Correlation and Causality between Stock Market and Macro Economic Variables in India: An Empirical Study

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Abstract—: In this paper, an attempt has been made to explore the causal relationship between stock market indicators and macro economic variables of India by using both correlation and Ganger Causality Regression techniques. Annual data has been used from 1981 to 2006 for all the above said variables to study the relationship. Augmented Dickey Fuller Unit Root Test has been done to check the stationary of the series. The findings of our study reveal that there is no causal relationship between stock market indicator i.e. sensex of Bombay stock exchange(BSE) and real gross domestic product of India despite they being highly co related. Therefore it is concluded in this paper that BSE SENSEX cannot yet be called as an "indicator" of India's growth and development.

Keywords- Bombay Stock Exchange(BSE), Stationary, Granger Causality, India

I.   INTRODUCTION

India pursued its liberalization policy in the early 1990s to get rid of crisis emanated from its foreign exchange front. One of the important components of the liberalization policy measures was financial liberalization. This financial liberalization paved a new way of growth and development and volatile atmosphere to the Indian economy especially in terms of BSE SENSEX which is credited as one of the main indicators of India's financial health as stock market is the prime most source for mobilizing household savings into upcoming productive ventures and hence lending a helping hand in the country's development.

The issue that has been focused upon in this paper is that does Stock Market really paving the way for country's development or putting into economics terminology: does any causal relationship exists between the stock market and real economy or is it just a myth.

The variables that have been taken up in this study are Bombay stock exchange(BSE) sensitive index (SENSEX), market capitalization(MCap) representing stock market, and real gross domestic product(GDP) and foreign exchange reserves (Forex)depicting real economic growth. This issue has been taken up in this study because BSE SENSEX has witnessed a remarkable growth and then fall in the past two decades and attracted great media attention but lesser academic interest.

II.   REVIEW OF EXISTING LITERATURE

Finance is the buzz word all around the world. It is the one which makes the business go around and all aspects of the economy start and end at it. In today's competitive world the easiest way to raise capital for new upcoming and promising ventures is to go public or turn towards masses through Stock Markets where small savings of these people can make miracles by investing wisely in reliable businesses and help management of these companies to make them biggest companies in the world. In India, only about 2% of the total population is involved in these markets but it is 100% of the population which gets affected directly or indirectly if something happens in these markets, which in itself shows a strong correlation between Stock Markets and Real Economy not just on the surface level but deep inside also they are interlinked. Many scholars have done research in this direction but results are usually ambiguous as many have found a strong bilateral relation between the two but on the other hand many studies have completely discarded this hypothesis that these markets are correlated from time to time. In this section, we have reviewed some existing literature pertaining to the above mentioned issues. The over all findings of different scholar s related to these issues are discussed briefly below. Shiller, R. (1990) had studied and compared the Standard & Poor Composite Stock Price Index from 1871 to January 2000 with the corresponding series of real S&P Composite earnings for the same years and found that stock price volatility is not matched by the earnings. In another study, Chowhan, P.K. et al. (2000) have tried to fetch reasons for turbulence in stock market in the short run in India taking into account SENSEX as the main index. The results of this study reveal that long run economic factors don't support such a spike in stock prices. In another study, Nath, G.C., et al. (2004) in their paper examine the extent of integration between Foreign Exchange and Stock market in India during the liberalization era. The results that they have derived from these techniques differ a lot. As per the former test it reveals the sign mild-to-strong causal relationship between returns in foreign exchange and capital markets during the study period. Whereas as per the latter test, there is a high degree of integration between the two and there is even bi-directional as well as contemporaneous causal relationship between them.

Brenner, M., et al. (2006) have concluded that the macro economic announcements have significant impact on the US

financial markets, but also that this impact varies greatly across asset classes. In another study, Husain, F. (2006) has examined the causal relationship between stock price and real sector variables of Pakistan economy. He has found unidirectional causality from real sector to stock prices. In case of India, Sarkar, P. et al. (2005) found that there is no positive relationship exists between real and stock market variables either in short run or long run during 1950-51 to 2005.

III. Data and Methodology

The annual data from 1979-80 to 2007-08 has been used in our study to investigate the correlation and causal relationship between stock market and macro economic variables of India. We have taken the macro economic variables such as GDP at factor cost and Forex Reserves from Major Macro Economic Variables and BSE SENSEX and Market Capitalization data from Financial Statistics maintained by Reserve Bank of India (RBI).

In our study an easy and fast way to show the relation between the said variables is to calculate the correlations between the two. Hence we have calculated and found a high degree of correlation between the two types of variables. The formal investigation has started with examining the stochastic properties of the variables used in the analysis. So, we have performed the Augmented Dickey Fuller (ADF) Unit Root Test on the series to test the stationarity. Next, we have applied Engle-Granger Test to test the causality between them but no significant causal relations were found between SENSEX and GDP.

In our study, we have used Granger (1969) causality model to test the causality between Stock market variables and Macro economic variables. The following is the model adopted in our model to empirically examine the above said hypothesis. Let's start by defining Granger's concept of causality. X is said to be Granger cause Y if Y can be predicted with greater accuracy by using past values of X. Consider the following equation:

$$Y_t = \alpha_0 + \alpha_1 Y_{t-1} + \alpha_2 Y_{t-2} + \beta_1 X_{t-1} + \beta_2 X_{t-2} + u_t$$

If $\beta_1 = \beta_2 = 0$, X does not Granger cause Y. If, on the other hand, any of the β coefficients is non-zero, then X does Granger cause Y. The null hypothesis that $\beta_1 = \beta_2 = 0$ can be tested by using the standard F-test of joint significance. Note that it has been taken two period lags in the above equation. In practice, the choice of the lag is arbitrary. Varying the lag length may lead to different result. As a practical guide, one can include as many as are necessary to ensure non-auto correlated residuals.

To estimate our Granger causality, we have made stationary test of the variables concerned by using Augmented Dickey-Fuller test. If the variables don't have unit root problem then Granger can be estimated by method found mixed results about the causality between stock market and growth variables. In our paper the test of stationarity of the time series of the above mentioned variables are systematically done in order to rule out the likely spurious results. In order to estimate that we have used the popular Augmented Dickey-Fuller (1979) tests. Consider

here two variables such as X and Y for methodological discussion relating to the study. If the calculated Augmented Dickey-Fuller (ADF) statistics is less than its critical value, then X is said to be stationary or integrated to order zero, i.e., I (0). If this is not the case, then the ADF test is performed on the first difference of X (i.e., ΔX). If ΔX is found to stationary then X is integrated order one i.e., I (1). If two variables X and Y are both integrated to order one I (1), then the next step is to find out whether they are co integrated. This can be done by using Johansen's co-integration approach. If the two variables are not co-integrated then the best approach is to find out the causality between them by using standard Granger test, which only establishes short run relationship. In practice, however, a number of econometrics packages can be used to perform these tests which also give the critical values of the ADF statistic. To discuss the ADF Test we have to estimate the equation:

$$y_t = \gamma + \delta_t + \alpha y_{t-1} + \sum \theta_f \Delta y_{t-1} + e_t$$

here ε_t is not white noise as in previous Dickey Fuller Tests. The purpose in adding the terms Δy_{t-1} is to allow for ARMA error processes. But if the MA parameter is large, the AR approximation would be poor unless k is large.

After estimating this augmented equation, the tests K(1), t(1), and F(0,1) are used.

IV. Estimation and Analysis

One can very well point out the volatility in SENSEX by looking at the Figure1 which shows the trend of SENSEX growth over past three decades. One can easily make out from here that how SENSEX has grown tremendously especially after economic liberalization period. Even the market capitalization of SENSEX which is nothing but total market value of shares traded in the market also follows a similar trend as SENSEX over the period as it starts rising in early 1990s but have an exploded growth 2003-04 onwards . The trend is shown in Figure.2. Figure 3 indicates that real economic factors like GDP has grown steadily over the period of time with not much erratic movements in between but an exponential growth is noticed after the economic reforms and more after 2000-2001. Figure 4 reveals that India's foreign exchange reserves which were the ones which had fallen tremendously in 1990-91 and had pulled the final chain of problems had shown a great recovery after that and now it is in ample reserves.

In order to find out the relationship between stock exchange indicators and economic variables we have first estimated correlation matrices. The results are presented in the Table.1

The correlation matrix result shows that all the variables undertaken in this study show a very high degree of correlation with each other, depicting that there is certainly some relation between stock market and real economy which needs to be studied in detail. The next step is to determine whether the series are stationary or not. The results of the unit root test is provided in the Table 2. Perusal of the Table 2 reveals that GDP, Market Capitalization and Foreign exchange Reserves are stationary at 5% and 1% level of significance. The results of the granger casulity test have

been provided in the Table.3. Results of the Grange Causality test reveals that there is not causal relationship between sensitive index number and real GDp of India during above said time period. In addition, the findings of the Grange Causality test reveals that Market Capitalization Granger causes GDP; and Foreign exchange reserves also Granger causes GDP. Hence in real economy Market Capitalization and Foreign exchange reserves play an important role in growth of GDP of India. And also MCap Granger causes BSE sensex , thus indicating that MCap plays a very important role not just in Stock Market development but also in real economy.

V. CONCLUSION AND POLICY IMPLICATIONS

The purpose of this study is to find out the causality, if any, between Stock market and real economic variables. Although there is a strong correlation between the two and other descriptive statistics indicate a much higher expansion in stock market variables than real economic variables, i.e., stock market boom is not much supported by real economy.

Hence the basic conclusion that comes out is that although these variables are moving in the same direction but are not fundamentally caused by each other. There is not causality between stock exchange indicator i.e., sensex and real GDP in India. In other words, it can be said that Stock market in India has not yet become strong enough to influence the Real economy mainly because just 2% of Indian population is involved in Stock Market businesses or investments. But as they are moving in the same direction means that there is surely some other exogenous variable(s) which influence them together. As concluded that MCap causes GDP, hence when the valuation of shares of the companies traded in the stock market increases they have a positive impact on the GDP of the country. Similarly Forex reserves also causes GDP in a positive manner, and the point worth noticing is that major chunk of this Foreign exchange reserves comes from foreign institutional investments(FIIs) in form of FPIs and FDIs mainly into Stock Market only, thus again giving a further topic of research of structure of these Foreign exchange reserves.

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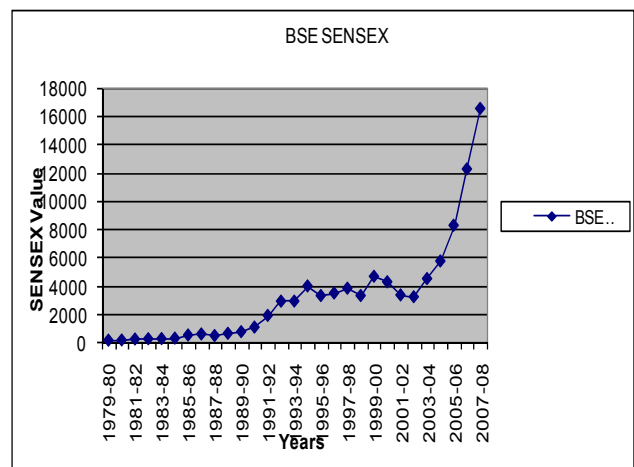
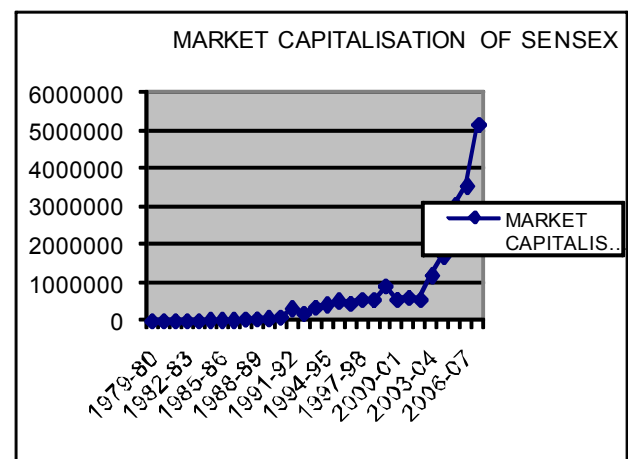Figure 1. Growth of SENSEX (1979-80 to 2007-08)

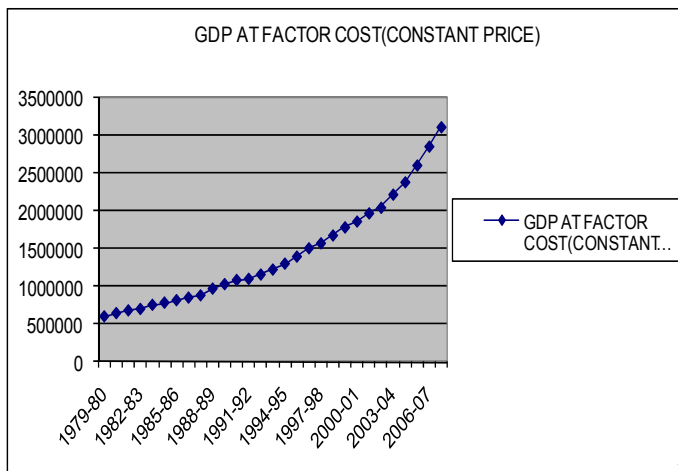Figure 2. Growth of Market Capitalization of SENSEX
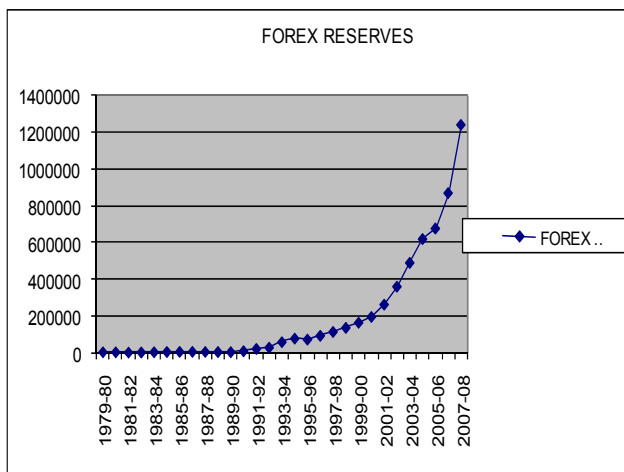
Figure 3.   Growth of GDP (1979-80 to 2006-2007)

Figure 4.   Growth of Forex Reserves

TABLE I.   CORRELATION MATRIX

Variables	BSE	FOREX	GDP	MCap
BSE	1	0.897854	0.919391	0.961845
FOREX	0.897854	1	0.921359	0.917111
GDP	0.919391	0.921359	1	0.873695
MCap	0.961845	0.917111	0.873695	1

TABLE II.   ADF TEST

Variables	ADF
GDP(-1)	3.592278**
Forex(-1)	4.732852*
BSE(-1)	0.060694
MCap(-1)	3.190342**

*Note: *, ** depicts significant at 1% and 5% levels respectively*

TABLE III.   GRANGER CAUSALITY TEST

Direction of Causality	F-Statistic
GDP causes MCap	0.00230
MCap causes GDP	4.70614**
BSE causes GDP	0.84272
GDP causes BSE	1.18311
GDP causes Forex	1.67954
Forex causes GDP	16.4609*
BSE causes MCap	0.98580
MCap causes BSE	4.83504**

*Note: *, ** represent significance at 1% and 5% level respectively.*