Dynamics of Macroeconomic Fundamentals Affecting Stock Market in India: A Causal Relationship Analysis

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Abstract

The study investigates the relationship between the Indian stock market (BSE Sensex) and five macroeconomic variables, namely, index of industrial production, wholesale price index, gold price, foreign institutional investment and real effective exchange rate using monthly data. The main purpose of the study is to examine the dynamics of short run and long run linkages between macroeconomic variables and stock prices. Johansen's co-integration and vector error correction model (VECM) have been applied to explore the long-run equilibrium relationship between stock market index and macroeconomic variables. The analysis reveals that macroeconomic variables and the stock market index are co-integrated and, hence, a long-run equilibrium relationship exists between them. It is observed that the stock prices positively relate to the industrial production, foreign institutional investment, inflation and exchange rate but negatively relate to gold price. All the macroeconomic variables are found significant in determining stock prices. Application of VECM statistically confirms the long run equilibrium relationship between Sensex and

macroeconomic variables and exhibits a healthy convergence rate to equilibrium. The Granger causality test has been applied to examine the dynamics of short run relationship and it is found that foreign institutional investment, gold price and real effective exchange rate are causing the stock prices in BSE. There exists unidirectional causality, running from foreign institutional investment to Sensex, from gold price to Sensex and from exchange rate to Sensex, while no causal relationship is found between Sensex and industrial production & inflation.

Keywords: *Stock Market Index, BSE Sensex, Macroeconomic Variables, Co-integration Test, Causality Test*

Introduction

Stock markets play a vital role in the financial sector of every economy. An efficient capital market drives the economic growth by stabilizing the financial sector. In an efficient capital market, stock prices adjust swiftly according to the new information available. The stock prices reflect all information about the stocks and also the expectations of the future performances of corporate houses. As a result, if stock prices reflect these assumptions in real, then it should be used as a major indicator for the economic activities (Ray, 2102). Hence the dynamic relationship between stock prices and macroeconomic variables contains academic interest as well as policy implications.

With the waves of economic reforms since 1991 in Indian economy, Indian capital market has undergone a series of

radical changes. This resulted in remarkable improvement in Indian stock market in terms of its size and depth. The process of development of domestic stock market has been further accelerated owing to a voluminous inflow of foreign institutional investment. However, unlike mature stock markets of advanced economies, the stock markets of emerging economies like India are characterised as the most volatile stock markets. Moreover, the stock markets of emerging economies including India are likely to be sensitive to factors such as changes in the level of economic activities, changes in political and international economic environment and also related to the changes in other macroeconomic factors (Naik & Padhi, 2012). In this view an empirical question to be answered is does and at what extent the Indian stock market responds to the changes in macroeconomic variables.

Review of Literature

In the past two decades, many researchers, financial analysts and practitioners have attempted to predict the relationship between stock market movement and macroeconomic variables. They have conducted empirical studies to examine the effect of stock price on macroeconomic variables or vice-versa. This section of the paper has discussed some such previous research works and their empirical conclusions that are related to our sector analysis.

Chen et al. (1986) have examined equity returns relative to a set of macroeconomic variables for developed countries

and found that the set of macroeconomic variables which can significantly explain stock returns includes growth in industrial production, changes in the risk premium, twists in the yield curve, measures of unanticipated inflation and changes in expected inflation during periods of volatile inflation. Later, Ratanapakorn and Sharma (2007) have examined the relationship between the US stock price index and macroeconomic variables using quarterly data for the period of 1975 to 1999. Employing Johansen's co-integration technique and vector error correction model (VECM) they found that the stock prices positively relates to industrial production, inflation, money supply, short term interest rate and also with the exchange rate, but, negatively related to long term interest rate. Their causality analysis revealed that every macroeconomic variable considered caused the stock price in the long run.

Many researches over the period of time have focused on the impact of macroeconomic variables on stock price movements in developing economies. In their study, Muhammad and Rasheed (2002) have examined the exchange rates and stock price relationships for Pakistan, India, Bangladesh and Sri Lanka using monthly data from 1994 to 2000. The results show that there is a bi-directional long-run causality between these variables for only Bangladesh and Sri Lanka. No associations between exchange rates and stock prices are found for Pakistan and India.

Wongbampo and Sharma (2002) explored the relationship

between stock returns and five macroeconomic variables such as GNP, inflation, money supply, interest rate, and exchange rate in five Asian countries viz. Malaysia, Indonesia, Philippines, Singapore and Thailand. Their study used monthly data for the period of 1985 to 1996, and it was found that, in the long run stock price indices of all the five countries were positively related to growth in output and negatively related to the aggregate price level. However, they found a negative relationship between stock prices and interest rate for Philippines, Singapore and Thailand, but positive relationship for Indonesia and Malaysia.

Maysami et al. (2004) also examined the relationship among the macroeconomic variables and sector wise stock indices in Singapore using monthly data from January 1989 to December 2001. They employed the Johansen co-integration and VECM approaches and found a significant long-run equilibrium relationship between the Singapore stock market and the macroeconomic variable tested.

Ahmed & Osman (2007) have investigated the long run equilibrium and short term dynamics between DSE stock index and a set of macroeconomic variables like money supply, 91 day T-bill rate, interest rate GDP and industrial production index. The cointegration test suggests that there exist two co integrating vectors one is statistically significant. In the VECM test, they found that the lagged stock index was adjusted to long run equilibrium by 43.82 percent by the combined lagged influence of all the selected macroeconomic variables. Granger causality test provides

only one unidirectional causality from interest rate change to stock market return.

Similarly, even Ali (2011) could not establish relationship between macroeconomic variables and stock prices in Dhaka Stock Exchange (DSE). A Multivariate Regression Model has been used to estimate the relationship. Regression results reveal that inflation and foreign remittance have negative influence and industrial production index; market P/Es and monthly percent average growth in market capitalization have positive influence on stock returns. No unidirectional Granger Causality is found between stock prices and all the predictor variables except one unidirectional causal relation from stock price and market P/Es. Finally, lack of Granger causality between stock price and selected micro and macro variables ultimately reveals the evidence of informationally inefficient market.

Robert (2008) has investigated the effect of two macroeconomic variables (exchange rate and oil price) on stock market returns for four emerging BRIC economies, namely, Brazil, Russia, India and China using monthly data from March 1999 to June 2006. Results affirmed that there was no significant relationship between present and past market returns with macroeconomic variables. Furthermore, no significant relationship was found between respective exchange rate and oil price on the stock market index of the four countries studied.

Akbar et al. (2012) have studied the relationship between the Karachi stock exchange index and macroeconomic

variables for the period of January 1999 to June 2008. Employing a co-integration and VECM, they found that there was a long-run equilibrium relationship exists between the stock market index and the set of macroeconomic variables. Their results indicated that stock prices were positively related with money supply and short-term interest rates and negatively related with inflation and foreign exchange reserve.

Empirical studies are also conducted focussing towards the relationship between fundamental macroeconomic factors and stock market performance in India. Studies of Bhattacharya and Mukherjee (2002), Nath and Samantha (2002) found the causal relationship between stock prices and macro-economic factors in India. They applied methodology of Toda and Yamamoto for the period of 1992-1993 to 2000-2001. It was found that industrial production affects significantly the stock prices. Similar results are obtained by Chakravarty (2005). In this study positive relationship between industrial production and stock prices was examined by using Granger causality test and observed uni-directionality from industrial production to stock prices in India.

However, the findings of Chowhan et al. (2000) are contradicting the above specified results. They have tried to fetch reasons for turbulence in stock market in the short run in India taking into account SENSEX as the main index. As per the results of this paper, even long run economic factors do not support such a spike in stock prices. Such a trend was noted not just in Indian stock markets but World wide.

The results of Chowhan et al. (2000) Kumar (2008) are supported by the similar findings of Sahu & Dhiman (2011). They have tried to explore the causal relationship between stock market indicator and macroeconomic variables of India by using correlation and Ganger causality regression techniques. Annual data was used from 1981 to 2006 for all the above said variables to study the relationship. The findings of the study reveal that there is no causal relationship between BSE Sensex and real GDP of India. The paper concluded with the observation that BSE Sensex cannot yet be called as an indicator of India's growth and development.

Another study conducted by Sarkar (2005) has examined the relation between growth and capital accumulation exists in case of India. They have used annual data on various variables like nominal and real share price, share market turnover ratio, number of listed firms in the stock market, fixed capital formation and growth of real GDP and industrial output. But results show no positive relationship exists between real and stock market variables either in short run or long run during 1950-51 to 2005.

However, the studies of Kanakaraj et al. (2008), Ahmed (2008), Singh (2010), Ray (2012), Naik & Padhi (2012) and others have found significant relationship between economic variables and stock returns. Kanakaraj et al. (2008) have tried empirically to explore upon and answer that if the recent stock market boom can be explained in the terms of macroeconomic fundamentals and have concluded by recommending a strong relationship between the two. The study period covered between 1997 and 2007.

Ahmed (2008) employed the Johansen's approach of co-integration and Toda – Yamamoto Granger causality test to investigate the relationship between stock prices and the macroeconomic variables using quarterly data for the period of March, 1995 to March 2007. The results indicated that there was an existence of a long-run relationship between stock price and FDI, money supply, & index of industrial production. Causality was found running from stock price movement to movement in industrial production.

Singh (2010) in his research paper, attempted to explore the causal relation between the BSE Sensex and three key macroeconomic variables of Indian economy by using correlation, unit root stationarity tests and Granger causality test. Monthly data was used from April,1995 to March, 2009 for all the variables, like, BSE Sensex, wholesale price index (WPI), index of industrial production(IIP) and exchange rate(Rs/$). Results showed that IIP was having bilateral causal relationship with BSE Sensex, while WPI was found to be related to stock market unidirectional.

Pal and Mittal (2011) investigated the relationship between the Indian stock market and macroeconomic variables using quarterly data for the period January 1995 to December 2008 with the Johansen's co-integration framework. Their analysis revealed that there was a long-run relationship exists between the stock market index and set of macroeconomic variables. The results also showed that inflation and exchange rate have a significant

impact on BSE Sensex but interest rate and gross domestic saving (GDS) were insignificant.

Sharma & Mahendru (2010) analyse long term relationship between BSE and macroeconomic variables, vis-à-vis, change in exchange rate, foreign exchange reserve, inflation rate and gold price. The study period ranges between January 2008 and January 2009. The multiple regression equation model was applied and the results reveal that exchange rate and gold prices highly effect the stock prices, while FOREX and inflation have limited influence on stock prices.

Sabunwala (2012) attempts to unravel the relationship between the real economic variables and the capital market in Indian context. The study considers the monthly data of several economic variables like the national output, fiscal deficit, interest rate, inflation, exchange rate, foreign institutional investment in Indian markets between 1994 and 2010, and tries to reveal the relative influence of these variables on the sensitive index of the Bombay stock exchange (BSE). Linear regression model was applied to identify the relationship between BSE stock price movement and macro-economic variables. The finding shows that interest rate, output, money supply, inflation rate and the exchange rate have considerable influence in the stock market movement in the considered period, while fiscal deficit and foreign institutional investment have very negligible impact on the stock market.

Ray (2012) explores the impact of different macroeconomic variables on the stock prices in India using annual data from

1990-91 to 2010-11. A multiple regression model was used to test the effects of macroeconomic variables on the stock prices and granger causality test is conducted to examine whether there exist any causal linkage between stock prices and macroeconomic variables. Results indicate that there is no causal association between stock price and interest rate, stock price and index of industrial production, but unidirectional causality exist between stock price and inflation, stock price and foreign direct investment, stock price and gross domestic product, stock price and exchange rate, stock price and gross fixed capital formation. However, bi- directional causality exist between stock price and foreign exchange reserve, stock price and money supply, stock price and crude oil price and stock price and whole price index. The multiple regression results of the study indicate that oil price and gold price have a significant negative effect on stock price, while balance of trade, interest rate, foreign exchange reserve, gross domestic product, industrial production index and money supply positively influence Indian stock price. On the other hand, inflation rate, foreign direct investment, exchange rate and wholesale price index do not appear to have any significant effect on stock price.

Naik & Padhi (2012) have investigated the relationship between the Indian stock market index (BSE Sensex) and five macroeconomic variables, namely, industrial production index, wholesale price index, money supply, treasury bills rates and exchange rates over the period April, 1994–June, 2011. Johansen's co-integration and vector error correction model were applied. The analysis reveals

that macroeconomic variables and the stock market index are co-integrated. It was observed that the stock prices positively relate to the money supply and industrial production but negatively relate to inflation. The exchange rate and the short-term interest rate were found to be insignificant in determining stock prices. In the Granger causality test, a bi-directional causality between industrial production and stock prices and unidirectional causality from money supply to stock price, stock price to inflation and interest rates to stock prices were found.

Makan et al (2012) have tried to test the influence of macroeconomic variables on BSE stock prices. The macroeconomic variables are represented by the IIP, CPI, call rate, exchange rate, gold price, oil price and FII. Monthly data for the duration of April 2005 – March 2012 was considered. The paper employed Granger causality test, regression analysis and correlation analysis to examine such relationships. Based on the results it was concluded that three out of seven variables were relatively more significant and likely to influence Indian stock market. These factors were exchange rate, FII and call rate. There is a positive relation between FII and Sensex, call rate and Sensex whereas exchange rate and Sensex shows a negative relation. In granger causality test call rate was seen affecting BSE.

The brief review of the selected literature on the sector of present analysis shows no consensus on the direction of causality. It can be observed from the review of literature that findings of different studies vary. In case of some

findings, causality is unidirectional, while others identified the presence of bi-directional relationship between macroeconomic variables and stock price behavior. Few studies also concluded without noticing any causal relationship. Different findings in different studies might be due to different methodologies applied, different set of variables used for the study and different time periods considered for the study etc. Thus, the causal link between fundamental macroeconomic variables and stock market movements needs fresh enquiry.

Objectives

The main objective of the study is to explore the causal nexus between fundamental macroeconomic variables and stock market returns in India. The specific objectives are:

- To examine the dynamics of short run linkages between macroeconomic variables and stock prices.
- To explore the presence of long run equilibrium relationship between macroeconomic variables and stock prices.
- To capture the linear interdependencies among the variables under study.

Theoretical Framework

The theoretical linkage between the macroeconomic variables and the stock market performance can be directly obtained from the Present Value Model (PVM) and the Arbitrage Pricing Theory (APT). The Present Value Model

focuses on the long run relationship between the stock market movement and the macroeconomic fundamentals. According to these models, any new information about the fundamental macroeconomic factors such as real output, inflation, exchange rate, interest rate, foreign investment and so on may influence the stock price/returns through the impact of expected dividends, the discount rate or both (Chen et al, 1986, Naik & Padhi, 2012). A simple discount model shows that the fundamental value of corporate stock equals the present value of expected future dividends. The future dividends must ultimately reflect real economic activity. If all currently available information is taken into account, there could be a close relationship between stock prices and expected future economic activity. As pointed out by Ahmed, (2008, quoted in Naik & Padi, 2012), these relationships can be viewed in two alternative ways; (i) the stock market as the leading indicator of economic activity or stock market leads economic activity; and (ii) the possible impact the stock market has on the aggregate demand through the aggregate consumption and investment suggesting stock market lags economic activity.

Research Methodology

Variables and Data

Among the many macroeconomic variables, the study is focused on five major variables, viz. the real economic output, foreign institutional investment, inflation, gold price and exchange rate. The purpose is to study the impact of these variables on Indian stock market performance. The

variables are selected based on their theoretical importance, performance measures of the economy and also their uses and findings in the existing stock of empirical literature. The level of real economic activity is regarded as the crucial determinant of stock market returns. To measure the growth rate in real sector Index of Industrial Production (IIP) is used as proxy. Theoretically it is said that increase in IIP increases the profit of industries and corporations. Hence, dividend increases and it results in increase of share prices. Therefore, a positive relationship is expected to between IIP and stock returns. The common perception is that Foreign Institutional Investment (FII) is a driving force of Indian stock market. It has been observed that Sensex increases when there are positive inflows of FII and decreases when there are negative FII inflows. To test this common perception empirically, FII has been included as another explanatory macroeconomic variable. Besides, inflation is another factor which might influence the stock market. When inflation begins to move upward it is likely that the RBI would resort to tight monetary policies which leads to increase in the discount rate. Hence, the cost of borrowing increases which in turn leads to reduction in investment in stock market. So, inflation is inversely related to equity prices. Inflation is measured, in the present study, by changes in Wholesale Price Index (WPI). Stock market is also sensitive to fluctuations in Gold Price (GP). Indian investors tend to invest less in stock as the gold price rises, causing stock prices to fall. Therefore, theoretically, a negative relationship is expected between gold price and

stock price. Exchange rate is another prominent variable which is predicted to generate positive impact on domestic stock price. Depreciation of domestic currency against foreign currencies increases the return on foreign currencies and induce investors to shift fund from Indian stock market to foreign currency assets, causing a crash in the stock price and vice versa. The study employs the Real Effective Exchange Rate (REER), which is the weighted average of Indian rupee relative to a basket of 36 other major currencies adjusted for the effects of inflation as foreign exchange rate.

Currently, there are two major stock exchanges in India; the Bombay Stock Exchange (BSE) and the National Stock Exchange (NSE). The study has used BSE indices to represent the Indian stock market. The monthly average of BSE Sensitive Index (Sensex) for the base year of 1978-79 has been compiled and the average is based on daily BSE closing index.

Hence, the present study tries to investigate the long run and short run relationship between the stock price indices and five macroeconomics variables, by considering the following model:

$X = (SENSEX, IIP, FII, WPI, GP, REER)$ ———————— (1)

Where, *SENSEX* is the BSE sensitive index, *IIP* is the index of industrial production, *WPI* is the wholesale price index, *GP* is the gold price and *REER* is the real effective exchange rate and *X* is a 6×1 vector of variables.

Study Period and Data Source

The study uses the monthly data for the period from April 2010 to June 2014 which involves 51 monthly observations. All the necessary data pertaining to the variables under study for the sample period are obtained from the Hand-book of Statistics on Indian Economy, published by the Reserve Bank of India.

Econometric Specification

With a view to accomplish the pre- determined set of objectives of our research, different set of econometric techniques and tests have been adopted by using E-views. In the present study, the entire methodology of estimating the causal relationship consists of four steps: first, stationary test; second, co-integration test; third, the error correction model; and fourth, causality test.

Test of Stationarity - Unit Root Test

Empirical work based on time series data assumes that the underlying time series is stationary. Broadly speaking a data series is said to be stationary if its mean and variance are constant overtime and the value of co-variance between two time periods depends only on the distance or lag between the two time periods and not on the actual time at which the covariance is computed (Gujarati and Sangeetha, 2007). The present study begins with unit root test of stationarity of all the variables, before applying them in cointegration and causality tests.

An empirical way of checking the stationarity of the time series is by applying Unit Root Test. It has become widely popular test of stationarity over the past several years. Stationarity condition has been tested using Augmented Dickey Fuller (ADF) method. ADF test is the modified version of Dickey-Fuller (DF) test. ADF makes a parametric correction in the original DF test for higher order correlation by adding lagged difference terms of the dependent variable to the right hand side of the regression. The ADF test, in the present study, consists of estimating the following regression.

$$Yt = bo + \beta \Delta Yt_{-1} + \mu_1 \Delta Yt_{-1} + \mu_2 \Delta Yt_{-2} + \sum_{i=1}^{m} \mu i \, \Delta Yt_{-1} + et \quad \text{--- (2)}$$

Where, represents the series to be tested, bO is the intercept term, β is the coefficient of intercept in the unit root test, μ_1 is the parameter of the augmented lagged first difference of the dependent variable, represents the i^{th} order autoregressive process, et is the white noise error term. The number of lagged difference terms to include is determined empirically, the idea being to include enough terms so that the error term is serially uncorrelated (Gujarathi and Sangeetha, 2007).

The stationary condition under ADF test requires that: p value is less than 1 (Ipl <1). Another way of stating the same is that the computed t value should be more negative than the critical t value (t statistic < critical value). The computed t statistic will have a negative sign and large negative t value is generally an indication of stationarity (Gujarathi and Sangeetha, 2007).

Johansen's Co-integration Test

If ADF test results exhibit the stationarity of the time series data and all the data sets are integrated at the same order, then we have to examine whether or not there exists a long run relationship between Sensex and macroeconomic variables. To investigate the cointegration between Sensex and macroeconomic variables, Johansen's Cointegration Test is administered. The Johansen method of co-integration applied in the study is as the follows:

$$Xt = a + \sum_{j=1}^{p} \beta j\, Xt - j + et \quad \text{———————————} \quad (3)$$

where, is an n×1 vector of non-stationary I(1) variables, is an n×1 vector of constants, is the maximum lag length, is an n×n matrix of coefficient and is a n×1 vector of white noise terms. The coefficient value (indicates the degree of co-integration or relationship, while the sign preceding to the coefficient indicates whether the long run relationship between the variables is positive or negative.

Vector Error Correction Model (VECM)

Johansen's co-integration test reflects only the long term balanced relations between BSE Sensex and macroeconomic variables. Of course, in the short run there may be disequilibrium. Inorder to cover the shortage, correcting mechanism of short term deviation from long term balance could be adopted. Therefore, under the circumstances of long term causality, short term causalities should be further tested (Ray, 2012). Hence, the Vector Error Correction Model (VECM) is used to analyze whether

error correction mechanism takes place if some disturbance comes in the equilibrium relationship. In other words, it is to measure the speed of convergence to the long run steady state of equilibrium. Thus the Johansen co-integration equation (3) has to be turned into a vector error correction equation as follows.

$$\Delta Xt = a + \sum_{j=1}^{p-1} \Gamma j \, \Delta Xt - j + \Pi Xt - p + et \text{ ---------- (4)}$$

Where is the first difference operator, is and is equal toand is an identity metrics.

Ganger Causality Test

After doing the co-integration test, the granger causality test is also applied in this study. This is to determine the causality relationship between the variables. Causality is a kind of statistical feedback concept which is widely used in the building of forecasting models (Ray, 2012). The Granger Causality Test (1969, 1988) seeks to determine whether past values of a variable help to predict changes in another variable. The Granger causality technique measures the information given by one variable in explaining the latest value of another variable. In addition, it also says that variable is granger caused by variable if variable assists in predicting the value of variable If this is the case, it means that the lagged values of variable are statistically significant in explaining the variable (Ray, 2012).

The granger method involves the estimation of the regression equations. Granger causality tests the causal relationship between two variables at a time. So,

estimating the power of one variable say, X, to predict the future value of the other variable, Y, contains a set of two equations as given below:

If the causality runs from Y to X, then the granger causality regression equation is;

$$Xt = n + \sum_{a}11\, Xt - 1 + \sum_{\beta}11\, Yt - 1 + \varepsilon_1 t \quad \text{-------- (5)}$$

If the causality runs from X to Y, then the granger causality regression equation is;

$$Yt = n + \sum_{a}12\, Yt - 1 + \sum_{\beta}12\, Xt - 1 + \varepsilon_2 t \quad \text{------ (6)}$$

From the equation (5), granger causes, if X can be predicted by using the past values of Y and at this point, statistically, the coefficient of Y, is significantly different from the zero based on F-test. Similarly, from equation (6), X*t* granger causes , if the coefficient of X i.e. is significant different from zero. This means past values of X can predict the future values of Y with greater accuracy.

Hypotheses

The following hypotheses are tested in this study.

H_o: Sensex, IIP, FII, GP, WPI and REER have a unit root

H_o: There is no co-integration between Sensex and macroeconomic variables

H_o: Sensex does not granger cause macroeconomic variables

H_o: Macroeconomic variables does not granger cause Sensex

Results and Discussion

In order to test whether there exists any co-integration and causality between BSE Sensex and five fundamental macroeconomic variables, viz. IIP, FII, WPI, REER and GP, the pre-condition is that the time series data pertaining to these variables are stationary and do not encounter unit root problem. For this purpose ADF unit root test is administered and the results are presented in Table-1.

Table 1 : Results of ADF unit root test

Variables	At Level I(0)		At 1st difference (1)		Order of Integration	Level of Significance	Decision
	t-stat	p-value	t-stat	p- value			
L Sensex	0.1529	0.9667	-6.7682	0	I(1)	1%	Reject H_0
FII	-4.57	0.0005	-9.1244	0	I(0)	1%	Reject H_0
LGP	-2.7616	0.0712	-5.9263	0	I(1)	1%	Reject H_0
LIIP	-3.2442	0.0233	12.3538	0	I(0)	5%	Reject H_0
LWPI	-1.6807	0.4347	-5.3548	0	I(1)	1%	Reject H_0
LREER	-1.7706	0.4222	-56451	0	I(1)	1%	Reject H_0
Critical Value	1%	-3.5683	1%	-3.5713			
	5%	-2.9212	5%	-2.9224			
	10%	-2.5986	10%	-2.5992			

The results show that of the six variables, time series of two variables, viz. FII and IIP do not have any unit root problem and hence become stationary 'at level' [I(0)]. However, after 'first differencing' [I(1)] even the remaining four time series variables viz. SENSEX, GP, WPI and REER attain stationary. Hence, the null hypotheses (H_0) of the study stating the variables taken for study have unit root problem are rejected and alternative hypotheses of no unit root problem are accepted. Table-1 reveals that all the variables of the study except IIP are stationary and integrated at 1percent level of significance. Whereas, even IIP becomes stationary at I(0) order of integration but at 5 percent level of significance.

After ensuring the stationarity of the time series data of Sensex and five macroeconomic variables, a co-integration test is carried out by using Johansen's method to identify whether there exists any long run equilibrium relationship between the variables under study. The results of Johansen co-integration test are shown in Table 2.

The results of Johansen co-integration test as presented in Table-2 exhibit that the trace statistic for the calculated Max-Eigen value (177.80) is more than its critical value (95.75) indicating the presence of co-integration between variables. But in a multivariate model Max Eigen test is more significant in making decisions regarding the presence of co-integration, while the trace statistic test would be suggested for bivariate model. The Max Eigen statistic value (77.5284) is greater than its critical value (40.0776) at

5 percent level of significance. This indicates a strong co-integration between the Sensex and other macroeconomic variables. The results of Johansen co-integration test denote that the null hypothesis H_0: there is no co-integration between the variables is rejected at 5 percent level of significance. This in turn leads to the inference that there is co-integration between the six variables under study and the results also reveal the existence of three co-integration equations.

Table 2 : Results of Johansen Co-integration test

Cointegration Test	No. of Cointegrating Equations	Max.Eigen Value	Statistic	C.V at 5%	Prob
Trace Test	H_0: r=0 (none)*	0.8146	177.8	95.7537	0
	H_1: r≤1 (at most 1)*	0.5942	100.2727	69.8189	0
Max. Eigen	H_0: r=0 (none)*	0.8146	77.5284	40.0776	0
	H_1: r≤1 (at most 1)*	0.5942	41.4881	33.8769	0.0051

Max-eigenvalue test indicates 3 co-integrating eqn(s) at the 0.05 level.
* denotes rejection of the hypothesis at the 0.05 level.

After confirming the presence of co-integrating vectors based on Johansen co-integration test results, the short run

and long run interaction of the underlying variables is examined by fitting them in Vector Error Correction Model (VECM) based on Johansen co-integration methodology. The results show that a long run equilibrium relationship exists between the stock market indices and the macroeconomic variables. The estimated co-integrating coefficients for the BSE Sensex based on the first normalized eigenvector, derived from the results presented in Table-3, are as follows:

LSENSEX= -35029.58 + 85.3753 LIIP + 11.58215FII +
[8.59258] [9.27283]

233.8315LWPI - 0.517947LGP +126.5219LREER ---(7)
[35.0714] [-26.5874] [5.49606]

The variables are converted into log transformation and these values represent long term elasticity measures. The t-statistics of the co-integrating coefficients of macroeconomic variables are given in brackets. The coefficients for LIIP, FII, LWPI and LREER are positive while the coefficient for LGP is negative and statistically significant. The signs of all variables except for LWPI are in line with theoretical predictions. The results reveal that stock returns are positively and significantly related to the Index of Industrial Production. This implies that increase in industrial production index increases the corporate earnings which enhance the value of the firms and hence the stock prices increase. A positively significant FII compliments the theoretical underlining which says that

increasing inflow of foreign institutional investment would drive the stock market positively, while their withdrawal from stock market would negatively affect the stock returns.

Besides IIP and FII, WPI is another major macroeconomic variable which determines the stock indices. Much against to the anticipation and contrary to the theoretical belief of inverse relationship, WPI was found positively related with stock market. The coefficients of other two variables of the study viz. GP and REER carry negative and positive signs respectively as expected. The negative coefficient value of gold price which is significant at 5 percent level is corresponding to the theoretical framework. According to the theoretical understanding, as the gold price rises, Indian investors tend to invest less in stocks, causing stock prices to fall and vice versa. The co-integration test also indicates that REER is another influential factor in stock market and its co-integration with Sensex is statistically significant at 5 percent level. The impact of change in REER is positive on BSE Sensex. India being import dominant country, appreciation of rupee against foreign currencies reduces the import bill which in turn causes higher cash flows, more profit and better stock price of the domestic firms.

Table 3 : Results of Vector Error Correction Model (VECM)

Panel A: Normalised Co-integrating Coefficients						
LSENSEX(-1)	**LIIP(-1)**	**FII(-1)**	**LWPI(-1)**	**LGP(-1)**	**LREER(-1)**	**Constant**
1	-85.3753	-11.58215	-233.8315	0.517947	-126.5219	35029.58
	(9.93594)	(1.24904)	(6.66729)	(0.01948)	(23.0205)	
	[-8.59258]	[-9.27283]	[-35.0714]	[26.5874]	[-5.49606]	
Panel B: Coefficient of Error Correction Terms						
DL(SENSEX)	**DL(IIP)**	**D(FII)**	**DL(WPI)**	**D(GP)**	**DL(REER)**	
- 0.882557	0.008991	-0.071021	0.000720	- 0.060031	0.002669	
(0.39267)	(0.00463)	(0.05925)	(0.00063)	(0.59034)	(0.00088)	
[-2.24760]	[1.94361]	[-1.19868]	[1.13438]	[-0.10169]	[3.04766]	

Note: Standard errors in ( ) and t-statistics in [ ].

The coefficient of the Error Correction Term (ECT), as shown in Table-3, is negative (-0.8826) and statistically significant at 5 percent level. This implies that Sensex do respond significantly to re-establish the equilibrium relationship once deviation occurs. Thus, the statistically significant negative ECT confirms the long run equilibrium relationship between Sensex and macroeconomic variables. The ECT (-0.8826) also exhibits a healthy convergence rate to equilibrium point per period. From this it could be inferred that the speed at which the BSE Sensex adjusts in the absence of any shocks is at the rate of approximately 8.83 percent per month.

As the Johansen co-integration test exhibits only the presence of long run equilibrium relationship between Sensex, IIP, FII, WPI, GP and REER, pairwise Granger causality test is applied to capture the degree and direction of relationship between such variables. The results of granger causality test are presented in Table-4.

Table flows to next page ...

Table 4 : Results of Granger Causality test

Hypotheses	Lag Length	Obs	F-stat	Prob	Decision	Relationship
H_0: FII does not Granger Cause L(SENSEX)	3	48	3.2652	0.0308	Reject H_0	Unidirectional
H_0: L(SENSEX) does not Granger Cause FII	3	48	1.02705	1.3906	Accept H_0	
H_0 : L(GP) does not Granger Cause L(SENSEX)	1	50	2.11946	0.1521	Reject H_0	Unidirectional
H_0 :L(SENSEX) does not Granger Cause L(GP)	1	50	1.21858	0.2753	Accept H_0	
H_0 : L(IIP) does not Granger Cause L(SENSEX)	2	49	0.07371	0.9291	Accept H_0	No relation
H_0 :L(SENSEX) does not Granger Cause L(IIP)	2	49	1.10360	0.3407	Accept H_0	
H_0 : L(REER) does not Granger Cause L(SENSEX)	1	50	7.98684	0.0069	Reject H_0	Unidirectional
H_0 :L(SENSEX) does not Granger Cause L(REER)	1	50	0.09183	0.7632	Accept H_0	
H_0 : L(WPI) does not Granger Cause L(SENSEX)	2	49	0.76897	0.4696	Accept H_0	No relation
H_0 : L(SENSEX) does not Granger Cause L(WPI)	2	49	0.02429	0.976	Accept H_0	

The granger causality test results indicate the presence of causality between the variables. Though the results rule out the possibility of any bidirectional causal relationship, it explores three unidirectional relations which Sensex shares with FII, GP and REER. The direction of the relationship runs from FII to Sensex, GP to Sensex and from REER to Sensex. FII does granger cause Sensex. This means that the value of the past inflow of FII in India predict the future BSE Sensex value with 95 percent accuracy. According to the test results, gold price appears to have an impact on the stock market in expected lines. The causality runs from gold price to the Sensex. The negative impact of gold price on stock market is confirmed from the negative sign commanded by its coefficient value in normalized co-integrating vectors. The REER has also found to be influencing the stock performance. Any change in the present value of REER would in turn cause significantly the following month's Sensex value. The causality result implies that appreciation of domestic currency will have an impact on domestic stock market and the relationship is likely to be positive, as found in co-integration test. It is also noticed from the causality test that IIP and WPI seems to have no causal relationship with Sensex. Hence, the null hypotheses are accepted.

Conclusion

The aim of this paper is to study the impact of macroeconomic variables on stock market and also to study the causality, if any, between them in Indian economy. The co-integration test results indicate that macroeconomic

variables and stock market are co-integrated and hence, there exists long run equilibrium relationship between them. Index of industrial production and foreign institutional investment have significant positive impact on BSE Sensex. Wholesale Price Index also found to be an influencing factor in Sensex, however, positively, which is much against to the theoretical predictions. Sensex is also found to be governed even by gold price and real effective exchange rate. The relationship between gold price and Sensex appears to be negative. Rise in gold price causes the stock returns to fall. It is also observed that appreciation of rupee relative to foreign currencies leads to upward rise in stock prices.

The causality test reveals the presence of causal relationship between Sensex and macroeconomic factors. The granger causality test pointed towards a unidirectional causality. Foreign institutional investment, gold price and real effective exchange rate are found causing volatilities in BSE Sensex. While the remaining two macroeconomic variables viz. index of industrial production and wholesale price index are not likely to be causing vibes in BSE Sensex. On the whole, it can be inferred that gold price, foreign institutional investment and real effective exchange rate results can be used to predict the stock market movement. Therefore, this concludes that Indian stock marketing is displaying the strong form of market efficiency.

From the results of the study it could be inferred that Indian stock market is volatile both in the short run and in the long run in response to shocks macroeconomic variables. Greater

macroeconomic stability will ensure lesser volatility in the stock market. As the macroeconomic fundamentals of the country grow, stock market would be more matured. Effective government policies for attracting FII, stabilizing exchange rate and keeping gold price in control are awaited for strengthening the stock market.

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