STOCK PRICE MOVEMENT AND THE REAL ECONOMIC PRODUCTION – CAUSALITY ANALYSIS WITH FINANCIAL MODELS IN INDIAN CONTEXT

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Abstract

This study work with the relationship between stock price movement and real economic production. Here drawing of two theoretical models supports my study. The study investigates the relationships between the Indian stock market index (BSE Sensex) and five macroeconomic variables, namely, industrial production index, wholesale price index, money supply, exchange rate and call money rate over the period March-1992 to June-2015. Vector Auto Regressive (VAR) model have been applied to explore relationship between stock market index and macroeconomic variables. The analysis reveals that relationship exists between the stock price return and industrial production and stock price return affects the performances of real sector production.

Keywords: Financial economy, economic growth, stock market, stock index, India.

JEL classification: C10, C51, C58, G00, G12.

1. INTRODUCTION

The financial economy and the real economy are expected to be integrated. A significant statistical relationship between the movement in stock return and the movement in GDP per capita is observed in matured developed economies (Schwert (1989), Chaudhuri and Koo (2001)). At least theoretically, an uptrend in stock indices is a symptom of good performance of the real economy. An increase in stock prices means an increase in wealth, which is likely to increase the demand for consumption and investment goods (Fama, 1990). Development of the financial sector enhances economic growth by supplying capital to the real sector in an efficient manner. Stock price movement influences the portfolio management decision of the investors and behaves as an indicator of the future trends in performance of the real sector. Similarly, the movement in stock prices is influenced highly by the trends in major macroeconomic indicators in the real economy. While the relationship between stock price behaviour and economic performance as observed in the developed world fails to reject the hypothesis as put forward by Fama

(1990), there is little evidence for non-rejecting it in the developing world. The hypothesis predicts that production in the current period is affected by the past production as well as the stock returns of preceding periods. Again, his test in this paper suggests that a large fraction of the variation of stock returns can be explained by expected returns of real activity. Whether this reverse causality relationship holds in case of a developing country context is also an important research question.

Investigating the causal relationship between stock returns and real activity is an interesting and formidable issue particularly in a developing country. This study addresses this issue with Indian data. As the real sector performance plays a significant role in theoretical analysis in the variation of stock returns, we examine the relations between stock returns and growth performance in real activity in Indian economy. It seems unlikely that GDP growth or index of industrial production alone captures fully the variation in stock returns, or the vice versa. In many cases, information about output does not translate into information about cash flows or the discount rates relevant for stock pricing. Also, the variation in stock prices might induce the variation in production through wealth effect[1]. Monetary variables like interest rate, exchange rate or money supply may influence the movement in stock index along with the real economic production. The objective of this study is to examine the both way causality between stock index and index of industrial production.

The paper is organized in the following section. Section 2 gives formation of theoretical models. Section 3 provides some selected literature review. Data source and methodology used in this study are described in section 4. The empirical results are reported and discussed in section 5. Finally, section 6 summarizes and concludes the findings of the study.

2. THE MODEL: ARBITRAGE PRICING THEORY, AND DIVIDEND DISCOUNT MODEL (DDM)

2.1 ARBITRAGE PRICING THEORY

Arbitrage Pricing Theory (APT) is an asset pricing model based on the idea that an asset's return can be predicted using the relationship between the asset and many common risk factors. This theory predicts a relationship between the returns of a portfolio and the return of a single asset through a linear combination of many independent macroeconomic variables. APT is a single-period model that assumes homogeneous expectations of investors and a frictionless capital market, where risk-free lending and borrowing are occurred at the same interest rate.

For a market with n risky securities, the random return R_i of any security i; for $i = 1,2,3,....,n$; is characterized as depending linearly on K common or

[1]Wealth effect is the premise that when the value of stock portfolios rises due to escalating stock prices, investors feel more comfortable and secure about their wealth, causing them to spend more.

pervasive economic factors, each of which has been mean-removed, plus an asset specific random term capturing the part of the security return that this linear equation is unable to capture.

Mathematically,

$$R_i = a_i + b_{i1}F_1 + b_{i2}F_2 + b_{i3}F_3 + \dots\dots + b_{ik}F_k + e_i \text{ .... } (1)$$

Where, a_i is a coefficient. The remaining coefficients, $b_{i1}, b_{i2}, b_{i3}, \dots.. b_{ik}$ commonly called factor loadings, are intended to capture the sensitivities of the random return of security i to the K^{th} common factors, which are themselves random variables. Among double subscripts for these coefficients the first subscript indicates the security involved, and the second subscript indicates the factor involved. The random noise term e_i; which is characterized as having a zero expected value, is the part of the security return that this linear relationship is unable to capture.

Mean removal for a random variable is to subtract its expected value from it. Originally, the economic factors are $F_1, F_2, F_3 \dots\dots, F_k$ with the corresponding expected values being $E(F_1)$; $E(F_2)$; $E(F_3)$;…….; $E(F_k)$Here, we have used $E(.)$ to denote the expected value of any random variable $(.)$. As

$$F_1 = F_1 - E(F_1),\ F_2 = F_2 - E(F_2),\ F_3 = F_3 - E(F_3), \dots.$$

$$\text{and } F_k = F_k - E(F_k)$$

are mean-removed random variables and their expected values $E(F_1)$; $E(F_2)$; $E(F_3)$;…….; $E(F_k)$– are all zeros.

By taking expected values of the two sides of equation (1), we can write

$$E(R_i) = a_i + b_{i1}E(F_1) + b_{i2}E(F_2) + b_{i3}E(F_3) + \dots\dots + b_{ik}E(F_k) + E(e_i) \text{...... } (2)$$

Which is directly leads to:

$$E(R_i) = a_i \text{ .... } (3)$$

That is, the intercept term a_i in the return generating equation for each security i is the expected value of R_i. This is because each random variable on the right hand side of equation (2) has a zero expected value. In statistical notation, it is usually labelled as μ_i .Thus, the return generating equation for each security i can be restated as

$$R_i = \mu_i + b_{i1}F_1 + b_{i2}F_2 + b_{i3}F_3 + \dots\dots + b_{ik}F_k + e_i \text{ .... } (4)$$

We must treat each μ_i there as a parameter that has yet to be determined. Given equation (4), each μ_i is related to the corresponding factor loadings b_{i1}, b_{i2}, b_{i3}....... linearly. Thus, it is reasonable for us to expect the relationship to be of the algebraic form the values of μ_i ; for $i = 1,2,3,...., n$:

$$\mu_i = \lambda_0 + \lambda_1 b_{i1} + \lambda_2 b_{i2} + \lambda_3 b_{i3} + ... + \lambda_k b_{ik} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (5)$$

Where, $\lambda_0, \lambda_1, \lambda_2, ..., \lambda_k$ are parameters. These parameters, which are common for all n securities, have yet to be determined.

The assumption of frictionless short sales makes it possible for someone to invest in the n securities with a zero cash outlay. Suppose that a dollar amount W_i is allocated to security i: If W_i is positive, the corresponding investment in security i is the dollar amount W_i : If W_i is negative instead, security i is held in a short position, and an immediate cash inflow, which is equal to the magnitude of W_i ; is generated.

To achieve a self-financed investment, for which the net dollar amount invested in the n securities is zero, the condition of

$$\sum_{i=1}^{n} W_i = 0 \text{ ,}\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (6)$$

must be satisfied. Here, the use of a summation sign is for notational simplicity, with $\sum_{i=1}^{n} W_i$ standing for the sum of the n individual terms, $W_1, W_2, ..., W_n$.

For each set of $W_1, W_2, ..., W_n$; the random end-of-period payoff from the investment can be expressed as $\sum_{i=1}^{n} W_i R_i$; which is the sum of the n individual terms, $W_1 R_1, W_2 R_2, ..., W_n R_n$. Given equation (4), we can write the investment's random end-of-period payoff as:

$$\sum_{i=1}^{n} W_i R_i = \sum_{i=1}^{n} W_i \mu_i + \left(\sum_{i=1}^{n} W_i b_{i1}\right) F_1 + \left(\sum_{i=1}^{n} W_i b_{i2}\right) F_2 + \left(\sum_{i=1}^{n} W_i b_{i3}\right) F_3 + ... + \left(\sum_{i=1}^{n} W_i b_{in}\right) F_n + \sum_{i=1}^{n} W_i e_i$$

(7)

In addition to the condition that equation (6) provides, let us impose more conditions in assigning $W_1, W_2, ..., W_n$ to the n individual securities. In the language of finance, such a self-financed investment has no systematic risk that is associated with the under- lying economic factors. Thus, the following conditions hold.

$$\sum_{i=1}^{n} W_i b_{i1} = 0 , \sum_{i=1}^{n} W_i b_{i2} = 0 , \sum_{i=1}^{n} W_i b_{i3} = 0 ,\ldots\ldots, \sum_{i=1}^{n} W_i b_{in} = 0$$

Once the conditions are imposed, equation (7) becomes

$$\sum_{i=1}^{n} W_i R_i = \sum_{i=1}^{n} W_i \mu_i + \sum_{i=1}^{n} W_i e_i \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (8)$$

Each $W_i e_i$ is part of the random component of the end-of-period payoff from the self-financed investment. Each W_i is not a random variable and each e_i ; which is random, has a zero expected value, the corresponding $W_i e_i$ term must have a zero expected value too. The sum $\sum_{i=1}^{n} W_i e_i$; which contains both positive and negative terms attenuates each other. Then equation (8) can be approximated as

$$\sum_{i=1}^{n} W_i R_i = \sum_{i=1}^{n} W_i \mu_i \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (9)$$

As $\sum_{i=1}^{n} W_i \mu_i$ is the dollar amount of the expected end-of-period payoff, an immediate implication of equation (9) is that the end-of-period payoff is always as expected. That is, there is no randomness in $\sum_{i=1}^{n} W_i R_i$. In a market where no arbitrage profits are available, a self-financed investment without any risk must have a zero end-of-period payoff[2].

Ross (1976) showed that the algebraic consequence of the above equations is that the expected return vector must be a linear combination of the constant vector and the coefficient vectors. Where λ_k is the risk premium required by an investor per unit of risk due to unexpected shocks in the kth factor and if there is a riskless asset with a riskless rate of return, R_f ,We can write, $R_f = \lambda_0$. By substituting equation (5) into equation (4)

$$R_i = R_f + b_{i1}(F_1 + \lambda_1) + b_{i2}(F_2 + \lambda_2) + b_{i3}(F_3 + \lambda_3) + \ldots\ldots\ldots\ldots\ldots + b_{ik}(F_k + \lambda_k) + e_i \quad (10)$$

Or, in excess return form:

$$R_i - R_f = b_{i1}(F_1 + \lambda_1) + b_{i2}(F_2 + \lambda_2) + b_{i3}(F_3 + \lambda_3) + \ldots\ldots\ldots\ldots\ldots + b_{ik}(F_k + \lambda_k) + e_i \quad (11)$$

[2]This economic feature is crucial for the model derivation.

2.2 DIVIDEND DISCOUNT MODEL (DDM)

The simplest model for equity valuation is Dividend Discount Model (DDM) - the intrinsic value of a stock is the present value of expected dividends on it. Much of the intuition that drives discounted cash flow (DCF) valuation is embedded in the Dividend Discount Model (DDM). An investor in a dividend paying stock expects two sets of future cash flows: a stream of future dividends and a sale price when the stock is sold. When one buys a stock today, there is usually no immediate benefit at all: The benefit comes in the future when one receives a flow of dividend payments, and/or sells the stock for a gain.

A stock price P_t for today and sells it tomorrow for price P_{t+1}generates a rate of return on this investment of

$$r_{t+1} = \frac{D_t + \Delta P_{t+1}}{P_t} \qquad \text{……………………} (12)$$

In equation (12) we have two components, first component D_t is the dividend payment during the period the stock was held, and the second component is the price change, it may capital gain (or loss), from period t to period t + 1.

Now the gross return equation, which is just one plus the rate of return, can be written as:

$$1 + r_{t+1} = \frac{D_t + P_{t+1}}{P_t} \qquad \text{……………………} (13)$$

A useful re-arrangement of equation (13) is the following:

$$P_t = \frac{D_t}{1 + r_{t+1}} + \frac{P_{t+1}}{1 + r_{t+1}} \text{……………………….} (14)$$

Now we are considering a rational expectation approach for determination of stock prices. In this context of stock prices, rational expectations mean investors understand above equation and that all expectations of future variables must be consistent with it. This implies

$$E_t P_t = E_t \left[\frac{D_t}{1 + r_{t+1}} + \frac{P_{t+1}}{1 + r_{t+1}} \right] \text{………………………..} (15)$$

Where E_t implies the expectation of a variable at time t. The stock price at time t can observed by the agent so $E_t P_t = P_t$, implying

$$P_t = E_t \left[\frac{D_t}{1 + r_{t+1}} + \frac{P_{t+1}}{1 + r_{t+1}} \right] \qquad \text{…………………………..} (16)$$

If we assume is that the return on stocks is expected to equal some constant value for all future periods:

$$E_t r_{t+k} = r \qquad K = 1,2,3.... \qquad ……….. (17)$$

Thus equation (16) can be written as

$$P_t = \frac{D_t}{1+r} + \frac{E_t P_{t+1}}{1+r} \qquad ………………………… (18)$$

Above equation is a specific example of what is known as first-order stochastic difference Equation. The general approach of this type of equation can be written as

$$y_t = ax_t + bE_t y_{t+1} \qquad ………………………… (19)$$

The above equation holds in all periods, so under the assumption of rational expectations, the agents understand the equation and formulate their expectation in a way that is consistent with it. Now we have:

$$E_t y_{t+1} = aE_t x_{t+1} + bE_t y_{t+2} \qquad ……………………….. (20)$$

Substituting this into the previous equation, we get

$$y_t = ax_t + abE_t x_{t+1} + b^2 E_t y_{t+2} \qquad ……………………….(21)$$

Repeating this method, we get a general solution of the form

$$y_t = ax_t + abE_t x_{t+1} + ab^2 E_t x_{t+2} + ... + ab^{N-1} E_t x_{t+N-1} + b^N E_t y_{t+N} \qquad …….. (22)$$

This equation can be written in more compact form as

$$y_t = a\sum_{k=0}^{N-1} b^k E_t x_{t+k} + b^N E_t y_{t+N} \qquad ………………… (23)$$

Comparing equations (18) and (19), we found that our stock price equation is a special case of the first-order stochastic difference equation with $y_t = P_t$; $x_t = D_t$; $a = \frac{1}{1+r}$ and $b = \frac{1}{1+r}$

This implies that the stock-price can be expressed as follows:

$$P_t = \sum_{k=0}^{N-1} \left(\frac{1}{1+r}\right)^{k+1} E_t D_{t+1} + \left(\frac{1}{1+r}\right)^N E_t P_{t+N} \qquad …………………… (24)$$

Again, an assumption holds that the final term tends to zero as N become large:

$$\lim_{N\to\infty}\left(\frac{1}{1+r}\right)^{N} E_t P_{t+N} = 0 \text{ .... (25)}$$

If equation (25) not hold and we set all future values of $D_t = 0$, and then the stock price would still be positive. But a stock that never pays out should be inherently worthless, so this condition rules this possibility out. With imposition of equation (25), our solution becomes:

$$P_t = \sum_{k=o}^{\infty}\left(\frac{1}{1+r}\right)^{k+1} E_t D_{t+k} \text{ .... (26)}$$

Above equation states that stock prices should equal a discounted present-value sum of expected future dividends, is usually known as the *dividend-discount model*. The Gordon(1962) growth model is a special case that is often used as a benchmark for thinking about stock prices is the case in which dividends are expected to grow at a constant rate such that:

$$E_t D_{t+k} = (1+g)^k D_t \text{ .... (27)}$$

Thus, according to the dividend-discount model the stock price should be given by:

$$P_t = \frac{D_t}{1+r}\sum_{k=0}^{\infty}\left(\frac{1+g}{1+r}\right)^{k} \text{ .... (28)}$$

Here we can use geometric series formula as long as $\frac{1+g}{1+r}\langle 1$ i.e., as long as r (the expected return on the stock market) is greater than g (the growth rate of dividends). Thus, we have:

$$P_t = \frac{D_t}{1+r}\frac{1}{1-\frac{1+g}{1+r}} = \frac{D_t}{1+r}\frac{1+r}{(1+r)-(1+g)} = \frac{D_t}{r-g}$$

When dividend growth is expected to be constant, prices are a multiple of current dividend payments, where that multiple depends positively on the expected future growth rate of dividends and negatively on the expected future rate of return on stocks. This formula is called the Gordon growth model.

3. LITERATURE REVIEW

There are notable numbers of studies looking into the relationship between stock price returns and real sector variables by using different methodologies and data sources. However, most of the studies are based on the data from developed countries. Chen et al. (1986) empirically examined the link between stock prices and macroeconomic variables by taking industrial production, changes in the risk premium, spread between long and short interest rate and measure of unanticipated inflation. Schwert (1989) found that the volatility of stock return is affected by the volatility of inflation rates, money growth and industrial production along with financial leverage, bond return, asset return volatility and trading activity. Mukharjee and Naka (1995) used Johansen's (1991) Vector error correction model to investigate whether co-integration exists between stock exchange index and six macro-economic variables like exchange rate, money supply, inflation, industrial production, long term government bond rate and call money rate in Japan. By employing the vector error correction model (VECM) in a system of seven equations, they found that the Japanese stock market is co-integrated with a group of six macroeconomic variables.

Levine and Zervos (1998) investigated the relationship between the financial sector development and the economic growth taking data of 47 countries during 1976-1993. By using ordinary least square approach they observed that stock market liquidity positively correlated with contemporaneous and future rates of economic growth after controlling for initial income, school enrolment rate, political instability, fiscal policy, inflation rate and initial value of the black market premium. Shen and Lee (2006) also empirically investigated the relationship between financial development and real GDP per capita growth in 48 countries from the period 1976–2001 and found that only stock market development has a positive effect on the growth of real per capita GDP. The results suggest that an even stronger second-order polynomial relationship exists between stock market development and growth.

Patrick (1966) examined the causal relationship between financial development and economic growth by taking separately the supply leading approach and demand flowing approach to financial development. In this study, an improved financial sector motivates the real sector for higher production which leads to higher per capita income and thus real economic growth. On the other hand, economic growth renders the development of intermediation systems for more productive activity. Thus, there may exit two way causal relationship between the financial sector and real economic growth. Ratanapakorn and Sharma (2007) analysed the short and long-term relations between US stock prices and six macroeconomic variables using monthly data from 1975 to 1999 found that every macroeconomic variable causes the stock prices in the long-run but not in the short-run. He found that the causality in reverse direction from stock price to macro-variables in short run whereas in the long run all macro variables affect the US stock prices along with large portion of variance of stock price explained by own shock.

Naik and Padhi (2012) empirically tested the same relationship between the stock price movement and the real macro-economic activity with the Indian data on monthly data over the period April-1994 to June-2011. Their study investigated the relationship between stock prices and five macroeconomics variables such as industrial production index, money supply, inflation, risk-free interest rates, and exchange rates for India. In time series analysis they used the co-integration for testing the existence of long run relationship and also used Vector error correction model (VECM) for analysing long run and short run causality between the macroeconomic variables and the stock market index. It is 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 are found to be insignificant in determining stock prices. There is bidirectional causality exists between industrial production and stock prices whereas, unidirectional causality from money supply to stock price, stock price to inflation and interest rates to stock prices are found. Increase in the industrial production, increases economic activity, increases profit of the firm and stock price also increases. In the reverse way, if the stock price is high, investment is also high, leads to higher industrial production and GDP growth. Growth rate of industrial production shows a strong relation with the stock return (Fama (1981)). Fama's (1990) article tried to draw a relationship between production and stock return. In this article industrial production, used as a proxy variable for expected cash flows, influenced 43% of the stock return. Ahmed (2008) study investigated the nature of causal relationships between stock prices and the macro economic variables of the Indian economy for the period March 1995 to March 2007 using quarterly data. This study also found that movement in stock prices causes' movement in IIP supports the same finding of stock prices leads real economic activity whereas stock prices had no significant effect on FDI. Thus, stock market movement in India seems to be driven by the performance of industry in domestic market rather than in export market.

Therefore, in this study we have tried to analysis the relationship between the stock price movement and the industrial production taking other macroeconomic variables as control variables as many previous studies capture that other macro variable like inflation rate, exchange rate, money supply, interest rate also influencing stock price movement. The macro economic factors are influencing the stock price and in some cases stock price is also influencing the macro economic factors. Thus, there exists an interrelationship between the stock price and the macroeconomic fundamentals. We can find out how this causal relationship occurs in two ways or one way direction. Though some studies tried to investigate the relationship between the stock price index and different macro-economic variables on Indian context but still some in-depth analysis is required to capture the recent scenario of this relationship on Indian economy after the liberalization policy in 1991.

4. DATA SOURCES AND ESTIMATION METHOD

The BSE Sensex is employed as a proxy for Indian stock market indices. Though it is not possible to incorporate every potential aspect to explain the stock market behaviour we limit to select five macroeconomic variables, such as index of industrial production, inflation, exchange rate, money supply and interest rate for serving this purpose. While GDP per capita is widely used to measure economic growth, here index of industrial production (IIP) is used as a proxy for real output, WPI is used in order to incorporate the inflation rate. Again, the real effective exchange rate of the Indian rupee with US dollar (the Monthly average and endmonth rates)used to represent exchange rate, money supply captured by broad money (M3) supply measure and weighted average call money rate is used to incorporate the short-term risk free interest rate.

The level of real economic productivity is measured by the Index of industrial production (IIP). The traditional measure of the real economic productivity is gross domestic product (GDP) or gross national product (GNP). Data unavailability on monthly basis series of GDP and GNP restricts to use the monthly series of IIP as alternative to incorporate the real economic productivity. GDP includes value added both from the real as well as the financial sectors. IIP, on the other hand, generated solely from the non-financial sector. Thus, in finding out the relation between stock price index and real sector growth, IIP may be the better choice as a proxy for output. Moreover, the industrial production series (IIP) explain more return variation than GDP or GNP series. Inflation rate is proxied by wholesale price index (WPI).IIP and WPI are indexes which are free from influences of price changes.

For the present purpose of analysis monthly data ranging from March-1992 to June-2015 are obtained, which comprises total 280 data points. This study uses the time series monthly data of index of industrial production (IIP), wholesale price index, exchange rate, money supply (M3) and call money rate obtained from *Handbook of Statistics on Indian Economy (2016)* published by the Reserve Bank of India. The data of Bombay Stock Exchange (BSE Sensex) is collected from the Historical Data of BSE Sensex. The close value of BSE Sensex data is taken for the analysis. The base period for index series (IIP and WPI) are2004-05 = 100. Whereas, BSE Sensex data is based for the month November-2004 = 100, for the purpose of making accuracy of the analysis.

The current series of IIP and WPI are based for the year 2004-05. To extend the series back to March-1992, we have combined the current series with the earlier series with base period 1993-94 for both IIP and WPI series, again with the earlier base 1980-81 for the IIP series and with the earlier base 1981-82 for the WPI series. The choice of the study period is to capture the scenario of post-liberalization period to current period based on availability of data series. All variables are converted into natural logarithmic form for smoothing out the series.

As the data used in this study are time series, we have applied time series econometrics. Any monthly macroeconomic series is composed of four components; trend (T) cyclical (C) seasonal (S) and irregular (I) component[3]. As series are monthly series, they have similar fluctuation on common interval. Seasonality

[3]The trend component shows the permanent growth in the series due to structural factors like technological change or/and improvement in total resources in the economy. The cyclical component shows ups and downs in the economy due to temporary factors like demand side imbalances. Seasonality occurs when the time series exhibits regular fluctuations during the same month (or months) every year, or during the same quarter every year. And the random term shows some unpredictable events in the economy.

presents in the data series. We converted each data series in to de-seasonalized[4] data series with their natural logarithm.

To examine the existence of causality among variables we use Vector Auto Regressive test or VAR test for analysing the causality and the direction of causality among variables. In VAR, a causality test, which is also called multivariate generalization of the Granger causality test, examines whether the lags of one variable X_1enter into the equation for another variable X_2. More precisely, a variable $X_1$is said to Granger-cause another X_2if the present value ofX_2can be predicted not only by using past values ofX_2 but also past values ofX_1.Granger-causalitybasically means a correlation between the current value of one variable and the past (lags) value of others. IfX_1Granger-causes X_2, then the causality is called unidirectional from $X_1$to X_2 or one way causal relationship. On the other hand, if both variables Granger-cause each other, then it can be stated as bi-directional causality or two way causal relationship.

VAR model, popularized by Sims (1980), estimated by considering the simple bivariate system is following:

$$X_{1t} = b_{10} - b_{12}X_{2t} + \gamma_{11}X_{1t-1} + \gamma_{12}X_{2t-1} + \varepsilon_{1t}$$

$$X_{2t} = b_{20} - b_{21}X_{1t} + \gamma_{21}X_{1t-1} + \gamma_{22}X_{2t-1} + \varepsilon_{2t} \quad (29)$$

Where,(i) both X_{1t} and X_{2t} are stationary. (ii) ε_{1t} and ε_{2t} are uncorrelated white-noise disturbances.

We apply VAR if the variables in the system of equation are not integrated of same order. To find out the order of integration of the variables, we have performed the Augmented Dickey-Fuller (ADF) unit root test. We have using an autoregressive (AR) model[5] to find out whether a time series variable is non-stationary or stationary. This test is important as it shows the number of times the variable has to be differenced to arrive at a stationary value. In general, economic variables which are stationary are called I (0) series and those which are to be differenced once in order to achieve a stationary value are called I (1) series.

The ADF unit root test is performed by estimating the following model (Dickey and Fuller, 1981):

$$\Delta Y_t = \phi_0 + \rho Y_{t-1} + \sum_{j=1}^{p} \beta_j \Delta Y_{t-j} + \gamma t + \varepsilon_t \quad \text{.....................(30)}$$

The hypothesis to be tested is

[4]For de-seasonalization each logarithmic data series regressed on the time variable and then subtracted the seasonal component from each data series.
[5]Order criterion must be selected for each series to incorporate the number of augmented terms in model formation of augmented dickey fuller unit root test. AIC tends to be more accurate for monthly data.

$H_0 : \rho = 0$

$H_1 : \rho < 0$

Rejection of H_0 means that the series does not contain unit root and it follows difference stationary process.

The Dickey Fuller unit root tests are biased toward non-rejection of the unit root null when there are structural breaks in the series. Perron (1989) showed that a standard Dickey-Fuller (1979) (DF) type unit root test is not consistent if the alternative is that of a stationary noise component with a break is present in the slope of the deterministic trend. His main point is that the existence of an exogenous shock which has a permanent effect will lead to a non-rejection of the unit root hypothesis even though it is not true. Break point implies if there is any change of the series with respect to time. If the value of the coefficient of the time variable significantly changes at a particular time, then that particular time is the break point.

5. EMPIRICAL RESULT AND INTERPRETATION

At first, we are converting each series in to log series simply taking the log transformation of each series for smoothing out fluctuations of each series. For our empirical study conduction, the time series properties of the variables need to be examined. The graphical depictions of each series are given the visual concept for further analysis (FigA.1 to FigA.6).

We found that these series have regular fluctuation and have some upward movement or permanent growth in the series. Thus, the series Bombay stock exchange (bse), index of industrial production (iip), wholesale price index (wpi), exchange rate (exrt) and money supply (mnss) (FigA.1 to FigA.5) incorporate seasonal component and trend component[6]. Again, for the series of call money rate (calmrt) from the graph (FigA.6) it is shown that this series is not incorporating any permanent growth or upward trend movement, thus is not incorporating the trend component. Bombay stock exchange (bse), index of industrial production (iip), wholesale price index (wpi), exchange rate (exrt) , money supply (mnss) and call money rate (calmrt) each series are seasonally adjusted for removing the seasonal component from each series (graphs FigA.1 to FigA.6 in appendix section).

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[6]A non-stationary series exhibits trend. Trend may be of two types; deterministic trend and stochastic trend. A time series with deterministic trend follows trend stationary process (TSP), while a non-stationary time series showing stochastic trend is a difference stationary process (DSP). In a series following TSP, cyclical fluctuations are temporary around a stable trend, while for DSP any random shock to the series has a permanent effect. The cyclical components of a TSP originate from the residuals of a regression of the series on the variable time, and a DSP involves regression of a series on its own lagged values and time. A TSP has a trend in the mean but no trend in the variance, but a DSP has a trend in the variance with or without trend in the mean.

Table 1: *Break point years of different series*

Series Name	Andrews Break Point	Significance Level
Ln_bse	May-2003	0.00
Ln_iip	March-2006	0.01
Ln_wpi	No significant break point found	
Ln_exrt	September-2011	0.01
Ln_mnss	No significant break point found	
Ln_calmrt	April-1996	0.06

Source: Historical Data of BSE Sensex and Handbook of Statistics on Indian Economy2016, RBI.

Above table shows the break points of different series. Here as the data is monthly data, break point of a series is a particular month of a year for which the coefficient of the time variable month changes. A series may have one or more than one break points. Here we have used Andrews's break point test, which repots the most significant break point. Stock index series break point is in May-2003 and index of industrial production series break point is in March-2006. Exchange rate and call money rate series incorporate breaks in monthSeptember-2011and April-1996 respectively. No significant breaks are found in wholesale price index and money supply series.

Unit root test on relevant economic variable is in order to determine time series characteristics. Tables 2 shows the results of Unit root test. The values of the coefficients are written in the second column in the tables with their significance (p-value) denoted by (*).

Table 2: *Results of the Unit root test of the seasonally adjusted series*

Series Name	Co-efficient value
Ln_bse	-0.08***
Δ Ln_bse	-0.96***
Ln_iip	-0.15***
Ln_wpi	-0.05**
Δ Ln_wpi	-1.18***
Ln_exrt	-0.02**
Δ Ln_exrt	-0.83***
Ln_mnss	-0.11***
Ln_calmrt	-0.22***

Source: Historical Data of BSE Sensex and Handbook of statistics on Indian Economy 2016, RBI.

Note: *** implies significant in 1% level, ** implies significant in 5% level,* implies significant in 10% level and the rest are insignificant.

In case of BSE Sensex, WPI and exchange rate, it is shown that in level form all coefficient values are significant in 1%, 5% and 10% level respectively and the vales of coefficients are close to zero. It implies there is unit root for each series in the level form and thus each series is non-stationary in level. But when the series are converted in first difference form their coefficients become negative means less than zero and also significant in 1% level implies stationarity of each series. Whereas coefficient values of IIP, money supply and call money rate series are significantly less than zero in 1% level implies stationarity of each series in level form.

The series of Bombay stock exchange (bse), wholesale price index (wpi), and exchange rate (exrt) is non-stationary in level but stationary in the first difference is sufficient to show that series are I (1).Index of industrial production (iip),money supply (mnss) and call money rate (calmrt) are stationary in level implies integrated of order zero i.e., I (0).

Now to examine the existence of causality among variables we use Vector Autoregression Model or VAR test for analysing the causality and the direction of causality among variables. Thus, we found how relationships exit between the stock price movement and the macroeconomic variables. In multivariate context all variables under consideration are not found to be of same orderly integrated. For this purpose, we are taken the stationary form of all series. As Bombay stock exchange (bse), wholesale price index (wpi), and exchange rate (exrt) are difference stationary then we are used first difference form of these series for the purpose of VAR analysis. Whereas index of industrial production (iip), money supply (mnss) and call money rate (calmrt) are stationary in level then we are used level stationary series of IIP, money supply and call money rate for VAR analysis.

Table 3: *Results of Vector Autoregression Model*

Independent Variables	**Dependent Variables**					
	ΔLn_bse	Ln_iip	ΔLn_wpi	ΔLn_exrt	Ln_mnss	Ln_calmrt
Δ Ln_bse	-0.01	0.04**	-0.03**	-0.04***	-0.02	0.13
Ln_iip	-0.12	0.93***	0.02	0.02	0.04	0.02
Δ Ln_wpi	0.01	-0.14	-0.11*	-0.28***	-0.22*	-1.59
Δ Ln_exrt	-0.75***	0.14	-0.05	0.25***	-0.06	4.32***
Ln_mnss	0.05	0.03***	-0.01	-0.01	0.98***	-0.03
Ln_calmrt	-0.02**	0.00	0.00	0.00	0.00	0.73***
Constant	0.01**	0.00***	0.01***	0.00***	0.01***	-0.01

Source: Historical Data of BSE Sensex and Handbook of statistics on Indian Economy 2016, RBI.

Note: *** implies significant in 1% level, ** implies significant in 5% level,* implies significant in 10% level and the rest are insignificant.

For previous period exchange rate and interest rate are significantly influencing the current stock index. There exits inverse relationship between stock index and change in exchange rate; and stock index and interest rate. Thus, the past period decrease in exchange rate increases the current stock price. If the real dollar exchange rate rises, firm's profit falls and so does the firm's share price and vice versa. Thus, exchange rates affect stock prices (Asprem (1989)).Interest rate and stock price are negatively related (Asprem (1989)). If the rate of interest paid by the banks to depositors increases, people switch their capital from share market to bank. This will lead to decrease the demand of share and decrease the price of share and vice versa. In case of current period index of industrial production is significantly positively influenced by previous period stock return, index of industrial production and money supply. If the stock price is high, investment is also high, leads to higher industrial production and GDP growth. Industrial production shows a positive relation with the stock return. Growth rate of industrial production shows a strong relation with the stock return (Fama (1981)).Increase in money supply increases economic activity as the cash flow in hands of public increases it raises the producible output. For inflation rate is significantly negatively affected by previous period stock return(Fama (1981)) and significantly negatively affected by past period inflation rate. If the stock price fall inflation rate move upward as people like to buy fewer financial assets and more durable goods with money which leads to increase in the price level of goods result of demand increase.

We get current period change in exchange rate is affected by previous period change in exchange rate as well as BSE Sensex return and inflation rate. Exchange rate is inversely related with BSE Sensex return and inflation rate. If the stock price decreases, then people in state of investment in the share market like to hold money in hand. Excess money supply increases the price level and thus the exchange rate. Again, if there is signal about a probable high inflation in the future, it may cause traders to sell the currency of domestic country. This leads depreciation of currency value i.e., depreciation of exchange rate. Present period money supply is influenced by past period money supply and inflation rate. Inflation rate is negatively affected money supply. If the inflation rate in the previous period is higher, then the central bank or monetary authority of a country decreases the money supply in the current period to control the higher inflation rate. Thus, the inflation rate and money supply negatively related. Again, it shows call money rate which is the proxy of interest rate positively significantly affected by past period interest rate and positively significantly affected by change in exchange rate. When the money supply increases, prices and exchange rate also rise. But since money supply is expected to return to its target level monetary authority increases the interest rate.

Above causality analysis found that there exists only one way causal relationship from stock price movement to real sector production. Two way causal relationship exists between stock return and exchange rate. Bahmani-Oskooee and Sohrabian (1992) paper found a two-way relationship between the stock prices and effective exchange rate of the dollar in the short-run. Unidirectional causality exists from interest rate to stock price movement. One way causal relation also found from stock return to present inflation. In general inflation and stock price are negatively correlated (Firth (1979), Fama (1981), Asprem (1989)). Though some studies also found that when the real output growth rate was controlled the negative relationship between real returns and inflation disappeared (Ahmed and Mustafa (2012)).

We have found that there exits causality runs from previous period stock price return movement to current period production. Results shows partial acceptance of the Fama's (1990) hypothesis that production in the current period is influenced by the past period production as well as the stock price returns of preceding periods. Some previous study like Chakraborty (2008) found that economic growth has 'caused' financial development in India. Whereas Mahajan and Verma (2014) found impact of financial development on economic growth of Indian economy, did not follow Chakraborty (2008) study. This present study also found that past period industrial production along with past period stock price movement influenced the present industrial production. In case of Indian economy, a developing economy, empirical findings did not confirm Fama's (1990) hypothesis.

6. CONCLUSION

Empirical findings of this study shows only one way causal relationship exists between the financial sector and real economy, which goes from the financial sector to the real sector not the other way. This follows the form of supply leading development approach. Supply leading financial development dominates the early stages of economic development especially as it makes it possible to finance investments which embody technological innovations more effectively (Patrick (1966)).

Real sector performance does not influence the financial market return in an emerging economy like India, where real sector is not well connected with the financial sector. Change in return of financial sector occurs largely due to service sector impact and banking sector impact. Speculation also plays a major role in determining the movement of stock price in a developing country like India.

Therefore, from this we can conclude that there exit past period industrial production and stock return both influence present period industrial production. This may indicate that investors in real markets consider both the industrial production and financial stock returns when calculating their expected returns. In this country past stock price movement along with past period producible output might be used to predict the future production. Thus, real production is not influenced the stock price return whereas stock returns influenced the real production. Here we are getting financial market influencing the real economic growth in case of the emerging economy India and thus causality runs from financial sector to economic growth.

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APPENDIX-A

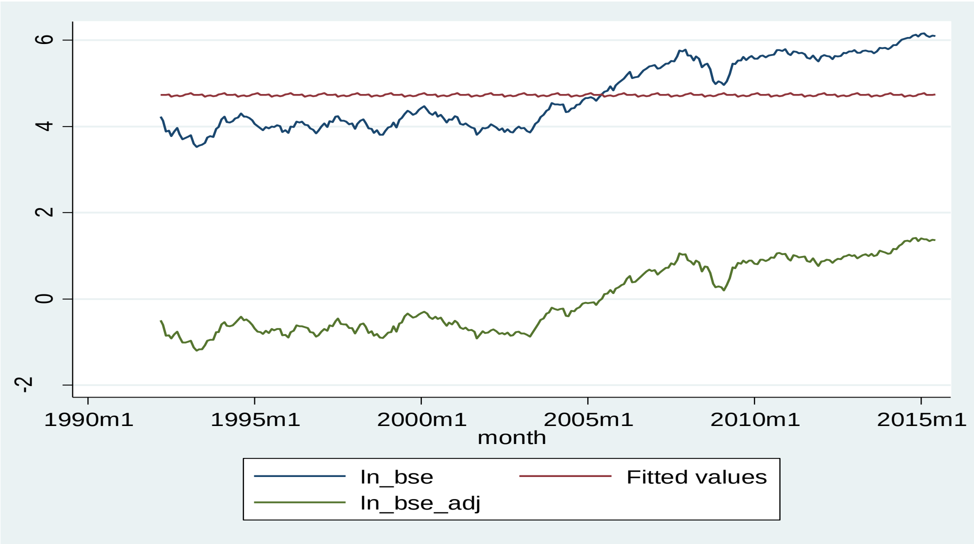

Figure A.1: *log series, seasonally adjusted series and trend series of BSE Sensex*
Source: Historical Data of BSE Sensex.

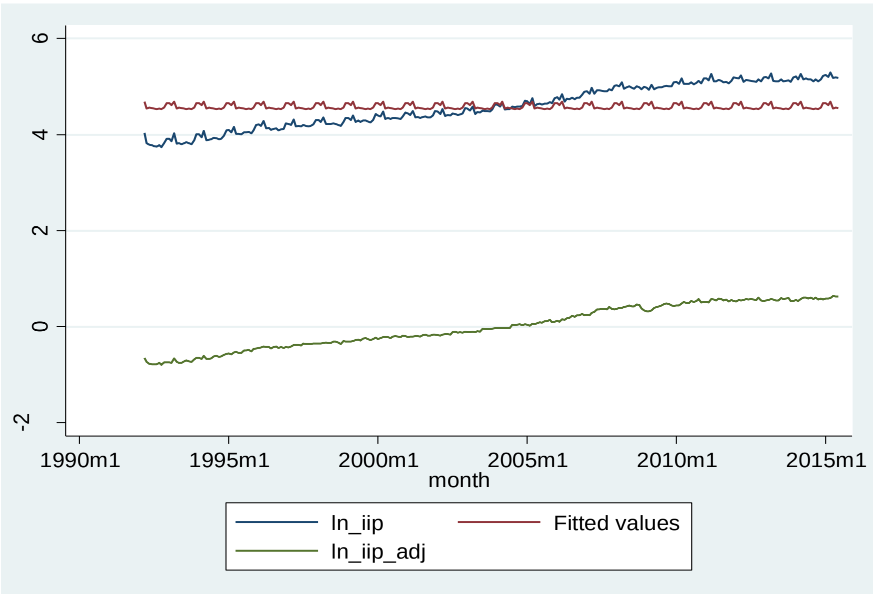

Figure A.2: *log series, seasonally adjusted series and trend series of IIP (index of industrial production)*
Source: Handbook of statistics on Indian Economy 2016, RBI.

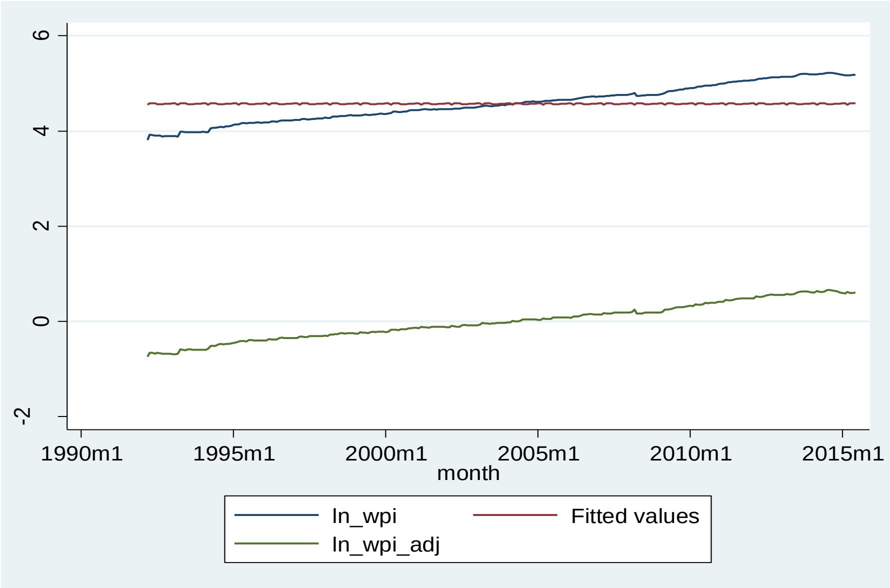

Figure A.3: *log series, seasonally adjusted series and trend series of WPI (wholesale price index):*
Source: Handbook of statistics on Indian Economy 2016, RBI.

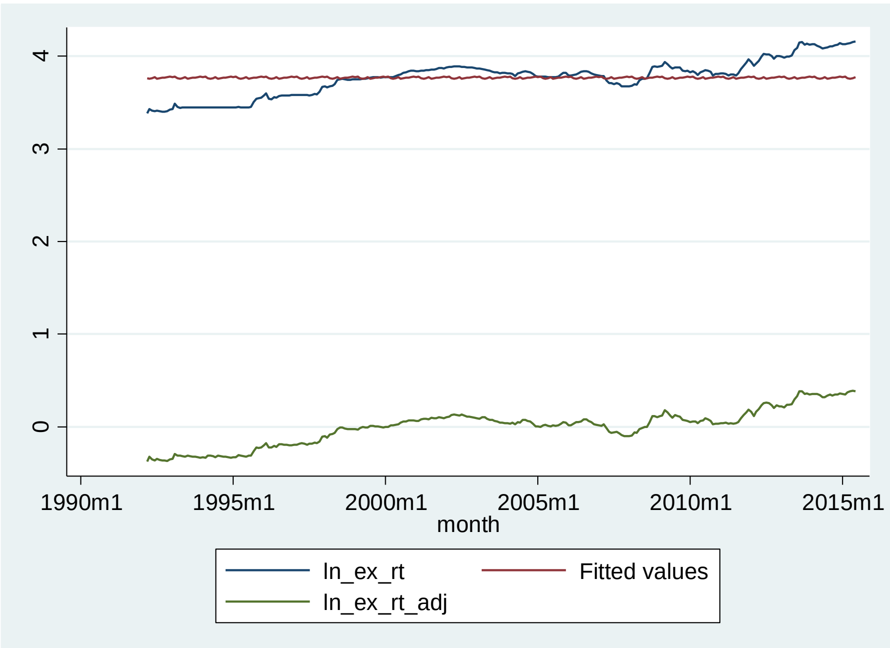

Figure A.4: *log series, seasonally adjusted series and trend series of Exchange Rate*
Source: Handbook of statistics on Indian Economy 2016, RBI.

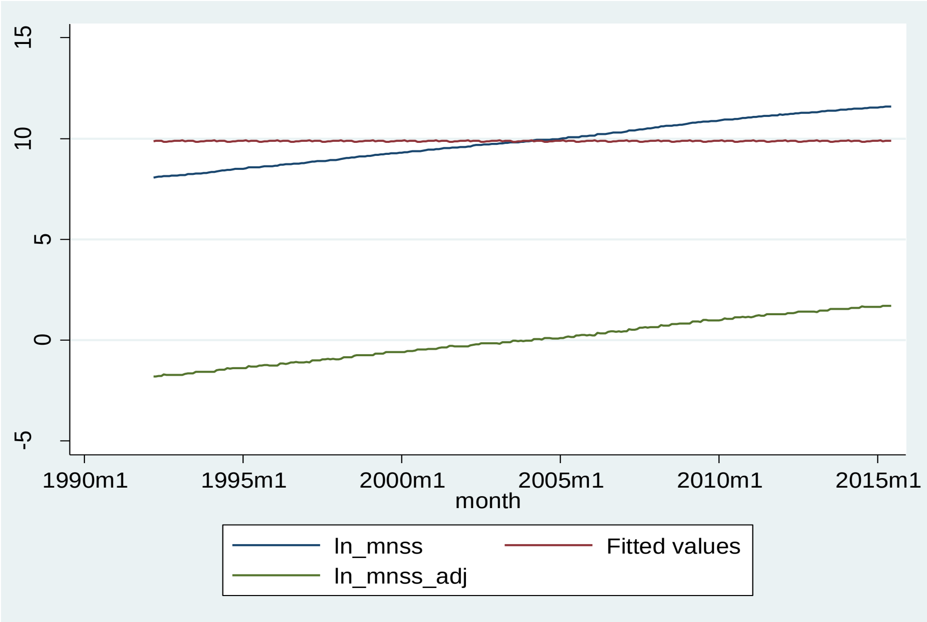

Figure A.5: *log series, seasonally adjusted series and trend series of Money Supply (m3)*
Source: Handbook of statistics on Indian Economy 2016, RBI.

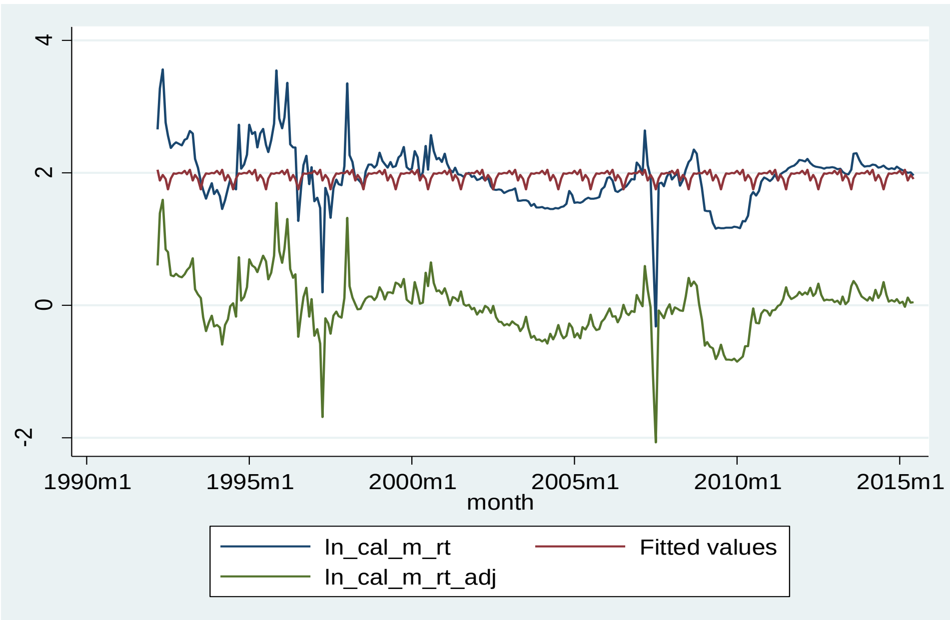

Figure A.6: *log series, seasonally adjusted series and trend series of Call Money Rate*:
Source: Handbook of statistics on Indian Economy 2016, RBI.

Table A.1: *Unit Root Test of BSE Sensex in level form:*

dependent variable	D.ln_bse_adj		
independent variables	Coef.	t-statistics	p-value
L1.ln_bse_adj	-0.08	-3.86	0.00
DL_bse	0.07	3.26	0.00
DP_bse	0.03	0.36	0.72
DT_bse	0.00	1.90	0.06
time	0.00	0.85	0.40
constant	-0.07	-3.30	0.00

Source: Historical Data of BSE Sensex

Table A.2: *Unit Root Test of BSE Sensex in 1st difference form:*

dependent variable	D.d1_ln_bse_adj		
independent variables	Coef.	t-statistics	p-value
L1.d1_ln_bse_adj	-0.96	-15.92	0.00
DL_bse	0.03	1.50	0.14
DP_bse	0.08	1.04	0.30
DT_bse	0.00	-0.81	0.42
time	0.00	0.04	0.97
constant	0.00	-0.14	0.89

Source: Historical Data of BSE Sensex

Table A.3: *Unit Root Test of IIP in level form:*

dependent variable	D.ln_iip_adj		
independent variables	Coef.	t-statistics	p-value
L1.ln_iip_adj	-0.15	-4.32	0.00
ln_iip_adj_d	-0.22	-3.69	0.00
ln_iip_adj_d2	-0.10	-1.81	0.07
DL_iip	0.03	3.67	0.00
DP_iip	-0.03	-1.26	0.21
DT_iip	0.00	-3.84	0.00
time	0.00	4.24	0.00
constant	-0.11	-3.99	0.00

Source: Handbook of statistics on Indian Economy 2016, RBI.

Table A.4: *Unit Root Test of WPI in level form:*

dependent variable	D.ln_wpi_adj		
independent variables	Coef.	t-statistics	p-value
L1.ln_wpi_adj	-0.05	-2.16	0.03

ln_wpi_adj_d	-0.15	-2.41	0.02
ln_wpi_adj_d2	-0.13	-2.13	0.03
ln_wpi_adj_d3	-0.10	-1.71	0.09
time	0.00	2.06	0.04
constant	-0.02	-1.62	0.11

Source: Handbook of statistics on Indian Economy 2016, RBI.

Table A.5: *Unit Root Test of WPI in 1st difference form:*

dependent variable	D.d1_ln_wpi_adj		
independent variables	Coef.	t-statistics	p-value
L1.d1_ln_wpi_adj	-1.18	-19.57	0.00
ln_wpi_adj_d	0.00		
ln_wpi_adj_d2	-0.16	-2.58	0.01
ln_wpi_adj_d3	-0.11	-1.99	0.05
time	0.00	-0.83	0.41
constant	0.01	4.17	0.00

Source: Handbook of statistics on Indian Economy 2016, RBI.

Table A.6: *Unit Root Test of Exchange Rate in level form:*

dependent variable	D.ln_ex_rt_adj		
independent variables	Coef.	t-statistics	p-value
L1.ln_ex_rt_adj	-0.02	-1.94	0.05
ln_ex_rt_adj_d	0.18	2.96	0.00
DL_ex_rt	0.01	1.32	0.19
DP_ex_rt	0.02	0.94	0.35
DT_ex_rt	0.00	-0.28	0.78
time	0.00	1.17	0.24
constant	0.00	-0.90	0.37

Source: Handbook of statistics on Indian Economy 2016, RBI.

Table A.7: *Unit Root Test of Exchange Rate in 1st difference form:*

dependent variable	D.d1_ln_ex_rt_adj		
independent variables	Coef.	t-statistics	p-value
L1.d1_ln_ex_rt_adj	-0.83	-14.02	0.00
ln_ex_rt_adj_d	0.00		
DL_ex_rt	0.01	1.34	0.18
DP_ex_rt	0.02	1.04	0.30
DT_ex_rt	0.00	-0.71	0.48
time	0.00	-0.58	0.56
constant	0.00	1.15	0.25

Source: Handbook of statistics on Indian Economy 2016, RBI.

Table A.8: *Unit Root Test of Money Supply in level form:*

dependent variable	D.ln_mnss_adj		
independent variables	Coef.	t-statistics	p-value
L1.ln_mnss_adj	-0.11	-2.52	0.01
ln_mnss_adj_d	-0.24	-3.76	0.00
ln_mnss_adj_d2	-0.26	-4.19	0.00
ln_mnss_adj_d3	-0.27	-4.63	0.00
time	0.00	2.49	0.01
constant	-0.18	-2.18	0.03

Source: Handbook of statistics on Indian Economy 2016, RBI.

Table A.9: *Unit Root Test of Call Money Rate in level form:*

dependent variable	D.ln_cal_m_rt_adj		
independent variables	Coef.	t-statistics	p-value
L1.ln_cal_m_rt_adj	-0.22	-4.99	0.00
ln_cal_m_rt_adj_d	-0.19	-3.00	0.00
ln_cal_m_rt_adj_d2	-0.15	-2.60	0.01
DL_cal_m_rt	-0.10	-1.77	0.08
DP_cal_m_rt	-0.05	-0.17	0.86
DT_cal_m_rt	0.00	0.40	0.69
constant	0.06	1.51	0.13

Source: Handbook of statistics on Indian Economy 2016, RBI.

1. We are using six series of monthly data. Monthly data is always incorporating the seasonal component. So, at first, we removed seasonal component from data series. For this purpose, regress each series on the time variable, here month, and predict the seasonal component of each series. After subtracting the predicted seasonal component from each series, we are getting the adjusted series without seasonal component. Thus, we deseasonalized each series for analysis.
2. For detect the significant break point of each series we are using the Perron model of structural break test.
3. For analysis of stationarity of a time series we are using unit root test. In this context we are using augmented dickey fuller test. Order criterion must be selected for each series to incorporate the number of augmented terms in model formation of augmented dickey fuller unit root test. AIC tends to be more accurate for monthly data.
4. Structural break dummy variables also intakes in model formation of augmented dickey fuller unit root test. If the series have a trend, then time variable also contain in model of stationarity test of augmented dickey fuller.
5. If a series is non-stationary in level, then first difference term is generated for unit root test in first difference, but the augmenting terms are remaining the same in model formation.

6. A non-stationary series exhibits trend. Trend may be of two types; deterministic trend and stochastic trend. A time series with deterministic trend follows trend stationary process (TSP), while a non-stationary time series showing stochastic trend is a difference stationary process (DSP). In a series following TSP, cyclical fluctuations are temporary around a stable trend, while for DSP any random shock to the series has a permanent effect. The cyclical components of a TSP originate from the residuals of a regression of the series on the variable time, and a DSP involves regression of a series on its own lagged values and time. A TSP has a trend in the mean but no trend in the variance, but a DSP has a trend in the variance with or without trend in the mean.

Note: Here in unit root test we are using Augmented Dickey Fuller model. The regression model for unit root incorporating both three break dummies, if that series have a significant structural break point, and time variable, if the series have a trend (trend is present or not in the series we can detect it by observing the graphical representation of each series). BSE Sensex, wpi and exchange rate are non-stationary in level but stationary in first difference. Whereas IIP, money supply and call money rate are level stationary. In case of BSE Sensex, wpi, IIP, money supply and exchange rate trend component is present in the series so, time variable is incorporated in the regression model. But in case of call money rate trend is not present in the series. So, in regression model we are not incorporated the time variable.

In case of IIP and money supply series, graphical plot shows a relatively smooth fluctuation and trend. But we are getting both the series level stationary (no unit root in the level shown by the augmented dickey fuller unit root test). Thus, the series is trend stationary (in trend stationary mean of the series is not constant but the variance is constant).