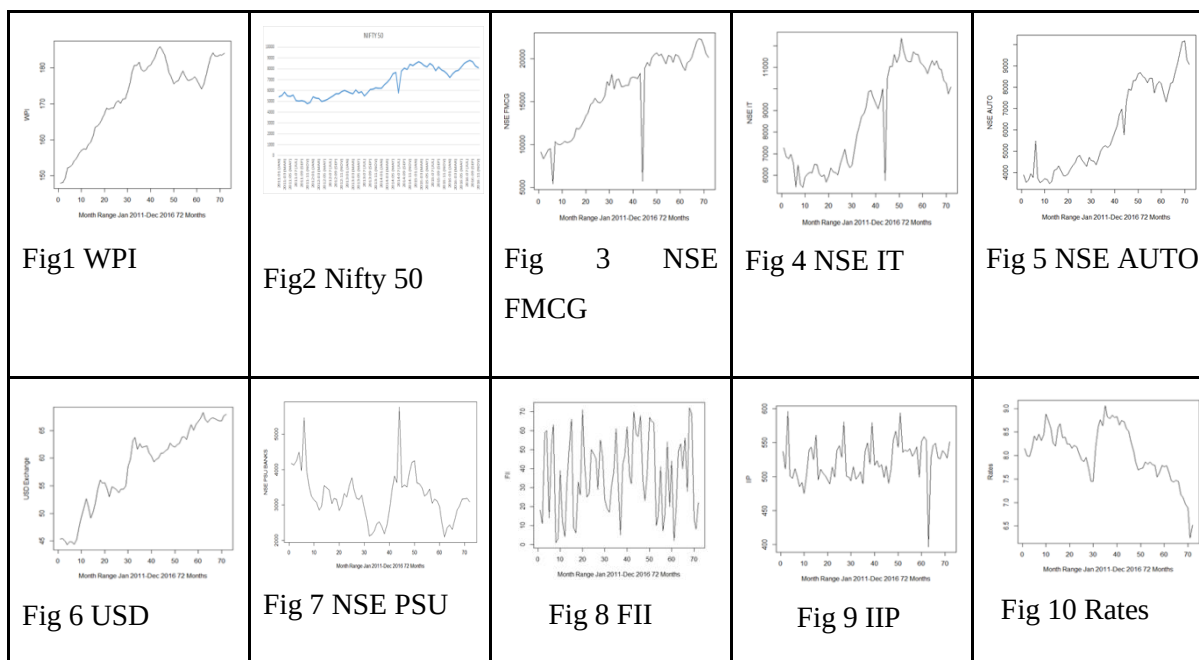
Null and alternative hypothesis are as follows:

$H_0 : \rho=0$ [Variable is not stationary] $H_a : \rho<0$ [Variable is stationary]

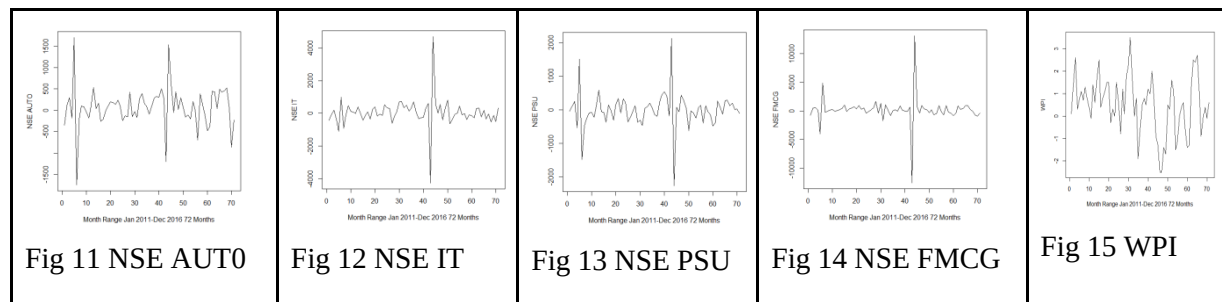
Our study also contains time series data. The time series variables considered in this paper are the stock market indices and seven macroeconomic variables. This necessitates the inclusion of ADF test in the present study. Thus we examine the stationarity for each individual time series.

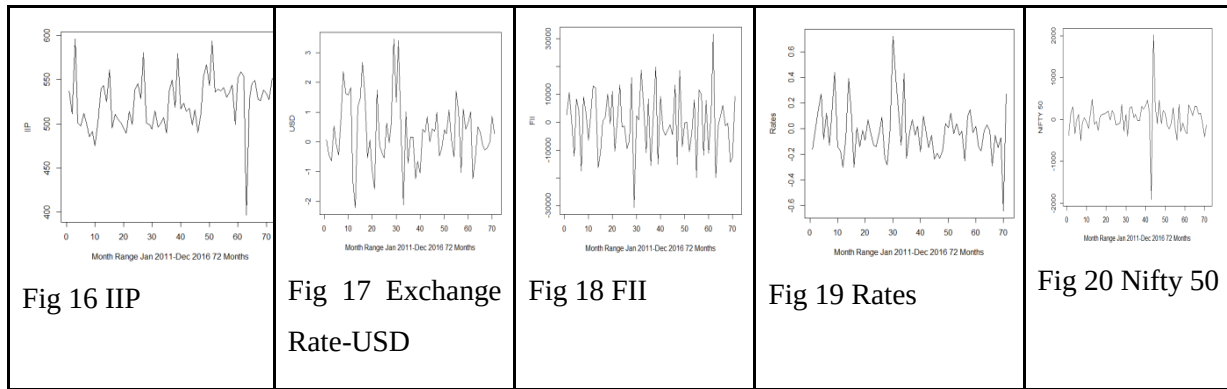
Note: We have considered P value for testing at 5% significance level. If the p-value is smaller than 0.05 then the Null hypothesis will be rejected & variables would be stationary & vice versa.

Graphs of indices (Original Monthly Average) and time in X axis



First difference graph of indices and time in X axis





ADF Level Null Hypothesis	P value	Null	Result
NSE NIFTY50 is not stationary	0.4183	ACCEPT	Variable is not stationary
NSE PSU BANKS is not stationary	0.311	ACCEPT	Variable is not stationary
NSE Auto is not stationary	0.5	ACCEPT	Variable is not stationary
NSE FMCG is not stationary	0.376	ACCEPT	Variable is not stationary
NSE IT is not stationary	0.6685	ACCEPT	Variable is not stationary
IIP main is not stationary	0.01	REJECT	Variable is stationary
WPI is not stationary	0.6994	ACCEPT	Variable is not stationary
Rates is not stationary	0.7474	ACCEPT	Variable is not stationary
USD is not stationary	0.5325	ACCEPT	Variable is not stationary
FII is not stationary	0.465	ACCEPT	Variable is not stationary

Results

	Nifty50	NSE AUTO	NSE PSU BANKS	NSE FMCG	NSE IT
IIP	32%	29%	6%	24%	34%
WPI	71%	72%	-36%	83%	70%
USD	78%	82%	-49%	89%	82%
FII	-12%	-16%	4%	-3%	-14%
Rates	-60%	-65%	2%	-52%	-42%

Table: Correlation Matrix

- It can be concluded that Exchange Rate-USD has a strong positive correlation with all NSE sectors and the NIFTY 50 except NSE PSU Banks
- Interest Rates has a negative correlation with almost all NSE Sectors & NIFTY 50
- IIP has moderately positive correlation with all the sectors

Min	1Q	Median	3Q	Max
-4021.7	-280.3	-13	305.5	4472.1

NSE IT	Estimate	Std. Error	t value	Pr(> t)
(Intercept)	1.379e ²	1.180e ²	1.168	0.247
IIP	2.397	2.637	0.909	0.3668
WPI	-1.044e ²	8.923e ¹	-1.17	0.2462
Exchange rate	-6.438e ¹	1.022e ²	-0.630	0.5310
Interest rates	1.095e ³	5.523e ²	1.983	0.0416*
FII	2.064e ⁻³	9.946e ⁻³	0.207	0.8363

Table: Simple Regression between NSE IT & Macroeconomic Variables

- It was found that the p-value of Exchange Rate was 0.0416 less than the significance level. Hence we accept the alternate hypothesis that there is a significant relationship between NSE IT and Exchange Rates.

Min	1Q	Median	3Q	Max
-1793.78	-125.88	7.49	124.59	1912.65

NIFTY 50	Estimate	Std. Error	t value	p-value
(Intercept)	9.411e ¹	5.314e ¹	1.771	0.0812 4
IIP	8.283e ⁻³	1.187	0.698	0.4878 4
WPI	-1.861e ¹	4.017e ¹	-0.463	0.6446 7

Exchange rate	-1.412e ²	4.601e ¹	-3.069	0.003*
Interest rates	3.084e ²	2.486e ²	1.240	0.21929
FII	3.422e ⁻³	4.477e ⁻³	0.764	0.4474

Table: Simple Regression between NIFTY 50 and Macroeconomic Variables

- The table above shows simple regression test for five macroeconomic variables and NSE NIFTY 50. It was found that the p value for exchange rate 0.003 is less than the significance level. Hence we accept the alternative hypothesis that there is a significant relationship between exchange rate and NSE NIFTY 50.

Min	1Q	Median	3Q	Max
-1934.30	152.94	3.25	191.53	1576.40

NSE Auto	Estimate	Std. Error	t value	Pr(> t)
(Intercept)	1.159e ²	6.453e ¹	1.796	0.0771
IIP	5.729e ⁻¹	1.442	0.397	0.6924
WPI	-4.461	4.878e ¹	-0.091	0.9274
Exchange rate	-1.138e ²	5.588e ¹	-2.037	0.0457*
Interest rates	1.999e ²	3.019e ²	0.662	0.5102
FII	2.098e ⁻³	5.437e ⁻³	0.386	0.7008

Table: Simple Regression between NSE Auto & Macroeconomic Variables

- It was observed through the p-values that Exchange rates does affect NSE Auto indices. Hence we can accept the alternate hypothesis that there is a significant relationship between NSE Auto Indices and exchange rates.

Min	1Q	Median	3Q	Max
-2203.75	-157.75	31.96	146.28	2103.31

NSE PSU	Estimate	Std. Error	t value	p-value
(Intercept)	-2.437e ⁰¹	7.12e ⁰¹	-0.342	0.734
IIP	-7.381e ⁻⁰¹	1.593e ⁰⁰	-0.463	0.045*
WPI	5.738e ⁰¹	5.389e ⁰¹	0.942	0.34
Exchange rate	-8.436e ⁰¹	6.172e ⁰¹	-1.367	0.176
Interest rates	-4.424e ⁰²	3.335e ⁰²	-1.326	0.189
FII	1.226e ⁻⁰³	6.006e ⁻⁰³	0.204	0.839

Table: Simple Regression between NSE PSU Banks & Macro Economic Variables

It was observed that the IIP affects NSE PSU Banks Indices. We have to accept the Alternate Hypothesis that there is a significant relationship between IIP and NSE PSU Banks Indices

Conclusion

In this paper we have observed that some key macroeconomic variables can influence the Indian stock market. The macroeconomic variables represented are IIP-Index of Industrial Production, WPI-Wholesale Price Index, Interest Rate, Exchange Rate(USD). We have used National Stock exchange to represent the Indian Stock Market as it has shown phenomenal growth in the past decades and mainly due to the fact that it was established in 1994 and has now been ranked as the largest stock exchange in India in terms of average daily turnover for equity shares based on annual reports of SEBI. To conduct our study we analyzed monthly data for a span of 6 years (January 2011 to December 2016) of 4 sectors NSE FMCG, IT, PSU BANKS, Auto and the benchmark index NIFTY 50. In this paper we have employed Correlation Matrix and Regression Analysis technique. The results can prove useful in understanding the behaviour of the NSE equity market with respect to changes in the macroeconomic variables.

Based upon our findings in this study we can say that two out of the five variables are relatively more likely to influence the stock market namely Exchange Rate-USD and WPI. There is a positive correlation between Exchange Rates and NSE NIFTY 50, NSE AUTO and NSE IT, IIP and NSE PSU Banks, WPI and NSE FMCG. Surprisingly FII is not found to be

correlated with any of the Sectoral Indices and NIFTY 50 as we had chosen Net Average FII i.e, Inflows - Outflows in the given period.

We can to some extent conclude that in the long term Indian Stock Market is driven by Macroeconomic factors and USD Exchange Rate as well. This makes trading on NSE Indices more favorable as growth is aligned by strong and secure market.

The results of this analysis should not be directly treated to arrive at conclusions for making an investment in the Stock Market. This study will be useful for Equity Derivatives Trades as well. Apart from our chosen 5 key Macroeconomic variables Money Supply(M3), Gold Price, Call Money Rate inclusion could have further led to a more stronger analysis. Also issues like cost of equity capital, asset valuation, industry analysis, a firm's management and operational efficiency analysis, and so on are not taken into account. Any investor should consider all relevant sources of information when making an investment decision. Some indicators such as consumer confidence, consumer disposable income, personal savings are not available with us because of immaturity of the market. Otherwise our research can be taken forward and at high level because Multicollinearity concept can be applied and more precise result can be achieved.

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