DO MACROECONOMIC VARIABLES IMPACT BSE SENSEX RETURNS? EVIDENCE FROM INDIA

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ABSTRACT

The emerging markets owing to their growth potentials have become favored investment destinations for international investors even after considering the risky nature of foreign markets. The research paper examines macroeconomic variables that are assumed to influence stock market returns in India. It attempts to identify whether any causal relationship exists between the stock market returns and macroeconomic indicators by using regression analysis. The indicators that have been taken into account are Index of Industrial Production (IIP) as a proxy for Gross Domestic Product (GDP), Wholesale Price Index (WPI) as a proxy for inflation, Money Supply M1 (MSM1), Rupee Dollar Exchange Rate (REDOLLXR), Foreign Portfolio Investment (FPI in equity only) and Federal Reserve Rates (FRR) on S & P BSE SENSEX index (BSESENX).

INTRODUCTION

After the economic reforms period in India, there has been a notable change in the financial system of India. Though the banking system still dominates the flow of funds, stock markets have acquired an important role in mobilizing funds to the corporate. The research in developing economies like India is drawing attention towards studying the relationship between stock markets performance and macroeconomic variables. Due to the potentials of economic growth in the emerging markets, FPI in India has increased manifold in the last decade. The study uses time-series data in analyzing a causal relationship between the dependent and independent variables. The variables have been tested on all parameters of a good fit regression model. Since the data used in the research is longitudinal, the residual issues have been handled well.

LITERATURE REVIEW

Kuwornu (2011) examines the relationship between macroeconomic variables and stock market returns from 1992 to 2008. He studied the causal relationship between consumer price index, crude oil price, exchange rate, and 91 day Treasury bill rate (as a proxy for interest rate) and stock market returns. Fama (1981) observes a positive correlation between stock market returns and macroeconomic variables.

Under the Arbitrage Pricing Theory (APT) framework, several studies have been conducted between the macroeconomic variables which affect future cash available for

investments and returns of a stock. Omran & Pointon (2001) have studied and found a negative relationship between inflation and the stock market of Egypt. Chatrath, Ramchander & Song (1997) also conducted a study on the relationship between inflation and stock prices of Indian companies. The researchers concluded a negative relationship between stock return and inflation. Using the APT framework for research Chen et al. (1986) researched to study the impact of interest rates, inflation rate, exchange rate, bond yield, and industrial production on US stock markets. They observed that these variables significantly influence US stock market returns. Zhao, (1999) finds a strong relationship between inflation and stock prices of China stocks.

Objective of the study

The objective of the study is to examine whether any causal relationship exists between the economic factors such as Index of Industrial Production (IIP) as a proxy for GDP, Wholesale Price Index (WPI) as a proxy for inflation, Money Supply M1 (MSM1), Rupee Dollar Exchange Rate (REDOLLXR), Foreign Portfolio Investment (FPI in equity only) and Federal Reserve Rates (FRR) on S & P BSE SENSEX index (BSESENX).

METHODOLOGY

The methodology used in the study aims at developing a multiple linear regression model based on IIP, WPI, MSM1, REDOLLXR, FPI (in equity only), and FRR as predictor variables and BSESENX as the criterion variable. FRR as the external variable is considered in the study as it is often given weightage in the prediction of the Indian stock market returns for both the short and long term owing to increasing investments of Foreign Portfolio Investors in the Indian equity market. As FPI investment is highly influenced by a change in the FRR of the US, it is used in the regression model along with the FPI.

Research Hypothesis

H_0: No significant linear relationship exists between the criterion variable (BSESENX) and the six predictor variables. (IIP, WPI, MSM1, REDOLLXR, FPI and FRR)
H_1: There exists a significant linear relationship between the criterion variable (BSESENX) and the six predictor variables. (IIP, WPI, MSM1, REDOLLXR, FPI and FRR)

Sample size and data collection

The study is based on time-series data of monthly observations of the aforementioned variables from April 2010 to March 2017 and includes 83 observations. The sample is taken from the year April 2010 onwards. This period represents the post subprime crisis period that besides having a global impact also negatively affected the Indian Economy and BSE Sensex Index. To remove outliers and to ensure the sanctity of the financial data, the sample is taken from 2010 onwards. For the criterion variable BSESENX, data is taken from the BSE website taking into account the monthly closing values of the S&P BSE SENSEX. The data for predictor variables IIP, WPI, MSM1, REDOLLXR, and FPI is taken from the Reserve Bank of India website. The monthly data for FRR is sourced from the website of the Federal Reserve Bank of the USA.

Research Framework

A multiple linear regression analysis has been conducted by taking S&P BSE SENSEX returns (BSESENX) as the criterion variable and taking IIP, WPI, MSM1, REDOLLXR, FPI, and FRR as the six predictors. Further, stability tests, descriptive statistics, Pearson's coefficient correlation test for checking multi-collinearity, and other tests have been conducted to test the goodness of fit. The following model will be tested in the study:

$$BSESENX_t = \alpha + \beta_1.IIP_t + \beta_2.WPI_t + \beta_3.MSM1_t + \beta_4.REDOLLXR_t + \beta_5.FPI_t + \beta_6.FRR_t + \varepsilon_t \quad (1)$$

Where, $BSESENX_t$= S&P BSE SENSEX index at time't' (criterion variable); α = constant; IIP_t= Index of Industrial Production; WPI= Wholesale Price Index; $MSM1_t$= Money Supply M1; $REDOLLXR_t$ = Rupee Dollar Exchange Rate; FPI_t = Foreign Portfolio Investment; FRR_t= Federal Reserve Rates at time't' respectively; and $\beta_1, \beta_2, \beta_3, \beta_4, \beta_5$ and β_6 are regression coefficients of the respective predictor variables and ε_t = error term at time't'.

Table 1 DESCRIPTION OF VARIABLES			
Variable	Type of Data	Units	Source
BSESENX	First differenced Raw data of Bombay Stock Exchange Sensitive Index	Monthly closing values	Bombay Stock Exchange India Website
IIP	First differenced Raw data of Index of Industrial Production	Monthly values	Reserve Bank of India Website
WPI	First differenced data of Wholesale Price Index	Monthly values	Reserve Bank of India Website
MSM1	First differenced data of Money Stock M1	Monthly values	Reserve Bank of India Website
REDOLLXR	First differenced data of Rupee Dollar Exchange Rate	Monthly values	Reserve Bank of India Website
FPI	First differenced data of Foreign Portfolio Investment in equity only)	Monthly values	Reserve Bank of India Website
FRR	First differenced data of Federal Reserve Rates	Monthly values	Federal Reserve Bank Website

Source: Generated by the author

The table 1 above describes the variables. The IIP is taken as a proxy for GDP as monthly data on GDP was not available. While WPI is taken as a proxy for inflation as monthly data was not available for inflation. Money stock M1 is taken as an independent variable since the level of money supply affects the level of investment in the stock market. M1 represents narrow money which includes demand deposits and other currency in circulation as this money is used for investment in the stock market. It excludes fixed deposits and other long-term deposits with banks. The rupee-dollar exchange rate is also considered for the study as it also affects the investment decision of foreign portfolio investors which in turn affects BSE Sensex. Federal Reserve Rates, though an exogenous variable, affects investment decisions of FPI in India which in turn affects the BSE Sensex Index. This inference is drawn from the news speculation about the increase or decrease in the FPI in India before Federal Reserve Bank (FRB) decides for change in the FRR from time to time. Hence it is taken as an independent variable. Out of these

predictors, FRR is the only variable that is exogenous and is out of the system, and is not affected by any of these variables.

Data analysis and interpretation

The data were first tested for stationarity of variables using the unit root test. The augmented Dickey-Fuller test (ADF) was used for finding the element of non-stationarity in the variables. The test revealed the presence of unit root in the BSESENX, IIP, WPI, MSM1, REDOLLXR, and FRR. Hence data for these variables were transformed at the first difference to make them stationary and to be fitted in the regression model. The data was then tested for stability of the dependent variable BSESENX using the CUSUM (Cumulative Sum Control Chart) test of recursive residuals at a 5% significance level.
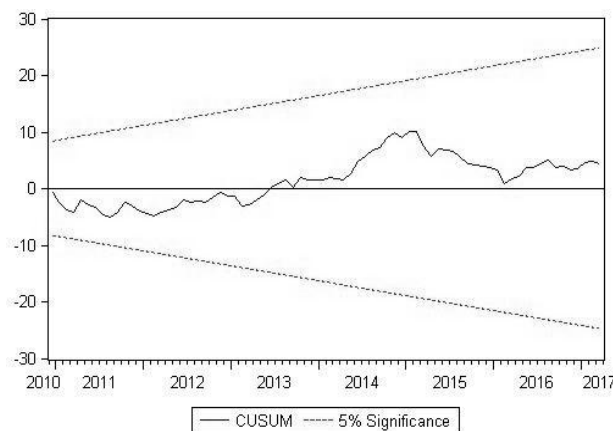

FIGURE 1
STABILITY TEST (CUSUM)

Source: generated by the author

Figure 1 depicts the stability of the criterion variable as it is within the control limits. Hence all the residuals are stable as the cumulative sums are located within the standard deviation band.

The descriptive statistics in table 2 below exhibit that BSESENX, MSM1, and FPI have the highest dispersion of data from their respective mean while deviation is relatively less in IIP, WPI, REDOLLXR, and FRR variables. The mean, minimum and maximum values of BSESENX and MSM1 are the highest. The skewness coefficients reveal some negative distribution of data. The variables BSESENX, IIP, WPI, and MSM1 have long left-tailed negative skewness while REDOLLXR, FPI, and FRR have long right-tailed positive skewness. The Kurtosis values show that the probability density function (PDF) has a fat-tailed distribution for IIP, MSM1, REDOLLXR, and FRR. The p values of the Jarque-Bera test reveal that variables BSESENX, IIP, WPI, and FPI are normally distributed while MSM1, REDOLLXR, and FRR are not normally distributed. But Jarque-Bera (J-B) statistics for the Histogram Normality test gives a J-B p-value of 0.1082 mentioned further in the paper which suggests that the model data is no different from a normal distribution (acceptance of null hypotheses).

Table 2
DESCRIPTIVE STATISTICS

Statistics	DBSESENX	DIIP	DWPI	DMSM1	DREDOLLXR	DFPIEQ	DFRR
Mean	145.3228	0.572934	0.562651	127.1878	0.245766	2.977831	0.007108
Median	102.8300	0.300000	0.600000	145.3900	0.183500	-0.550000	0.000000
Maximum	2339.860	25.10000	3.500000	2934.850	5.459200	332.3900	0.130000
Minimum	-2181.330	-27.70000	-2.500000	-3770.580	-3.797200	-301.5800	-0.040000
Std. Dev.	960.7023	10.59759	1.205648	764.3838	1.524622	115.4207	0.031720
Skewness	-0.108130	-0.305013	-0.329724	-2.478114	0.266043	0.086347	2.543243
Kurtosis	2.709050	3.643320	3.088842	19.17690	4.533726	2.927883	10.05687
Jarque-Bera	0.454494	2.718227	1.531232	989.9693	9.114199	0.121126	261.6983
Probability	0.796724	0.256888	0.465047	0.000000	0.010492	0.941235	0.000000
Sum	12061.79	47.55350	46.70000	10556.59	20.39860	247.1600	0.590000
Sum Sq. Dev.	75681805	9209.324	119.1942	47911179	190.6067	1092399	0.082506
Observations	83	83	83	83	83	83	83

Source: calculated by the author

Multi Collinearity Diagnosis

Further, Pearson's correlation matrix was used to check the problem of multi collinearity as the strong correlation among independent variables can give spurious results in the regression analysis. The correlation matrix in Table 3 below shows the correlation among independent variables for the study period from April 2010 to March 2017. From the table, it can be observed that the independent variables show a correlation value ranging between -0.54 to 0.33 values which means a moderately negative to a moderately positive correlation.

Table 3
PEARSON CORRELATION MATRIX OF VARIABLES

	DIIP	DWPI	DMSM1	DREDOLLXR	DFPIEQ	DFRR
DIIP	**1.000000**	-	-	-	-	-
DWPI	-0.235242	**1.000000**	-	-	-	-
DMSM1	0.012342	-0.009571	**1.000000**	-	-	-
DREDOLLXR	-0.118294	0.007249	-0.142122	**1.000000**	-	-
DFPIEQ	0.334313	-0.043924	0.137567	-0.547479	**1.000000**	-
DFRR	0.242510	-0.233091	-0.031554	-0.068332	0.060791	**1.000000**

Source: calculated by the author

The result of Variance Inflation Factor (VIF) in the Ordinary Least Squares (OLS) regression equation in table 4 below exhibit that the VIF for all the independent variables is between 1 and 5. Therefore, it can be expressed that the predictor variables have very weak multi collinearity and multiple regression analysis is fit to be conducted using all the mentioned independent variables in the study.

Table 4 VARIANCE INFLATION FACTORS			
Variable	**Coefficient Variance**	**Uncentered VIF**	**Centered VIF**
C	8155.106	1.443738	NA
DIIP	63.53029	1.251619	1.247928
DWPI	4321.695	1.340937	1.098728
DMSM1	0.010067	1.057573	1.028744
DREDOLLXR	3574.344	1.491387	1.453166
DFPIEQ	0.691230	1.611674	1.610589
DFRR	6293851.	1.163902	1.107600

Source: calculated by the author

Goodness of Fit

The regression equation was further analyzed for the goodness of fit using the following test parameters:

1. Augment Dickey-Fuller (ADF) unit root test.
2. Jarque Bera test for Normality.
3. Breush-Godfrey Serial correlation LM test.
4. Breush-Pegan-Godfrey test for heteroskedasticity.

As mentioned earlier, the individual data sets of the variables were found non-stationary by using Augment Dickey-Fuller (ADF) Test. Table 5 below shows the test results of the ADF unit root test for all variables. From the table, it is evident that the p-value of all variables is more than 0.05. Hence, all the variables have unit root at level except FPI whose p-value is more than 0.05. So data for all variables including FPI to ensure uniformity of data was converted at first difference. The observed p values of all variables at first difference were recorded below 0.05. Hence data was found to be stationary at first difference.

Table 5 ADF UNIT ROOT TEST				
Variable	**At level**		**1st difference**	
ADF	t-statistic	p-value	t-statistic	p-value
BSESENX	-0.547272	0.8754	-9.482785	0.0000
IIP	-0.419464	0.8995	-11.81768	0.0001
WPI	-2.166779	0.2199	-4.912811	0.0001
MSM1	0.131635	0.9661	-5.274656	0.0000
FPI	-5.625940	0.0000	-11.76935	0.0001
FRR	4.315501	1.0000	-4.816978	0.0001

Source: calculated by the author

Figure 2 below shows the Jarque-Bera (J-B) statistics to test whether the residuals are normally distributed. The table observes the p-value of the J-B test is more than 0.05. Hence it can be interpreted that the residuals are normally distributed.
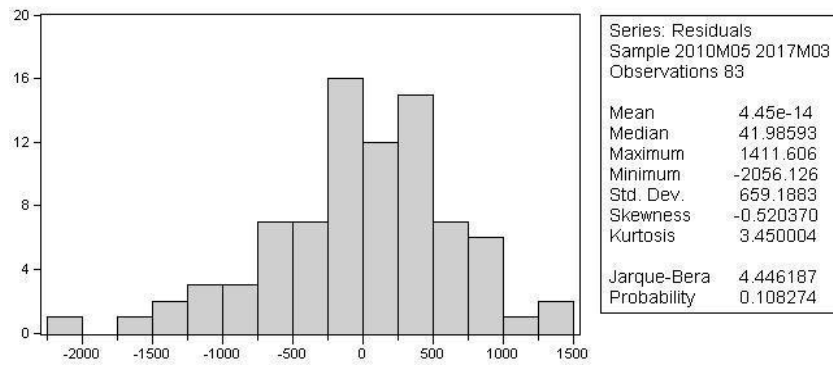
FIGURE 2
JARQUE-BERA NORMALITY TEST FOR RESIDUALS

Source: generated by the author

Table 6 below exhibits the results of the Breush-Godfrey serial correlation LM test and Breush- Pegan Godfrey test for heteroskedasticity. The Chi-square value of Breusch – Godfrey (B-G) serial correlation LM test is 0.7899 which means that there is no serial correlation in the residuals. Similarly, Breusch-Pagan-Godfrey (B-P-G) Heteroskedasticity with the probability Chi-square value of 0.9672 validates that there is no heteroskedasticity in the residuals and the model is a good fit model.

Table 6			
BREUSCH-GODFREY SERIAL CORRELATION LM TEST AND BREUSCH-PAGAN-GODFREY HETEROSKEDASTICITY TEST			
Breusch-Godfrey Serial Correlation LM Test:			
F-statistic	0.211471	Prob. F(2,74)	0.8099
Obs*R-squared	0.471685	Prob. Chi-Square(2)	0.7899
Breusch-Pagan-Godfrey Heteroskedasticity Test			
F-statistic	0.213695	Prob. F(6,76)	0.9714
Obs*R-squared	1.377033	Prob. Chi-Square(6)	0.9672
Scaled explained SS	1.414335	Prob. Chi-Square(6)	0.965

Source: calculated by the author

The following table 7 is the outcome of the regression equation (1) in which BSE Sensex is the target variable and IIP, WPI, MSM1, REDOLLXR, FPI and FRR are independent variables.

TABLE 7
MODEL SUMMARY

Dependent Variable: BSESENX
Method: Least Squares
Sample (adjusted): 2010M05 2017M03
Included observations: 83 after Adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	158.7620	90.30563	1.758053	0.0828
IIP	1.682561	7.970589	0.211096	0.8334
WPI	124.1550	65.73960	1.888588	0.0628
MSM1	0.059404	0.100333	0.592063	0.5556
REDOLLXR	-317.0466	59.78581	-5.303041	0.0000
FPI	2.338102	0.831402	2.812239	0.0063
FRR	-2934.218	2508.755	-1.169591	0.2458
R-squared	0.529195	Mean dependent var		145.3228
Adjusted R-squared	0.492026	S.D. dependent var		960.7023
S.E. of regression	684.7146	Akaike info criterion		15.97645
Sum squared resid	35631392	Schwarz criterion		16.18045
Log-likelihood	-656.0226	Hannan-Quinn criteria.		16.05840
F-statistic	14.23759	Durbin-Watson stat		1.859756
Prob(F-statistic)	0.000000			

Source: calculated by the author

INTERPRETATION AND CONCLUSION

The f-statistics of the model in table 7 above has a p-value of less than 0.05 which states that there is a statistically significant linear relationship between the dependent variable BSE Sensex returns and the other six independent variables. Since the p-value of f-statistics is less than 0.05, the null hypothesis is rejected and alternate hypothesis H_1 is accepted that there exists a statistically significant linear relationship between the criterion variable (BSESENX) and the six predictor variables (IIP, WPI, MSM1, REDOLLXR, FPI, and FRR).

However, the t-statistics reveal that only the Rupee dollar exchange rate (REDOLLXR) and Foreign Portfolio Investment (FPI) are individually significant in affecting the dependent variable BSESENX. The negative values of the coefficients of REDOLLXR and FRR are in line with the economic theory. As when the Rupee dollar exchange rate increases (depreciation in rupee) the Sensex records a bearish trend and vice versa. While when FRR increases, the FPI divert their funds in the US fixed deposits and bond market as domestic markets are always considered less risky than foreign markets. While when FRR decreases, the influx of FPI in India increases which results in bullish Sensex. The positive values of the coefficients of other independent variables IIP, WPI, MSM1, and FPI are also in line with the theory of intuition. However, these variables have no statistically significant linear relationship with the dependent variable individually. The R square value of the model is 52.9 percent. Though the model cannot be used for forecasting, the study has revealed that IIP, WPI, MSM1, and FRR should not be given much importance in predicting BSE Sensex return behavior. Conclusively it can be argued that the Rupee dollar exchange rate and Foreign Portfolio Investment should be given due importance because they are statistically significant in determining BSE Sensex returns.

LIMITATIONS

The study does not take into account variables that could have explained the movement of BSE SENSEX returns with one hundred percent predictability as the R-squared value of the model is 52.9 percent. There are variables outside the model that are also important in explaining returns of the BSE Sensex. Besides the study does not take into account a comparison between the impact of macroeconomic variables on the stock market indices across countries. This limitation was due to non-access to the panel data of other countries.

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