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Testing Granger Causal Relationship between Macroeconomic Variables and Stock Price Behaviour: Evidence from India

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Abstract: The key objective of the present study is to explore 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 is designed 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 macro economic variables. Our estimates of multivariate Granger causality 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. The results have implications on domestic as well as foreign investors, stock market regulators, policy makers and stock market analysts.

Key words: Granger Causality, Multivariate Regression Model, Macroeconomic Variables, Stock Prices, India.

1. Introduction

In 1991, government of India has introduced a series of policy measures to liberalize its economy to cope up with the ongoing process of globalization all over the world. Relaxation of licensing rule, rationalization of tax structure, enhancement of the ceiling of foreign direct investment and private participation are some of the outcomes of liberalization which has resultant impact in the integration of Indian economy with rest of the economies around the world and has also resulted in increased share in international trade and increased foreign reserve. Stock markets play a very crucial function in the financial sector of each and every economy. An efficient capital market encourages economic growth and prosperity by stabilizing the financial sector and providing a significant investment avenue that contributes to attract domestic and foreign capital.

In an efficient capital market, stock prices adjust swiftly according to the new information available. As a result, the stock prices reflect all information about the stocks. The stock prices reflect 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. Consequently, the dynamic relationship between stock prices and macroeconomic variables can be used to make nation's macroeconomic policies (Mysami, Howe, Hamzah, 2004).With the successive waves of globalization ,capital market can not be far behind .Therefore, several reforms in the capital market have also been initiated such as opening up of the stock markets to foreign investors, enhancement of the regulatory power of SEBI, trading in derivatives etc which have resulted in remarkable development in the size and depth of stock markets in India A perception of the macro dynamics of Indian stock market can be helpful for traders, investors policy makers of the country.

Although there are a voluminous empirical studies on the effect of macroeconomic variables on stock market indices and the relationship between the stock market and the economy has been studied comprehensively all over the world, majority of studies usually focused on industrially developed economies and the effects of these macroeconomic factors on the stock market indices in developing countries like India has not been studied properly. Results of the study may facilitate in identifying whether the movement of stock market is the result of some macro variables in Indian economy. This motivates us to undertake the study of the effects of macroeconomic variables on stock prices in Indian context.

The objective of the study is to investigate the effect of macroeconomic variables on stock prices as well as causal

relationship between macro economic variables and stock prices in Indian context.

The remainder of the paper is organized as follows: Section 2 briefly depicts and reviews existing literature on the nexus between stock price and macro economic variables , section 3 explains the data and methodology; Section 4 analyses the empirical results; the conclusion is presented in section 5.

2. Brief review of existing literature

There is no scarcity of literature on study of causal relationship between stock market and macro economic variables. A great deal of studies has been conducted to observe the effects of macroeconomic variables on stock market of industrialized economies. The center of attention in now being shifted towards the analysis of stock markets of developing economies like India due to their immense profit potentials. The review of the literature shows that there are copious studies which confirm a causal relationship between stock prices and economic variables.

Fama (1981) examined the relationship between real output and stock prices and showed that there was strong relationship between stock prices and gross national product.

Chen, Roll and Ross (1986) test the multifactor model in the USA by employing seven macroeconomic variables. They found that consumption, oil prices, and the market index are not priced by the financial market. However, industrial production, changes in risk premium and twists in the yield curve are found to be significant in explaining stock return.

Mukherjee and Naka (1995) explored the relationship between industrial production and stock prices in Japan and found positive relationship between industrial production and stock exchange prices.

Mookerjee and Yu (1997) find that money supply and foreign exchange reserves have a long run relationship with stock prices in Singapore.

Niarchos and Alexakis (2000) investigated the effect of macro economic variables like inflation, money supply and exchange rate on stock market in the Athens Stock Exchange taking a time from January, 1984 to December, 1994 on a monthly basis. The statistical evidence suggests that monthly stock prices in the Athens Stock Exchange are positively correlated to those variables.

Bhattacharya and Mukherjee (2002), Nath and Smantha (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, stating that change in industrial production affects the stock prices.

Wongbangpo and Sharma (2002) showed that in the ASEAN-5 countries, high inflation in Indonesia and Philippine leads to a long run negative relationship between stock prices and the money supply, while the money growth in Malaysia, Singapore and Thailand causes a positive effect on their stock market indices.

Kim (2003) in his study found that the S&P 500 stock price has a positive correlation with industrial production but negative relationship with the real exchange rate, interest rate, and inflation.

Nishat and Shaheen (2004) found industrial production having largest positive relationship stock prices in Pakistan.

Chakravarty (2005) has also examined positive relationship between industrial production and stock prices using Granger causality test and observed unidirectionality from industrial production to stock prices in India.

Tan, Loh and Zainudin (2006) tested the dynamic nexus between macroeconomic variables and the Malaysian stock indices (Kuala Lumpur Composite Index) during the period of 1996-2005 and found that the inflation rate, industrial production, crude oil price and Treasury Bills' rate have long-run relation with Malaysian stock market. Results indicate that consumer price index, industrial production index, crude oil price and treasury bills are significantly and negatively related to the Kuala Lumpur Composite Index in the long run, except industrial production index coupled with a positive coefficient.

Ahmed. M. N. and Imam M. Osman (2007) examines the long run equilibrium and short terrn 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 percent by 43.82 percent by the combined lagged influence of all the selected macroeconomic variables. Granger causality test provides a unidirectional causality from interest rate change to stock market return.

Ratanapakorn and Sharma (2007) reported a positive relationship between stock prices and inflation while Humpe and Macmillan (2009), illustrated negative impact of inflation on stock prices.

Taking into consideration the monthly data on stock price indices, foreign exchange rates, consumer price index and industrial production index ranging from January 1993 to December 2002, Mahmood and Dinniah (2009) examined the dynamics relationship between stock prices and economic variables in six Asian-Pacific selected countries like Malaysia, Korea, Thailand, Hong Kong, Japan and Australia. The results indicate the existence of a long run equilibrium relationship between stock price indices and different macro economic variables in four countries, i.e., Japan, Korea, Hong Kong and Australia. Short run relationship exists in all countries except for Hong Kong and Thailand that show some interactions. The Hong Kong shows relationship only between exchange rate and stock price while the Thailand reports significant interaction only between output and stock prices.

Mohammad, Hussain and Ali (2009) observe the affiliation between macroeconomics variables and Karachi Stock Exchange in Pakistan taking into consideration quarterly data of foreign exchange rate, foreign exchange reserve, gross fixed capital formation,

money supply, interest rate, industrial production index and whole sales price index. The result shows that exchange rate and exchange reserve and highly influenced the stock prices.

Asaolu T.O. and Ogunmuyiwa M.S. (2010) studied the impacts of macroeconomic variables on share price of Nigeria considering average share price of the Nigerian Stock Exchange as dependent variable and External Debt, Inflation rate, Fiscal Deficit, Exchange rate, Foreign Capital Inflow, Investment, Industrial output as independent variables. The findings of Granger Causality test indicated that Average Share Price (ASP) does not Granger cause any of the nine (9) macroeconomic variables in Nigeria in the sample period. Only exchange rate granger causes average share price when considered in pairs. The Johansen co-integration test showed a long run relationship between share price and the macroeconomic variables. Error correction method also showed a weak relationship between share price and macroeconomic variables which means stock price is not a leading indicator of macroeconomic variables in Nigeria.

Ali M. B. (2011) examined the impact of changes in selected microeconomic and macroeconomic variables on stock returns at Dhaka Stock Exchange (DSE). A Multivariate Regression Model computed on Standard OLS Formula has been used to estimate the relationship. Regression results suggest 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.

Aggarwal (1981), Soenen and Hennigar (1988), Bahmani-Oskooee and Sohrabian (1992), Abdalla and Murinde (1997), Smyth and Nandha (2003), Farooq and Keung (2004), Aquino (2004), Aquino (2005), Homma *et al.* (2005), and Hartmann and Pierdzioch (2007) examines the nexus between exchange rate and stock prices. The theory demonstrates that changes in the exchange rate have an important bearing on a firm's overall profits through firm's foreign operation which results fluctuations in stock prices.

The findings of the literature suggest that a significant linkage exists between macroeconomic variables and stock prices in developed economies but such relationship doesn't exist in developing economies.

3. Methodology and data

The empirical investigation is carried out using annual data ranging from 1990-91 to 2010-11 which covers 21 annual observations. After reviewing the literature thoroughly, we have selected various macro economic variables for our present study that has been influenced by the various works carried out so far.

The empirical investigation considers BSE (Sensex) share price indices as proxy for Indian stock prices. The macroeconomic variables are balance of trade (BoT), call / notice money rate (CNMR), consumer price index as proxy for inflation (CPI), foreign direct investment (FDI), foreign exchange reserve (FOREXREV), gross domestic product(GDP), gross fixed capita formation(GFCF), gold price(GLD), Index of Industrial Production(IIP) [base:2004-05],broad money supply(M3) representing money with public, demand deposit of bank, demand deposit with RBI, crude oil prices(OIL), exchange rate(REER), wholesale index of prices[base:2004-05](WPI).All data have been collected from Handbook of Statistics on Indian Economy,2010-11 except inflation and crude oil price data. Data on Consumer price index representing proxy for inflation has been collected from OECD Stat(base:2004-05) , crude oil price data per barrel in USD (converted in INR with USD-INR exchange rate)from International Energy Statistics.

A multiple regression model is designed to test the effects of macroeconomic variables on the stock prices as follows:

$$SP_t = \alpha + \beta_1 BOT_t + \beta_2 CNMR_t + \beta_3 CPI_t + \beta_4 FDI_t + \beta_5 FOREXREV_t + \beta_6 GDP_t + \beta_7 GFCF_t + \beta_8 GLD_t + \beta_9 IIP_t + \beta_{10} M3_t + \beta_{11} OIL_t + \beta_{12} REER_t + \beta_{13} WPI_t + \mu_t \quad \text{----------(1)}$$

3.1. Explanatory variables

3.1.1. Consumer Price Index (CPI)

Inflation is measured by changes in the Consumer Price Index (CPI) . High rate of inflation increase the cost of living and a shift of resources from investments to consumption. This leads to a fall in demand for market instruments which lead to reduction in the volume of stock traded.. High rate of inflation increase the cost of living and a shift of resources from investments to consumption. This leads to a fall in demand for market instruments which lead to reduction in the volume of stock traded. Also the monetary policy responds to the increase in the rate of inflation with economic tightening policies. Inflation is ultimately translated into nominal interest rate and an increase in nominal interest rates increase discount rate which results in reduction of present value of cash flows. High Inflation affects corporate profits, which in turn causes dividends to diminish thereby lower stock prices. When inflation begins to move upward, it likely leads to tight monetary policies which result in increase in the discount rate. It indicates that the cost of borrowing increases which in turn leads to investment reduction in the stock market. So, it is said that an increase in inflation is negatively related to equity prices.

3.1.2. Gold Price (GLD)

Gold is a substitute investment avenue for Indian investors. As the gold price rises, Indian investors tend to invest less in stocks, causing stock prices to fall. Therefore, a negative relationship is expected between gold price and stock price.

3.1.3. Industrial Production Index (IIP)

Industrial Production Index is used as proxy to measure the growth rate in real sector. Industrial production presents a measure of overall economic activity in the economy and affects stock prices through its influence on expected future cash flows. Thus, it is expected that an increase in industrial production index is positively related to stock price. The IIP and stock prices are positively related because increase in IPI results in increase in production of industrial sector that leads to increase in the profit of industries and corporations. As dividend increases, it results in increase of share prices, therefore, it is expected to have positive relationship between IPI and share price according to economic theory.

3.1.4. Oil Price (OIL)

Crude oil is an indispensable input for production and therefore, the price of oil is included as a proxy for real economic activity. India is largely an importer of crude oil and consequently, oil price takes part an imperative role in Indian economy. It is apparent that any key movement in oil prices leads to uncertainties in the stock market which could persuade investors to suspend or delay their investments. Moreover, increase in oil prices results in higher transportation, production and heating costs which have negative effect on corporate earnings. Rising fuel prices also raise alarm about inflation and diminish consumers' discretionary spending. Therefore, the financial risk of investments increases when there is wide fluctuation in oil prices. Therefore, for oil importing countries like India, an increase in oil price will lead to an increase in production costs and hence to decreased future cash flow, leading to a negative impact on the stock market. Therefore, an increase in the price of oil in the international market means lower real economic activity in all sectors which will cause stock price to fall.

3.1.5. Foreign Exchange Rate (REER)

The study uses end of month US Dollars/Indian rupee exchange rate is employed as foreign exchange rate. For an import dominated country like India; currency depreciation will have an adverse impact on a domestic stock market. As Indian currency depreciates against the U.S. dollar, products imported become more expensive. As a result, if the demand for these goods is elastic, the volume of imports would increase, which in turn causes lower cash flows, profits and the stock price of the domestic companies. Thus, a negative relationship is expected between foreign exchange rate and stock returns.

3.1.6. Money Supply (M3)

Broad Money (M3) has been considered as a proxy of money supply. Increase in money supply leads to increase in liquidity available for buying securities that eventually results in upward movement of nominal equity prices. Therefore, a positive relationship is expected between money supply and stock price. Moreover, an increase in money supply could also result in increased inflation, which in turn may trigger an increase in interest rate and dampen stock prices.

3.1.7. Interest Rate (CNMR)

Call or notice money rate (CNMR) is considered as a proxy of interest rate. The logic behind the negative relationship between interest rates and stock prices suggest that an upward trend in interest rates enhances the opportunity cost of holding money and thus substitution between stocks and interest bearing securities resulting declining stock prices. Thus, a change in nominal interest rates should move asset prices in the opposite direction

3.1.8. Gross fixed capital formation (GFCF)

Gross fixed capital formation via fixed assets accumulation can be increased by bonds financing and equity financing. Corporate houses finance their assets by floating their shares in stock market. As a result, supply of shares increase which cause to decline share prices. Economic theory suggests that increase in Gross fixed capital formation cause to decline share prices in short run but in long run production is increased which cause to raise share prices.

3.1.9. Foreign Direct Investment (FDI)

FDI comes to countries with excellent institutions and fundamentals to assist the domestic financial system. FDI can fuel the development of stock markets through different channels. Foreign investors might want to finance part of their investment with external capital or might want to recover their investment by selling equity in capital markets. Second, given that foreign investors partly invest through purchasing existing equity, the liquidity of stock markets will likely rise. Therefore, FDI can be a complement, not a substitute, of stock market development. On this footing, FDI should be positively correlated with the stock prices of (domestic or international) equity markets.

On the reverse side of coin, it is opined that FDI tends to be larger in countries that are riskier, financially underdeveloped, and institutionally weak. Under this view, FDI is a substitute for stock market development. FDI takes place to overcome the difficulties of investing through capital markets, given that shareholders rights are not protected. In view of this, FDI should be negatively correlated with the stock price of stock markets.

3.1.10. Gross Domestic Product (GDP)

Changes in information about the future course of real GDP may cause prices to change in the stock market. The rationalization for the linkage between the stock market and real GDP growth is that changes in stock prices will reduce firms' asset positions and affect the cost of their borrowing. When it costs more for firms to borrow money, they borrow and invest less, and when firms invest less, real GDP growth slows. According to this view—referred to by some as *balance-sheet effects* and others as the *credit channel*—stock prices will change because of changes in real economic conditions or some other factor, but the credit channel may impact the severity and length of recessions.

3.1.11. Wholesale Price Index(WPI)

A rise in prices of several items indicates that the input prices for production of various goods and services are rising. In these cases, market analysts and fund managers will always consider the net impact on the margin of the entity that they are tracking. While there might be an increase in the input prices, it has to be considered in the backdrop of the company's ability to pass on the price hike to the end-user. If a company is able to sustain its profit margin despite high inflation, the stock price is likely to hold. If the high inflation sustains, at some stage, it will lead to a chain reaction across the economy, pushing up interest rates and even affecting demand. An increase in interest rates will push up borrowing costs for corporate while lower demand will hurt growth in revenues. This is likely to impact sentiment for the stock market as a whole. Industrial production, which reflects real economic activity, affects the stock market index positively. As industrial production increases, sales and earnings of firms rise, which leads to increases in stock prices as investors feel confident of investments in the stock market.

3.1.12. Balance of Trade (BoT)

In terms of the stock market, a prolonged trade deficit could have adverse effects. If a country has been importing more goods than it is exporting for a sustained period of time, it is essentially going into debt. Over time, investors will notice the decline in spending on domestically produced goods, which will hurt domestic producers and their stock prices. Given enough time, investors will realize fewer investment opportunities domestically and begin to invest in foreign stock markets, as prospects in these markets will be much better. This will lower demand in the domestic stock market and cause that market to decline. Therefore, a positive relation is expected between stock price and balance of trade.

3.1.13. Foreign Exchange Reserve (FOREXREV)

Uncertainty about access to capital markets also persuades the level of foreign currency reserves which Reserve bank hold. Access to capital markets can be cut off because a country's credit rating falls or because the market itself is short of liquidity. In these circumstances, Reserve bank can be pressed into drawing on international reserves. Though building foreign exchange reserves by way of foreign borrowing is not the optimum approach to foreign exchange accumulation, in some circumstances countries may need to resort to the capital markets in order to boost reserves, in order to fund foreign currency payments and to boost confidence in the economy. It is expected that foreign exchange reserve has positive impact on stock prices.

3.2.Unit root test

When dealing with time series data, a number of econometric issues can influence the estimation of parameters using OLS. Regressing a time series variable on another time series variable using the Ordinary Least Squares (OLS) estimation can obtain a very high R^2, although there is no meaningful relationship between the variables. This situation reflects the problem of spurious regression between totally unrelated variables generated by a non-stationary process. Therefore, prior to testing and implementing the Granger Causality test, econometric methodology needs to examine the stationarity; for each individual time series, most macro economic data are non stationary, i.e. they tend to exhibit a deterministic and/or stochastic trend. Therefore, it is recommended that a stationarity (unit root) test be carried out to test for the order of integration. A series is said to be stationary if the mean and variance are time-invariant. A non-stationary time series will have a time dependent mean or make sure that the variables are stationary, because if they are not, the standard assumptions for asymptotic analysis in the Granger test will not be valid. Therefore, a stochastic process that is said to be stationary simply implies that the mean $[(E(Y_t)]$ and the variance $[Var\ (Y_t)]$ of Y remain constant over time for all t, and the covariance $[covar\ (Y_t, Ys)]$ and hence the correlation between any two values of Y taken from different time periods depends on the difference apart in time between the two values for all $t \neq s$. Since standard regression analysis requires that data series be stationary, it is obviously important that we first test for this requirement to determine whether the series used in the regression process is a difference stationary or a trend stationary.

We also use a formal test of stationarity, that is, the Augmented Dickey-Fuller (ADF) test and Phillips- Perron (PP) Test. To test the stationary of variables, we use the Augmented Dickey Fuller (ADF) test which is mostly used to test for unit root. Following equation checks the stationarity of time series data used in the study:

$$\Delta y_t = \beta_1 + \beta_1 t + \alpha y_{t-1} + \gamma \sum_{t=1}^{n} \Delta y_{t-1} + \varepsilon_t \text{ ------(2)}$$

Where ε_t is white nose error term in the model of unit root test, with a null hypothesis that variable has unit root. The

ADF regression test for the existence of unit root of y_t that represents all variables at time t. The test for a unit root is conducted on the coefficient of y_{t-1} in the regression. If the coefficient is significantly different from zero (less than zero) then the hypothesis that y contains a unit root is rejected. The null and alternative hypothesis for the existence of unit root in variable y_t is H_0; $\alpha = 0$ versus H1: $\alpha < 0$. Rejection of the null hypothesis denotes stationarity in the series.

If the ADF test-statistic (t-statistic) is less (in the absolute value) than the Mackinnon critical t-values, the null hypothesis of a unit root can not be rejected for the time series and hence, one can conclude that the series is non-stationary at their levels. The unit root test tests for the existence of a unit root in two cases: with intercept only and with intercept and trend to take into the account the impact of the trend on the series.

The PP tests are non-parametric unit root tests that are modified so that serial correlation does not affect their asymptotic distribution. PP tests reveal that all variables are integrated of order one with and without linear trends, and with or without intercept terms. Phillips–Perron test (named after Peter C. B. Phillips and Pierre Perron) is a unit root test. That is, it is used in time series analysis to test the null hypothesis that a time series is integrated of order 1. It builds on the Dickey–Fuller test of the null hypothesis $\delta = 0$ in $\Delta\ y_t = \delta y_{t-1} + u_t$, here Δ is the first difference operator. Like the augmented Dickey–Fuller test, the Phillips–Perron test addresses the issue that the process generating data for y_t might have a higher order of autocorrelation than is admitted in the test equation - making y_{t-1} endogenous and thus invalidating the Dickey–Fuller t-test. Whilst the augmented Dickey–Fuller test addresses this issue by introducing lags of $\Delta\ y_t$ as regressors in the test equation, the Phillips–Perron test makes a non-parametric correction to the t-test statistic. The test is robust with respect to unspecified autocorrelation and heteroscedasticity in the disturbance process of the test equation.

The KPPS (1992) Test is based on the residuals (ε_t) from an ordinary least square regression of the variable of interest on the exogenous variable(s) as follows:

$$Y_t = X'_t \beta + \varepsilon_t \quad \text{.....(3)}$$

where Y_t is the variable of interest (real exchange rate) and X_t is a vector of exogenous variable(s). The Lagrange Multiplier (LM) statistic used in the test as follows:

$$LM = T^{-2} \sum_{i=1}^{T} S(t)^2 / f_0 \text{ ---------- (4)}$$

where T is the sample size, S(t) is the partial sum of residuals which is calculated as $S(t) = \sum_{i=1}^{t} S_r$. Here ε_t is the estimated residual from (3.1). f_0 is an estimator of the residual spectrum at frequency zero. This statistic has to be compared with KPSS et al. (1992) critical values.

3.3. Granger Causality test

Causality is a kind of statistical feedback concept which is widely used in the building of forecasting models. Historically, Granger (1969) and Sim (1972) were the ones who formalized the application of causality in economics. Granger causality test is a technique for determining whether one time series is significant in forecasting another (Granger, 1969). The standard Granger causality test (Granger, 1988) seeks to determine whether past values of a variable helps to predict changes in another variable. The definition states that in the conditional distribution, lagged values of Y_t add no information to explanation of movements of X_t beyond that provided by lagged values of X_t itself (Green, 2003). We should take note of the fact that 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 Y is Granger caused by variable X if variable X assists in predicting the value of variable Y. If this is the case, it means that the lagged values of variable X are statistically significant in explaining variable Y. The null hypothesis (H_0) that we test in this case is that the X variable does not Granger cause variable Y and variable Y does not Granger cause variable X. In summary, one variable (X_t) is said to granger cause another variable (Y_t) if the lagged values of X_t can predict Y_t and vice-versa.

4.Analysis of result

Table 1 presents descriptive statistics for the variables used in our estimate. Summary statistics in table 1 include the mean and the standard deviation, minimum and maximum value for the period 1990-91 to2010-11.The mean, median, maximum, minimum and standard deviation can determine the statistical behaviour of the variables. The relatively higher figure of standard deviation indicates that the data dispersion in the series is quite large. This finding suggests that almost all the years included in the sample were having larger dispersion level of different independent variables under our study across time series.

Table:1: Descriptive Statistics

	Mean	Median	Maximum	Minimum	Std. Dev.	Skewness	Kurtosis	Jarque-Bera	Probability	Obs.
SP	6471.571	3977.00	18605.00	1050.00	5272.65	1.192805	2.962116	4.980999	0.082869	21
BOT	-134068.7	-38579	-3350	-533681	179917.4	-1.282927	3.107333	5.770737	0.055834	21
CNMR	8.70524	7.22	19.57	3.24	4.456472	1.233224	3.475366	5.520669	0.063271	21

CPI	88.5857	85.4	164.8	39.6	34.6496	0.566964	2.617028	1.253401	0.534352	21
FDI	45195.1	18406.00	179059	174.0	60560.28	1.301654	3.05844	5.933052	0.051482	21
FOREXREV	448448.6	197204.0	1361013	11416.0	477552.8	0.898686	2.266976	3.296883	0.192349	21
GDP	2312386	1864300	4877842	1083572	1211777	0.882719	2.377670	3.066057	0.215881	21
GFCF	95915.0	69120.00	274563.0	24293.00	75433.31	1.270778	3.312984	5.737783	0.056762	21
GLD	6873.70	4957.6	19227.08	3451.52	4248.11	1.77231	5.07161	14.7489	0.000627	21
IIP	86.8733	79.35	165.5	44.75	35.91577	0.67651	2.411357	1.905021	0.385771	21
M3	1832499	1224092	6014809	249493	1689469	1.175917	3.313914	4.925954	0.085181	21
OIL	1407.331	1096.91	4200.49	416.09	1081.95	1.109765	3.22263	4.353894	0.113387	21
REER	77.7152	67.81	104.1	60.23	16.36576	0.607014	1.585049	3.041456	0.218553	21
WPI	85.14476	83.13	143.3	39.36	29.33946	0.298301	2.170896	0.91293	0.633519	21

Source: Author's own estimate

Asterisk (*) denotes that the null of normality was rejected at 10% significance level.

All the variables are asymmetrical. More specifically, skewness is positive for all series excluding BoT, indicating the flat tails on the right-hand side of the distribution comparably with the left-hand side. On the contrary, BoT has a negative skewness, which indicates the flat tail on the left-hand side of the distribution. On the whole, the distribution shows positive or negative skewness which indicates flatter tails than the normal distribution. Kurtosis value of all variables also shows data is not normally distributed because values of kurtosis are deviated from 3. Out of fourteen variables, seven variables show leptokurtic distribution (kurtosis>3).

The Jarque-Bera test, a type of Lagrange multiplier test, was developed to test normality of regression residuals. The Jarque-Bera statistic is computed from skewness and kurtosis and asymptotically follows the chi-squared distribution with two degrees of freedom. While testing for normality, it was found that Jarque-Bera statistics where p values for variables like SP, BOT, CNMR , FDI, GFCF, GLD , M3 are lower than 0.10 which implies that variables under our consideration are normally distributed.

The calculated Jarque-Bera statistics and corresponding p-values are used to test for the normality assumption. Based on the Jarque-Bera statistics and p-values, this assumption is rejected at 10 percent level of significance for all variables, with the exceptions –CPI, FOREXREV, GDP, IIP, OIL, REER, WPI. So the descriptive statistics shows that all the values are not normally distributed about its mean and variance or in other word, we see no randomness in data. So, the results of above descriptive statistics raise the issue the inefficiency of market.

Table:2 : Regression results

Dependent Variable: SP				
Method: Least Squares				
Sample: 1990-91 to 2010-11				
Included observations: 21				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-5106.963	9821.906	-0.519956	0.6191
BOT	0.016498	0.008744	1.886779	0.1215
CNMR	15.20454	8.4691	1.795295	0.1106
CPI	78.75380	278.9333	0.282339	0.7858
FDI	0.012400	0.036919	0.335856	0.7468
FOREXREV	0.013735	0.007590	1.809645	0.1133
GDP	0.005840	0.003469	1.683258	0.1462
GFCF	0.008713	0.029362	0.296738	0.7753
GLD	-1.021409	0.447978	-2.280042	0.0867
IIP	75.55026	36.6104	2.063628	0.0918
M3	0.006388	0.003484	1.833524	0.1097
OIL	-1.117761	0.63495	-1.760392	0.1385
REER	-32.98086	90.75444	-0.363408	0.7270
WPI	-142.3356	191.7017	-0.742485	0.4820
R-squared	0.982818	Mean dependent var		6471.571
Adjusted R-squared	0.950907	S.D. dependent var		5272.653
S.E. of regression	1168.253	Akaike info criterion		17.19913
Sum squared resid	9553704.	Schwarz criterion		17.89548
Log likelihood	-166.5908	F-statistic		30.79954
Durbin-Watson stat	1.936619	Prob(F-statistic)		0.000067

Source: Author's own estimate

Explanatory power of the models as indicated by R^2 (multiple coefficient of determination) and adjusted R^2 is fairly good. The model explains around 95% of the variation in the dependent variable. The Durbin-Watson statistic ranges in value from 0 to 4. A value near 2 indicates non-autocorrelation; Values approaching 0 indicate positive autocorrelation and values toward 4 indicate negative autocorrelation. The Durbin-Watson statistic (D-W Statistic) being less than 2 (1.936619) suggests that there is no auto-correlation among residuals.

According to the test results, consumer price index (CPI) does not have any effect on stock prices at 5% or 10% significant level. This means that the market evaluates inflation figures nearly correct before the announcement of the actual rate. Gold price (GLD) appears to have negative relationship with stock price which is at par with our expectation since gold is another alternative investment avenue for Indian investors. A remarkable point in the results that there exists significant relationship between interest rate and stock prices. The effect of interest rate on stock prices is statistically significant but with the wrong sign. Foreign direct investment (FDI) does not seem to be a significant factor of stock prices. This statistical insignificance is unexpected since foreign capital with efficient technological skills augment industrial growth vis-a –vis economic growth of a country which in turn enhances share prices. The result shows that oil price (OIL) is negatively related to stock prices as was expected and significant at 10% level which is an indication of the fact that in India, oil is important factor in determining the production cost of the firms .The association between exchange rates and stock prices is found to be negatively related, showing that a depreciation of the Indian currency in terms of US Dollars would have a favorable impact on the Indian stock market. This negative relationship was found to exist between exchange rate and stock prices but it insignificantly persists. The study shows that the relationship observed between industrial production index and stock price is positive and significant at 5% level as expected indicating that growth in industrial production enables stock price to move upward. Money supply (M3) has a significant favourable impact on stock prices which implies that changes in money supply come into view to influence both the equilibrium in the financial asset markets and the real economic variables. The study suggests that gross fixed capital formation and whole price index do not have any significant expected impact on stock prices. Both balance of trade and GDP growth left a positive impact on stock prices as expected because favourable balance of trade via excess export over import and economic growth via GDP growth augment liquidity flow in the economy eligible for making demand of stock which allow stock price to rise. Last but not least, it has been found that foreign currency reserve has favourable impact on stock prices as was expected.

In a nut shell, balance of trade (BOT), interest rate(CNMR),gold price(GLD),industrial production index (IIP), gross domestic product(GDP),oil price (OIL), foreign currency reserve (FOREXREV) and money supply (M3) seem to effect the Indian Stock prices. On the other hand, exchange rate (REER), consumer price index (CPI) and foreign direct investment (FDI), wholesale index of prices (WPI) do not appear to have significant effects on stock prices.

Table:3: Unit Root Test: The Results of the Augmented Dickey Fuller (ADF) Test for Level &First differences with an Intercept and Linear Trend

ADF Test												
Macro economic variables and Stock Prices	Levels						First Differences					
	Intercept			Intercept&Trend			Intercept			Intercept&Trend		
	Lag0	Lag1	Lag2	Lag0	Lag1	Lag2	Lag0	Lag1	Lag2	Lag0	Lag1	Lag2
BoT	0.468	-1.07	-0.636	-1.33	-2.12	-1.10	-2.29	-2.31	-0.936	-2.05	-2.72	-1.57
CNMR	-2.43	-3.06	-2.54	-3.82	-4.79	-3.84	-5.81	-5.53	-5.71	-5.79	-5.67	-5.62
CPI	4.35	1.57	1.14	2.80	-0.882	-1.62	-0.633	-0.248	-0.353	-1.55	-0.849	-0.754
FDI	-0.072	-2.37	-2.26	-1.47	-3.27	-3.61	-1.68	-1.94	-2.82	-1.17	-1.46	-2.49
FOREXREV	1.60	0.701	1.88	-1.16	-1.45	-0.548	-2.81	-2.82	-1.35	-3.34	-4.53	-2.29
GDP	2.79	1.96	1.34	-0.394	-0.406	-0.574	-2.92	-1.66	-1.23	-4.22	-2.70	-2.19
GFCF	1.89	1.10	0.413	0.068	-0.261	-0.745	-2.92	-1.68	-1.28	-3.64	-2.29	-1.66
GLD	7.14	5.01	2.37	3.85	3.51	1.81	-0.752	1.14	2.01	-2.65	-0.619	0.323
IIP	5.56	2.81	3.35	1.31	1.18	1.69	-1.15	-0.792	-0.385	-2.69	-2.73	-1.42
M3	20.79	0.797	2.36	8.02	-0.703	0.925	2.08	-0.583	-0.605	-0.628	-2.06	-2.09
OIL	-0.763	0.013	0.476	-2.97	-1.79	-1.26	-7.99	-2.92	-1.96	-7.96	-3.34	-2.40
REER	-0.421	-0.473	-0.446	-2.59	-2.15	-2.02	-4.17	-3.05	-2.20	-4.17	-3.03	-1.87
WPI	2.51	2.81	2.08	1.37	2.02	0.459	-2.56	-0.145	0.123	-3.61	-1.16	-0.683
SP	0.643	0.801	1.06	-0.919	-0.761	-0.591	-4.21	-2.89	-1.69	-4.64	-3.56	-2.34
Critical Values												
1%	-3.8067			-4.5000			-3.8304			-4.5348		
5%	-3.0199			-3.6591			-3.0294			-3.6746		
10%	-2.6502			-3.2677			-2.6552			-3.2762		

Source: Author's own estimate

ADF tests specify the existence of a unit root to be the null hypothesis.

Ho: series has unit root; H_1: series is trend stationary

Table:4 : Unit Root Test: The Results of the Phillips-Perron (PP) Test for Level &First differences with an Intercept and Linear Trend

PP Test												
Macro economic variables and Stock Prices	Levels						First Differences					
	Intercept			Intercept&Trend			Intercept			Intercept&Trend		
	Lag0	Lag1	Lag2	Lag0	Lag1	Lag2	Lag0	Lag1	Lag2	Lag0	Lag1	Lag2

BoT	0.468	0.218	0.199	-1.33	-1.43	-1.42	-2.29	-2.38	-2.27	-2.05	-2.21	-1.98
CNMR	-2.43	-2.34	-2.25	-3.82	-3.81	-3.77	-5.80	-5.92	-6.51	-5.79	-5.95	-6.72
CPI	4.35	3.33	2.87	2.80	2.03	1.64	-0.633	-0.555	-0.589	-1.55	-1.51	-1.53
FDI	-0.072	-0.326	-0.415	-1.47	-1.64	-1.69	-1.68	-1.85	-1.95	-1.17	-1.41	-1.58
FOREXREV	1.60	1.35	1.48	-1.17	-1.23	-1.16	-2.81	-2.84	-2.72	-3.34	-3.38	-3.24
GDP	2.79	2.84	2.83	-0.394	-0.376	-0.387	-2.92	-2.85	-2.91	-4.22	-4.22	-4.22
GFCF	1.89	1.77	1.65	0.068	-0.027	-0.13	-2.92	-2.87	-2.93	-3.64	-3.62	-3.65
GLD	7.14	8.76	8.66	3.85	4.90	4.83	-0.753	-0.033	-0.246	-2.65	-2.51	-2.59
IIP	5.56	5.31	5.93	1.32	1.19	1.51	-1.14	-1.06	-0.744	-2.69	-2.76	-2.58
M3	20.79	17.18	16.49	8.02	6.57	6.31	2.08	1.63	1.46	-0.628	-0.793	-0.865
OIL	-0.763	-0.204	-0.255	-2.97	-2.86	-2.93	-7.99	-8.07	-8.14	-7.96	-8.20	-8.60
REER	-0.422	-0.458	-0.465	-2.58	-2.58	-2.59	-4.17	-4.17	-4.18	-4.17	-4.17	-4.18
WPI	2.51	2.75	2.44	1.37	2.23	1.90	-2.56	-2.47	-2.95	-3.62	-3.63	-3.89
SP	0.643	0.812	1.047	-0.919	-0.854	-0.726	-4.20	-4.21	-4.19	-4.64	-4.65	-4.72
Critical Values												
1%	-3.8067			-4.5000			-3.8304			-4.5348		
5%	-3.0199			-3.6591			-3.0294			-3.6746		
10%	-2.6502			-3.2677			-2.6552			-3.2762		

Source: Author's own estimate

PP tests specify the existence of a unit root to be the null hypothesis.

Ho: series has unit root; H_1: series is trend stationary

Table 3&4 present the results of the unit root test. The results show that all the variables of our interest, namely BoT, CNMR , CPI , FDI , FOREXREV, GDP, GFCF, GLD, IIP, M3, OIL, REER, WPI, SP did not attain stationarity after first differencing, I(1), using both ADF and PP test. The augmented Dickey Fuller Test and Phillips-Perron (P-P) Test fail to provide result of stationary at first difference at all lag differences. The results indicate that the null hypothesis of a unit root can not be rejected for the given variable as none of the ADF value and PP value is not smaller than the critical t-value at 1%,5% and 10%level of significance for all variables and, hence, one can conclude that the variables are not stationary at their levels and first differences both in ADF and PP test.

Table:5: Unit root test through Kwiatkowski, Phillips, Schmidt and Shinn(KPSS) test

KPSS- Exchange rate												
Exchange rate	KPSS level						KPSS First Difference					
	Without Trend			With trend			Without Trend			With trend		
	Lag 0	Lag 1	Lag 2	Lag 0	Lag 1	Lag 2	Lag 0	Lag 1	Lag 2	Lag 0	Lag 1	Lag 2
BoT	1.5758	0.8447	0.6093	0.4464	0.2456	0.1830	0.3809	0.2783	0.2595	0.0879	0.07209	0.0794***
CNMR	1.2662	0.8231	0.6859	0.1148	0.1073	0.1319	0.0377	0.0537	0.1054	0.0229	0.0333	0.0692***
CPI	1.9523	1.0806	0.7830	0.3107	0.1864	0.1488	0.9593	0.9593	0.4232	0.3559	0.2131	0.1641*
FDI	1.5292	0.8188	0.5944	0.3923	0.2179	0.1655	0.2341	0.1675	0.1496	0.0940	0.0716	0.0681***
FOREXREV	1.8498	0.9938	0.7050	0.4942	0.2722	0.1996	0.6388	0.4667	0.4366	0.0760	0.0649	0.0816***
GDP	1.8684	1.0171	0.7278	0.4785	0.2691	0.1985	0.8620	0.6600	0.5325	0.0718	0.0758	0.0764***
GFCF	1.4785	0.8263	0.6076	0.4206	0.2348	0.1742	0.6436	0.4875	0.3915	0.1571	0.1425	0.1286**
GLD	1.3743	0.7990	0.5995	0.4287	0.2509	0.1911	1.1855	0.7440	0.5539	0.3297	0.2524	0.1966*
IIP	1.9705	1.0800	0.7743	0.4384	0.2639	0.2031	1.1772	0.7914	0.6695	0.1430	0.1207	0.1322**
M3	1.7769	0.9882	0.7187	0.4543	0.2625	0.1992	1.6664	0.9056	0.6549	0.4418	0.2425	0.1807*
OIL	1.7179	0.9782	0.6901	0.3069	0.2306	0.1778	0.0696	0.1638	0.1846	0.0246	0.0606	0.0762***
REER	1.5750	0.8517	0.6024	0.3158	0.1949	0.1531	0.2523	0.2476	0.2528	0.0951	0.0962	0.1030***

WPI	2.0352	1.1170	0.7998	0.3599	0.2249	0.1704	0.6023	0.5716	0.4393	0.2120	0.2371	0.1896*
SP	1.5618	0.8863	0.6498	0.4002	0.2385	0.1816	0.2836	0.2987	0.3277	0.0642	0.0756	0.0948***

Source: Author's own estimate

In contrast, the null hypothesis under the KPSS test states that there exist a stationary series.
Ho: series is trend stationary ; H_1: series is non stationary.
Note:
1) 1%, 5% and 10% critical values for KPSS are 0.739, 0.463 and 0.347 for *without trend.*
2)1%, 5% and 10% critical values for KPSS *with trend* are 0.216, 0.146 and 0.1199.
3) *, **, *** denotes acceptance of the null hypothesis of trend stationarity at the 1%, 5%, and 10% significance levels, respectively. 4) The null hypothesis of stationarity is accepted if the value of the KPSS test statistics is less than it is critical value.
5) † the null of level stationarity is tested.

To circumvent the low power in the standard unit root tests, the newly developed KPSS test is applied to test the null of stationary real exchange against the alternative of non-stationarity. The results of applying the KPSS test on these variables show strong evidence of stationarity since the null of stationarity is accepted at the 1, 5 and 10 percent significance level. An inspection of the figures reveals in table-5 that each series is first difference stationary at 1%,5% and 10% level using the KPSS test. However, the ADF and PP test result are not as impressive, as all the variables did not pass the differenced stationarity test at the one, five and ten percent levels. We therefore rely on the KPSS test result as a basis for a cointegration test among all stationary series of the same order meaning that the two series are stationary at their first differences [they are integrated of the order one i.e I(1)].

Table:6 :Granger Causality test

Pairwise Granger Causality Tests				
Lags: 2				
	Obs.	F-Statistic	Probability	
SP does not Granger Cause BOT	19 #	21.0305	6.1E-05*	Reject
BOT does not Granger Cause SP		9.69360	0.0022 *	Reject
SP does not Granger Cause CNMR	19	1.46531	0.26435	Accept
CNMR does not Granger Cause SP		0.42569	0.66150	Accept
SP does not Granger Cause CPI	19	12.2631	0.00084 *	Reject
CPI does not Granger Cause SP		1.52881	0.25088	Accept
SP does not Granger Cause FDI	19	8.15140	0.00449 *	Reject
FDI does not Granger Cause SP		1.42932	0.27236	Accept
SP does not Granger Cause FOREXREV	19	2.80479	0.09454 *	Reject
FOREXREV does not Granger Cause SP		8.28324	0.00423 *	Reject
SP does not Granger Cause GDP	19	1.00680	0.39037	Accept
GDP does not Granger Cause SP		6.37625	0.01075 *	Reject
SP does not Granger Cause GFCF	19	5.79019	0.01471*	Reject
GFCF does not Granger Cause SP		2.08820	0.16082	Accept
SP does not Granger Cause GLD	19	1.04139	0.37876	Accept
GLD does not Granger Cause SP		8.57536	0.00370*	Reject
SP does not Granger Cause IIP	19	1.23077	0.32181	Accept
IIP does not Granger Cause SP		2.60333	0.10933	Accept
SP does not Granger Cause M3	19	5.17128	0.02081 *	Reject
M3 does not Granger Cause SP		3.39085	0.06297**	Reject
SP does not Granger Cause OIL	19	9.80750	0.00217*	Reject
OIL does not Granger Cause SP		8.64239	0.00359*	Reject
SP does not Granger Cause REER	19	0.32524	0.72767	Accept
REER does not Granger Cause SP		6.23611	0.01157*	Reject
WPI does not Granger Cause SP	19	2.92832	0.08661**	Reject
SP does not Granger Cause WPI		7.27610	0.00681*	Reject

Source: Author's own estimate

Observations after lag.
*(**) Indicates significant causal relationship at 5 (10) significance level.

The results of pairwise granger causality between stock price and (SP) and different macro economic variables are contained in Table 6. We have found that causality between stock price(SP) and balance of trade(BOT),stock price and whole sale index of prices (WPI) are bidirectional , no causality exist between stock price (SP) and interest rate (CNMR), stock price(SP) and index of industrial production(IIP).There exist unidirectional causality between stock price(SP) and inflation(CPI),stock price(SP) and foreign direct investment(FDI) ,stock price(SP) and gross domestic product(GDP), stock price and exchange rate(REER),stock price(SP) and gross fixed capital formation(GFCF).Bi- directional causality exist between stock price (SP) and foreign exchange reserve(FOREXREV),stock price (SP) and money supply(M3),stock price(SP) and crude oil price(OIL) and stock price(SP) and whole price index(WPI).

5. Conclusion

The key objective of the present study is to explore the impact of different macroeconomic variables on the stock prices in India using annual data from 1990-91 to 2010-11. In this study, the BSE Sensitive Index was used as a proxy for the Indian stock price. The vital macroeconomic variables included in the study are balance of trade (BoT), call / notice money rate (CNMR), consumer price index as proxy for inflation (CPI), foreign direct investment (FDI), foreign exchange reserve (FOREXREV), gross domestic product(GDP), gross fixed capita formation(GFCF), gold price(GLD), Index of Industrial Production(IIP) [base:2004-05],broad money supply(M3) representing money with public, demand deposit of bank, demand deposit with RBI, crude oil prices(OIL), exchange rate(REER), wholesale index of prices[base:2004-05](WPI). The results shows that series of variables used are not stationary at levels but at first difference.

Our estimates of multivariate Granger causality indicate that there is no causal association between stock price (SP) and interest rate (CNMR), stock price(SP) and index of industrial production(IIP)and unidirectional causality between stock price(SP) and inflation(CPI),stock price(SP) and foreign direct investment(FDI) ,stock price(SP) and gross domestic product(GDP), stock price and exchange rate(REER),stock price(SP) and gross fixed capital formation(GFCF). However, bi- directional causality exist between stock price (SP) and foreign exchange reserve(FOREXREV),stock price (SP) and money supply(M3),stock price(SP) and crude oil price(OIL) and stock price(SP) and whole price index(WPI.).

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.

The results have implications on domestic as well as foreign investors, stock market regulators, policy makers and stock market analysts. Investors and security analysts could forecast stock prices and earn profits. Stock market regulators could take initiatives to scrutinize the activities of companies to prevent manipulation of stock prices and get the general public educated on the stock market and encourage them to invest in stocks. Policy makers should be acquainted of these macroeconomic effects on stock market and make their decisions in a more efficient and precise manner.

Since ambiguous research results were found in this study, it provides potential researchers ample opportunity for further research where a variety of other variables can also be taken into consideration which influences the stock market index. Prospective researchers can investigate the effect of macroeconomic variables on stock prices using alternative methodologies and daily or weekly data to empirically assess whether the results are sensitive to the frequency of data. Other aspects on which future researchers can pay attention are the longer time horizon, larger sample sizes with greater numbers of sectors using other macroeconomic and non-macroeconomic variables. In conclusion, it can be said that this paper certainly assist other researchers to find indication about the lead and lag relationship between stock price and different macroeconomic variables in Indian context.

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