Cointegration of FDI, IIP, CPI and BR with Sensex

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Abstract – The study investigates the relationship between macroeconomic variables and stock market, by taking the data range from January 2009 to December 2017 using monthly data. The macroeconomic variables considered are foreign direct investment, index of industrial production, consumer price index as a measure of inflation and bank rate along-with the major stock index Sensex. Cointegration technique by Johansen and Juselius is used in the paper and further for long run relationship VECM was for short run VAR Model is applied. The empirical results revealed that the Sensex does not have a significant relationship of long run with FDI, BR, IIP, and CPI but there exist short run relationship. Based on this relationship residual testing of the model was conducted with respect to heteroskedasticity, auto correlation & normality tests.

Keywords: Cointegration, Macroeconomic variables, Sensex, VECM.

Introduction

In the present decade equity market in India has witnessed extra-ordinary growth. Right from early nineties, the stock market observed heightened activity in terms of various bull and bear runs. The movement in the stock market is majorly sensitive to the changes in the micro and macro level economic factors. The macro factors play an important role as they are non-diversifiable and affect the stock market as a whole. That becomes the major reason for viewing and analyzing carefully the occurrence of volatility in the stock market by large number of global players.

There are widely documented studies concerning the association among stock market behavior and economic comovement of domestic and international factors and markets, particularly for established share markets such as the U.S., U.K., Germany, and Japan. Examples of pioneer studies are Ross, Roll and Chen (1986) and Fama (1981, 1990). Literature reveals differential causal pattern between key macroeconomic variables and stock prices. These relationships varies in a number of different stock markets and time horizons in the literature. These studies trace the issue of market efficiency, or the existence of the efficiency of the market hypothesis.

Literature Review

Some studies conducted to document the relationship between stock market and macroeconomic variables are detailed below.

Gupta and Chattopadhyay (2013) explored the level of domestic financial integration existing within the country by studying the impact of certain macro-economic variables, namely, money

supply (M3), call money rate, foreign exchange rate, gold price, foreign institutional investment, inflation rate, index of industrial production from October 2005 to October 2009. By applying unit root rest and Johansen test for co-integration it was estimated that S&P Nifty is significantly influenced by money supply, gold prices and foreign institutional investment in the long run.

Sireesha (2013) investigated the impact of select macroeconomic factors upon the movements of the Indian stock market index, Nifty along with gold and silver prices by using linear regression technique on a monthly data for a period of 20 years from January 1993 to December 2012 .The behavior of nominal and real returns at various levels of inflation, GDP, IIP and Money Supply was studied. Stock returns were significantly influenced by inflation, GDP, USD-INR and JPY-INR and gold returns were significantly influenced by money supply and all the four currencies and silver returns were significantly influenced by money supply and EUR-INR.

Patel (2012) investigated the effect of macroeconomic determinants on the performance of the Indian Stock Market using monthly data from January 1991 to December 2011 for eight macroeconomic variables, and two stock market indices namely Sensex and S&P CNX Nifty. By applying Augmented Dickey Fuller Unit root test, Johansen Cointegration test, Granger Causality test and Vector Error Correction Model (VECM), the study found that the long run relationship between macroeconomic variables and stock market indices exist.

Soumaré and Tchana (2011) studied the causal relationship between foreign direct investment (FDI) and financial market development by taking panel data from emerging economies. Data coverage is from 1994 to 2006 of 29 countries located in Africa (4 countries), Asia (15 countries), Eastern Europe (4 countries) and Latin America (6 countries). VAR methodology was used and results indicated positive relationship between FDI and stock market development but for banking sector the relationship was found to be uncertain.

Objectives

- To study the existence of short run and long run relationship among these macroeconomic variables and share index.
- To design a suitable model for forecasting and checking the reliability of the forecasted model.

Hypothesis

H_{11}: Time series data does not have unit root. (For Stationarity)

H_{12}: Serial Correlation is present among residuals (For Serial Correlation)

H_{13}: Heteroskedasticity is present among residuals (For Heteroskedasticity)

H_{14}: Distribution of residuals is not normal (For Normality)

Collection of Data

The data of macro-economic variables is collected from Reserve Bank of India's data base of Indian Economy, Ministry of Statistics and Programme Implementation, Ministry of Commerce and Industry and OECD websites and Sensex figures are taken from BSE website.

Sampling Plan and Technique

Independent variables are FDI, IIP, CPI and BR where monthly data of these variables are considered alongwith Sensex as a dependent variable.

Findings

Unit Root Tests: The first step for conducting a cointegration analysis is checking the stationarity of the data for which Augmented Dickey Fuller test is applied. At level I (0) the absolute values are lesser than critical values at 5% and even p-values for all variables are higher than 5%. Thus the null hypothesis of having unit root in the data cannot be rejected and is thus accepted. As stationarity is not achieved at level I (0), ADF test is conducted at first difference. For all variables absolute ADF test values are higher than critical values at 5%. Also p-values of all the variables are lesser than 5%. Hence it can be concluded from ADF results that all the variables are stationary at first difference.

Table 1: Unit Root Test Results

Variables	ADF at I(1)		
	Test Statistics	Critical Values at 5%	P-value
FDI	-10.8267	-2.8892	0.0000
IIP	-11.6284	-2.8892	0.0000
CPI	-7.6423	-2.8889	0.0000
BR	-9.9605	-2.8886	0.0000
SENSEX	-10.9682	-2.8889	0.0000

***Cointegration Tests*:** Trace statistic and Eigen value both the methods concluded that there is a maximum of 1 co-integration equation between the variables and Sensex as in both the methods test results values are less than 5% significant values at maximum 1 possible relationship.

Table 2: Cointegration Test Results

Hypothesized No. of CE(s)	**TraceTest**			**Max-Eigen Value Test**		
	Statistic	**Value at 5%**	**Prob.**	**Statistic**	**Value at 5%**	**Prob.**
None	82.1246	69.8188	0.0038	47.2228	33.8768	0.0008
At most 1	34.9018	47.8561	0.4532	18.5799	27.5843	0.4477
At most 2	16.3219	29.7977	0.6895	9.1452	21.1312	0.8205
At most 3	7.17665	15.4947	0.5572	5.81522	14.2646	0.6371
	Indicates 1 CE			Indicates 1 CE		

Lag Determination: Amongst all the methods for selecting a perfect lag length namely sequential modified LR test statistic (LR), Akaike Information Criterion (AIC), Final Prediction Error (FPE), Hannan-Quinn Information Criterion (HQ) and Schwarz Information Criterion (SIC), here, SIC and

HQ are giving the lowest lag length of 1. Therefore, SIC and HQ method is used and lag length of 1 is taken into consideration.

Error Correction Model: In the estimates of the VECM model equation, the coefficient C (1) should be negative with a p-value of less than 5%, but here it is positive and the p value of C (1) is also greater than 5% (14.71%), which is insignificant and, consequently, the error correction term becomes insignificant, concluding that the variables FDI, IIP, CPI and BR does not impact Sensex in the long run. As there is no long-term relationship between Sensex and selected macroeconomic variables, a VAR model is applied for short-term relationships.

Short run equation is:

SENSEX = 0.894416 *SENSEX(-1) + 0.007069*SENSEX(-2) – 0.011629*FDI(-1) – 0.01393*FDI(-2) – 24.20263*IIP(-1) + 10.67004*IIP(-2) - 203.1328*CPI(-1) + 250.247*CPI(-2) – 259.1339*BR(-1) + 144.8932*BR(-2) + 2033.481

Residual Testing of Vector Auto Regressive Model:

Serial Correlation – According to Breusch-Godfrey Serial Correlation test, probability of R-squared is 0.9027, which is considerably more than probability value of 0.05, signifies that there is absence of serial correlation among the variables.

Table 3: Serial Correlation Test Results

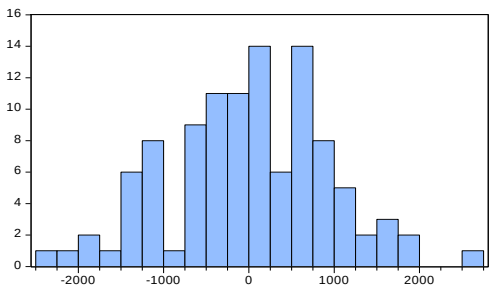
R-squared observed	0.01494	Probability Chi-Square	0.9027

Heteroskedasticity - Chi-square p-value of Observed R is 0.6451, significantly is more than 5%, considerably the basic hypothesis of homogeneity can be accepted and thus residuals are not heteroskedastic in the model which is a desirable property for the model.

Table 4: Heteroskedasticity Test Results

R-squared observed	7.8338	Probability Chi-Square	0.6451

Normality Jarque Bara - P-value of Jarque-Bera statistics is 0.9176 significantly is more than 5%, considerably the basic hypothesis is accepted stating that residual is normally distributed.



FFig.1: Histogram & Jarque Bara Results

Forecasting

Looking to the Theil's inequality coefficient of 0.02023 the forecast is being considered as reliable as coefficient is far away from one and even bias and variance proportions are very less.

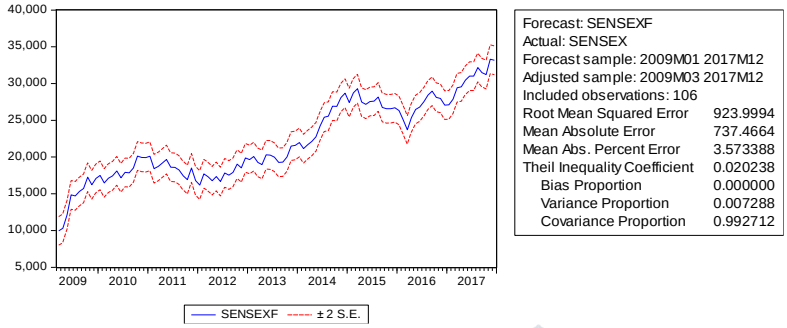


Fig. 2: Forecasting Results

Conclusion

Selected macroeconomic variables (FDI, IIP, CPI and BR) does not have any long term relationship with Sensex meaning these variables does not cause Sensex in the long term but short term association do exist which majorly shows negative relationship. All residual testing suggested that model is good and acceptable. Further, the reference of the study can be used for application of different variables or different time frame or different test.

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