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Cointegration and Causality between Macroeconomic variables and Stock Prices: Empirical Analysis from Indian Economy

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Abstract

The study aims at examining how fiscal fundamental macroeconomic variables affect the performance of the stock market in India by using monthly data from April 2004- July 2015. The study makes use of Ng-Perron unit root tests to check the non-stationarity property of the series; the Auto Regressive Distributed Lag (ARDL) bounds test and a Vector Error Correction Model (VECM) for testing both short and long run dynamic relationships. The variance decomposition (VDC) is used to predict the exogenous shocks of the variables. The findings of the bounds test confirm that there exists a long-run co-integrating relationship between different macroeconomic variables and the stock prices in India. The ARDL result suggests a long-run negative relationship exists between crude oil prices, inflation and stock prices. The results of the influence of both the variables on stock prices are consistent in the short run as well. The results of the short-run estimation confirm positive and significant relationship for Gold, T-bill rates and Real Effective Exchange Rate. The VECM result shows a bidirectional causality is running between Inflation and CNX nifty index. Further, the result

indicates the presence of long run causality for the equation with a CNX nifty index as the dependent variable. The results of VDC analysis and IRF show that a major percentage of stock prices change is its own innovative shocks. The study implies that appropriate policy measures should be taken by the proficient authorities for the purpose of controlling inflation, which ultimately leads to the control of volatility of the stock market.

Keywords: **S**tock price, Fiscal deficit, ARDL, VECM, VDC, IRF, India

1. Introduction

The stock market is one of the most vital components of a free-market economy. It plays an important role in the mobilization of capital in emerging and developed countries, leading to economic prosperity of the country. The stock market is influenced by various factors ranging from economic, political and socio-cultural behavior of any country. Especially the stock markets of emerging economies are likely to be sensitive to fundamental changes in macroeconomic structure and policies play an important role in achieving financial stability. The dynamic linkage between macroeconomic variables and stock prices has fetched increasing amount of attention from economists, financial analysts, investors, practitioners and policy makers (Kwon and Shin, 1999).

Following Fama (1981) study, a number of empirical studies explored this topic to understand the fundamentals of this association in one country or in a selected group of countries. (Hamao, 1988; Fama, 1990; Chen, 1991; Canova and de-Nicolo, 1995; Dickson, 2000 and Nasseh and Strauss, 2000). But most of these studies are conducted on developed market where all aspects are more efficient and well connected with the overall economy. However, research on the relationship between real economic activity and the stock market in developing countries, such as Latin American, Eastern Europe, Middle Eastern, and South Asian countries, is still ongoing. Further, in respect to the Indian economy, few studies have been conducted on the dynamic relationships between the stock market and macroeconomic variables.

Studies on Indian stock market behavior have also been conducted in recent years. Agrawalla and Tuteja (2008) stated that rising indices in the stock markets cannot be taken to be a leading indicator of the revival of the economy in India and vice-versa. However, Shah and Thomas (1997) supported the idea that stock prices are a minor which reflect the real economy. Similar results were found in Kanakaraj et al. (2008). There are several other studies regarding the interaction of share market returns and the macroeconomic variables and all studies provide a different conclusion related to their test and methodology. Further, these studies have been carried out either in a bivariate setting or have mostly used traditional econometric technique. The present study is different from previous empirical literature or it can be said that it is an extension of the previous empirical work, including Tandon and Malhotra (2012), Ray (2012), Dasgupta (2013), and Fang and You (2014); in particular, to Fang and You's (2014) work in two aspects. First, the present study employs a wide range of fundamental macroeconomic variables, including foreign institutional investors, gold, treasury bill rates, wholesale price index, Crude oil price, and real effective exchange rate that might affect the behavior of stock prices in India, using longer and current timeframe that captures a longer period of second-generation reform in India (2004-2015). Second, the present study employs co-integration with ARDL that allows co-integrating relationship to be estimated by OLS modeling, thus, not requiring the pre testing of the variables included in the model for unit root unlike other techniques used by Tandon and Malhotra (2012), Ray (2012), and Dasgupta (2013); in particular, used by Fang and You's (2014).

However, unlike the conventional studies, in this paper, we employ the Auto Regressive Distributed Lag (ARDL) approach to cointegration to examine the long-run stability between the macroeconomic variables and Indian stock prices. The study also uses VECM based granger causality to check the direction of causal relationships between variables. Variance Decomposition (VDC) and Impulse Response Function (IRF) is also used to explore the degree of exogeneity of the variables involved in this study. For the purpose of analysis monthly data starting from the April 2004 to July 2015 is used.

The rest of the paper is organized as follows: Section 2 presents the review of empirical literature on the relationship between selected macroeconomic variables and stock market development. Section 3 outlines the data issues and econometric methodology used in the study; section 4 analyses the empirical results of the study, and section 5 presents the summary and policy implications of the study.

2. Literature Review

The relationship between stock performance and fundamental macroeconomic variables has been a subject of keen interest for economists, policy makers, academicians and researchers since the inception of stock markets. It is believed that macroeconomic events always exert a certain amount of influence on the stock markets. A large number of studies have been conducted worldwide to find out the relationship between macroeconomic variables and the fluctuations in the stock prices and it has been found out that with the minor variation these macroeconomic variables exerts a significant impact on stock prices. Some of the previous research works in this context are as follows:

Fama (1981) stated that expected inflation is negatively associated with the share price. Darrat (1994) found that budget deficits, long term bond rates, the amount of industrial production and the volatility of interest rate have an impact on the stock returns. Gjrde and Saettem (1999) examined the causal relation between stock returns and macroeconomic variables in Norway. Results showed that a positive link exists between oil price, real activity and stock returns. A study by Flannery and Protopapadakis (2002) concluded that two popular measures of aggregate economic activity (real gross national product and industrial production) were not related to stock returns. Mookerjee and Qiao (1997) investigated that stock prices co-integrated with both measures of the money supply (M1 and M2) and aggregate foreign exchange reserves. Ibrahim and Aziz (2003) investigated the relationship between stock prices and IPI (Industrial Production Index), money supply, CPI and exchange rate in Malaysia. Stock prices were found to share a positive long-run relationship with IPI and CPI.

Geske and Roll (1983); Chen et al. (1986); Mukherjee and Naka (1995); Wongbangpo and

Sharma (2002); Nishat and Shaheen (2004); Ratanapakorn and Sharma (2007); Rahman et al. (2009); found a positive relationship between IIP and stock prices.

Uddin and Alam (2009) found that Interest Rate has a significant negative relationship with Share Price. Mukherjee and Naka (1995) and Sarbapriya Ray (2012) found a relationship of the call money rate with stock prices. Coleman and Tettey (2008) studied the impact of macroeconomic indicators on the Ghana Stock Exchange (GSE) and concluded that lending rates from deposit money banks and inflation have an adverse impact on stock market performance contradict to the findings of Adam and Tweneboah (2008). Rahman et Al. (2009) showed that monetary policy variables have considerable long-term effects on the Malaysian stock exchange.

Studies on Indian stock market have also been conducted in recent years. Bhattacharya and Mukherjee (2002), Dharmendra Singh (2010), Naik and Padhi (2012), Dasgupta (2012) and Rafique et al. (2013) by using different methodologies, studied the impact of macroeconomic variables like the Index of Industrial Production, Money Supply, national income, Gross Domestic Product, interest rate, inflation, FDI, FII, trade openness, exchange rate and Whole Sale Price Index on stock market and found a significant impact of selected macroeconomic variables on the stock market. Naik and Padhi (2012) and Hussin et al. (2012) used the VECM to model the relationship between the stock prices and macroeconomic variables and, hence, a long-run equilibrium relationship exists between them. Hsing et al. (2011) applied the exponential GARCH model and found that the Argentine stock market index is positively associated with real GDP, the ratio of M2 money supply to GDP, the peso/USD exchange rate and the U.S. stock market index. Bekhet and Matar (2013) found the existence of a long-term equilibrium relationship between the Stock Price Index and the macroeconomic variables. Mazuruse (2014) used canonical Correlation Analysis (CCA) found that maximization of stock returns at the ZSE is mostly influenced by the changes in CPI, money supply, exchange rate and treasury bills. Rafay et al. (2014) found a unidirectional relationship between exchange rate and KSE 100 index. Bhargava (2014) found that interest rates are significant predictors of stock price movements.

From the above studies we can conclude that inconsistent results were obtained with regards to which variables significantly affects Indian stock market behavior. Further, the study finds that there has very few studies conducted while taking into account the effects of fundamental macroeconomic variables on the National Stock Exchange (CNX nifty) of India, using the ARDL approach on the emerging economy like India. This study attempts to fill this gap by exploring the effects of variations in macroeconomic variables towards stock prices in India with the help of monthly time series data.

3. Methodology and Data Description

3.1 Model Specification and Data

The following general specification has been used in this study to empirically examine the effect of fundamental macroeconomic factors on stock prices.

$$LNSE = \alpha_0 + \alpha_1 LIIP + \alpha_2 LFII + \alpha_3 LGOLD + \alpha_4 LTBR + \alpha_5 LWPI + \alpha_6 LCO + \alpha_7 LREER + \varepsilon_t \quad \mathbf{(1)}$$

Where LNSE= National Stock Exchange represented by CNX nifty index, the LIIP= Index of Industrial Production, the LFII= Foreign Institutional Investors, LGOLD= Gold, LTBR= Treasury bill rates (T-bill rates), LWPI= Wholesale price Index used as a proxy for inflation, LCO= Crude oil price and LREER= Real effective exchange rate, variables in the general model specification above. All the variables are taken in their natural logarithm.

The Study empirically estimated the effect of fundamental macroeconomic variables on stock prices with the help of above described methodology in India. The study uses monthly data covering the period from April 2004 to July 2015. The data has been taken and compiled from Handbook of Statistics on Indian economy, RBI; Economic Survey, Government of India; World Bank database; Official website of SEBI (Securities Exchange Board of India) and RBI (Reserve Bank of India).

3.2 Co-integration with ARDL

To empirically analyze the dynamic relationship of stock prices with macroeconomic fundamentals, the model specified in 3.1 has been estimated by the Auto Regressive Distributed Lag (ARDL) co-integration procedure developed by Pesaran et al. (2001). The procedure is adopted for four reasons. Firstly, the bounds testing is simple as opposed to other multivariate cointegration technique such as Johansen &Juselius (1990), it allows co-integrating relationship to be estimated by OLS once the lag order is selected. Secondly, the bound test procedure does not require the pre testing of the variables included in the model for unit root unlike other techniques such as Engle and Granger (1987) and Johansen & Juselius (1992). These approaches require that all the variables to be integrated of the same order (I(1)). Otherwise the predictive power will be lost (Kim et al., 2004; Perron, 1989, 1997). However ARDL technique is applicable irrespective of whether regressor in the model is I(0) or I(1). The procedure will, however crash in the presence of I(2) series. Thirdly, the test is relatively more efficient in small sample data sizes as is the case of this study. Fourth the error correction method integrates the short run dynamics with long run equilibrium without losing long run information. The unrestricted error correction model (UECM) of ARDL model is used to examine the long run & the short run relationship takes the following form.

$$\Delta LNSE_t = \delta_0 + \delta_1 T + \delta_2 LIIP_{t-1} + \delta_3 LFII_{t-1+}$$

$$\delta_4 LGOLD_{t-1} + \delta_5 LTBR_{t-1} + \delta_6 LWPI_{t-1} + \delta_7 LCO_{t-1} + \delta_8 LREER_{t-1} +$$
$$\sum_{i=1}^{q} \alpha_i \Delta LNSE_{t-i} + \sum_{i=1}^{q} \beta_i \Delta LIIP_{t-i} + \sum_{i=1}^{q} \mu_i \Delta LFII_{t-i} + \sum_{i=1}^{q} \sigma_i \Delta LGOLD_{t-i} +$$

$$\sum_{i=1}^{q} \omega_i \Delta LTBR_{t-i} + \sum_{i=1}^{q} \partial_i \Delta LWPI_{t-i} + \sum_{i=1}^{q} \varphi_i \Delta LCO_{t-i} + \sum_{i=1}^{q} \vartheta_i \Delta LREER_{t-i} + \varepsilon_t \quad (2)$$

Where the series is as defined earlier and T is time trend and L implies that the variables have been transformed in natural logs. The first part of the equation (2) with δ_2, δ_3, δ_4, $\delta_5, \delta_6, \delta_7$ and δ_8 refer to the long run coefficients and the second part with α, β, μ, σ, ω, ∂, φ and ϑ refers to the short run coefficients. The null hypothesis of no co-integration $H_0: \delta_2 = \delta_3 = \delta_4 = \delta_5 = \delta_6 = \delta_7 = \delta_8 = 0$ and the alternative hypothesis $H_1: \delta_2 \neq \delta_3 \neq \delta_4 \neq \delta_5 \neq \delta_6 \neq \delta_7 \neq \delta_8 \neq 0$ implies co-integration among the series (equation 2).

3.3 ARDL Bounds Testing Approach

The first step in the ARDL test is to estimate the equation (2) by OLS in order to test for the existence of a long run relationship among variables by conducting an Wald test (F- statistics) for the joint significance of the coefficients of the lagged levels of variables i.e. H_0 (Null hypothesis) as against H_1(Alternative hypothesis) as stated earlier. Then the calculated F-statistics is compared to the tabulated critical values in Pesaran (2001). If the computed F-values fall below the lower bound critical values, the null hypothesis of no cointegration cannot be rejected. Contrary, if the computed F-statistics exceeds the upper bound, then it can be concluded that the variables are co-integrated. Further, if the calculated F statistics fall in between upper and lower bounds, the inference about co-integrating relationship is not confirmed.

The long run and short run dynamic relationship can be estimated on a cointegrating relationship has been established by the bounds test. The long run co-integrating relationship can be estimated using the following specifications:

$$\Delta LNSE_t = \alpha_0 + \sum_{i=1}^{q} \delta_1 LNSE_{t-i} + \sum_{i=1}^{q} \delta_2 LIIP_{t-i} + \sum_{i=1}^{q} \delta_3 LFII_{t-i} + \sum_{i=1}^{q} \delta_4 LGOLD_{t-i} + \sum_{i=1}^{q} \delta_5 LTBR_{t-i} + \sum_{i=1}^{q} \delta_6 LWPI_{t-i} + \sum_{i=1}^{q} \delta_7 LCO_{t-i} + \sum_{i=1}^{q} \delta_8 LREER_{t-i} + \varepsilon_t \quad \textbf{(3)}$$

All the variables used are defined in section 3.1

The third and final step, we obtain the short run dynamic parameters by estimating an error correction model with the long run estimates. This is specified as below:

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$$\Delta LNSE_t = \mu + \sum_{i=1}^{q}\alpha_i \Delta LNSE_{t-i} + \sum_{i=1}^{q_1}\beta_i \Delta LIIP_{t-i} + \sum_{i=1}^{q_2}\mu_i \Delta LFII_{t-i} + \sum_{i=1}^{q_3}\sigma_i \Delta LGOLD_{t-i} + \sum_{i=1}^{q_4}\omega_i \Delta LTBR_{t-i} + \sum_{i=1}^{q_5}\partial_i \Delta LWPI_{t-i} + \sum_{i=1}^{q_6}\varphi_i \Delta LCO_{t-i} + \sum_{i=1}^{q_7}\vartheta_i \Delta LREER_{t-i} + \phi ECM_{t-1} + \varepsilon_t \quad (4)$$

Where $\alpha, \beta, \mu, \sigma, \omega, \partial, \varphi$ and ϑ are short run dynamic coefficient to equilibrium and $\phi$is the speed adjustment coefficient.

3.4 VECM based Granger Causality Test

The direction of causality between stock prices and fundamental macroeconomic indicators is investigated by applying Vector Error Correction Model (VECM) granger causality approach after confirming the presence of co-integrating relationship among the variables in the study. Granger (1969) argued that VECM is more appropriate to examine the causality between the series at I(1). VECM is restricted form of unrestricted VAR and restriction is levied on the presence of the long run relationship between the series. The system of error correction model (ECM) uses all the series endogenously. This system allows the predicted values to explain itself both by its own lags and lags of forcing variables as well as the lags of the error correction term and by residual term. The VECM equation is modeled as follows:

$$\begin{pmatrix} \Delta LNSE_t \\ \Delta LIIP_t \\ \Delta LFII_t \\ \Delta LGOLD_t \\ \Delta LTBR_t \\ \Delta LWPI_t \\ \Delta LCO_t \\ \Delta LREER_t \end{pmatrix} = \begin{pmatrix} C1 \\ C2 \\ C3 \\ C4 \\ C5 \\ C6 \\ C7 \\ C8 \end{pmatrix} + \sum_{i=1}^{p} \begin{bmatrix} \beta_{11i} & \beta_{12i} & \beta_{13i} & \beta_{14i} & \beta_{15i} & \beta_{16i} & \beta_{17i} & \beta_{18i} \\ \beta_{21i} & \beta_{22i} & \beta_{23i} & \beta_{24i} & \beta_{25i} & \beta_{26i} & \beta_{27i} & \beta_{28i} \\ \beta_{31i} & \beta_{32i} & \beta_{33i} & \beta_{34i} & \beta_{35i} & \beta_{36i} & \beta_{37i} & \beta_{38i} \\ \beta_{41i} & \beta_{42i} & \beta_{43i} & \beta_{44i} & \beta_{45i} & \beta_{46i} & \beta_{47i} & \beta_{48i} \\ \beta_{51i} & \beta_{52i} & \beta_{53i} & \beta_{54i} & \beta_{55i} & \beta_{56i} & \beta_{57i} & \beta_{58i} \\ \beta_{61i} & \beta_{62i} & \beta_{63i} & \beta_{64i} & \beta_{65i} & \beta_{66i} & \beta_{67i} & \beta_{68i} \\ \beta_{71i} & \beta_{72i} & \beta_{73i} & \beta_{74i} & \beta_{75i} & \beta_{76i} & \beta_{77i} & \beta_{78i} \\ \beta_{81i} & \beta_{82i} & \beta_{83i} & \beta_{84i} & \beta_{85i} & \beta_{86i} & \beta_{87i} & \beta_{88i} \end{bmatrix} \begin{pmatrix} \Delta LNSE_{t-i} \\ \Delta LIIP_{t-i} \\ \Delta LFII_{t-i} \\ \Delta LGOLD_{t-i} \\ \Delta LTBR_{t-i} \\ \Delta LWPI_{t-i} \\ \Delta LCO_{t-i} \\ \Delta LREER_{t-i} \end{pmatrix} + \begin{pmatrix} \gamma_1 \\ \gamma_2 \\ \gamma_3 \\ \gamma_4 \\ \gamma_5 \\ \gamma_6 \\ \gamma_7 \\ \gamma_8 \end{pmatrix} ECM_{t-1} + \begin{pmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \\ \varepsilon_{3t} \\ \varepsilon_{4t} \\ \varepsilon_{5t} \\ \varepsilon_{6t} \\ \varepsilon_{7t} \\ \varepsilon_{8t} \end{pmatrix} \quad \textbf{(5)}$$

The C's, β's and γ's are the parameters to be estimated. ECM_{t-1} represents the one period lagged error-term derived from the co-integration vector and the ε's are serially independent with mean zero and finite covariance matrix. From the Equation (5) given the use of a VAR structure, all variables are treated as endogenous variables. The F test is applied here to examine the direction of any causal relationship between the variables. The LIIP variable does not Granger cause LNSE in the short run, if and only if all the coefficients of β12i's are not significantly different from zero in Equation (5). There are referred to as the short-run Granger causality test. The coefficients on the ECM represent how fast deviations from the long-run equilibrium are eliminated. Another channel of causality can be studied by testing the significance of ECM's. This test is referred to as the long run causality test.

4. Estimation Results

4.1 Stationarity Test and Lag Length Selection before Co-Integration

Before we conduct tests for co-integration, we have to make sure that the variables under consideration are not integrated at an order higher than one. Thus, to test the integration properties of the series, we have used Ng-Perron unit root test. The results of the stationarity tests are presented in Table 1. The results show that all the variables are non-stationary at levels. The next step is to difference the variables once in order to perform stationary tests on differenced variables. The results show that after differencing the variables once, all the variables were confirmed to be stationary. It is, therefore, worth concluding that all the variables used in this study are integrated of order one i.e. difference stationary I(1). Therefore the study uses autoregressive distributed lag (ARDL) approach to co-integration. In addition, it is also important to ascertain that the optimal lag order of the model is chosen appropriately so that the error terms of the equations are not serially correlated. Consequently, the lag order should be high enough so that the conditional ECM is not subject to over parameterization problems (Narayan, 2005; Pesaran 2001). The results of these tests are presented in Table 2. The results of Table 2 suggest that the optimal lag length is one based on both FPE, SIC, AIC and HQ.

Table 1. Unit Root Test: Ng-Perron Test

Variables	Without trend and intercept				Stationarity Status
	Mza	MZt	MSB	MPT	
LNSE	0.576	0.429	0.744	38.514	I (1)
ΔLNSE	-6.556	-1.739	0.265	3.983	
LFII	0.481	1.630	9.626	51.912	I (1)
ΔLFII	-54.747	-5.231	0.095	0.447	
LGOLD	0.828	1.514	1.828	209.246	I (1)
ΔLGOLD	-15.656	-2.791	0.178	1.589	
LIIP	-3.459	-1.243	0.359	7.068	I (1)
ΔLIIP	-57.168	-5.345	0.093	0.431	
LREER	0.153	0.098	0.642	28.032	I (1)
ΔLREER	-53.440	-5.129	0.095	0.557	
LTBR	1.457	1.558	1.070	85.539	I (1)
ΔLTBR	-16.494	-2.869	0.174	1.494	
LWPI	0.143	0.093	0.652	28.471	I (1)
ΔLWPI	-14.298	-2.640	0.185	1.840	
LCO	-2.340	-1.065	0.455	10.366	I (1)
ΔLCO	-23.521	-3.323	0.141	1.402	

Source: Author’s own Calculation by using E-views 8.0

Δ denotes the first difference of the series. L implies that the variables have been transformed in natural logs.

Table 2. Lag Order Selection Criterion

Lag	*LogL*	*LR*	*FPE*	*AIC*	*SIC*	*HQ*
0	-281.469	NA	1.27e-08	4.522	4.701	4.595
1	725.217	1871.807	5.11e-15*	-10.206*	-8.602*	-9.554*
2	786.204	105.775*	5.41e-15	-10.159	-7.129	-8.928
3	837.308	82.245	6.81e-15	-9.957	-5.501	-8.147
4	880.668	64.362	9.93e-15	-9.635	-3.753	-7.245
5	931.249	68.758	1.34e-14	-9.425	-2.117	-6.456
6	982.161	62.844	1.90e-14	-9.221	-0.486	-5.672
7	1041.636	65.979	2.51e-14	-9.150	1.009	-5.022
8	1097.682	55.170	3.81e-14	-9.026	2.560	-4.318

* indicates lag order selected by the criterion

LR: sequential modified LR test statistic (each test at 5% level)

FPE: Final prediction error

AIC: Akaike information criterion

SC: Schwarz information criterion

HQ: Hannan-Quinn information criterion

4.2 ARDL Bounds Test

After determining the order of integration of all the variables in table 1, the next step is to employ an ARDL approach to co-integration in order to determine the long run relationship among the variables. By applying, the procedure in OLS regression for the first difference part of the equation (1) and then test for the joint significance of the parameters of the lagged level variables when added to the first regression.

The F-Statistics tests the joint Null hypothesis that the coefficients of lagged level variables in the equation (1) are zero. Table 3, reports the result of the calculated F-Statistics & diagnostic tests of the estimated model. The result shows the calculated F-statistics were 5.25316. Thus the calculated F-statistics turns out to be higher than the upper-bound critical value at the 5 percent level. This suggests that there is a cointegrating relationship among the variables included in the model, i.e. CNX nifty (LNSE), the Index of Industrial Production (LIIP), Financial Institutional Investment (LFII), Gold (LGOLD), T-Bill Rate (LTBR), Wholesale Price Index (LWPI), Crude oil price (LCO) and Real Effective Exchange Rate (LREER).

Table 3. ARDL bounds test results

Panel I: Bound testing to co-integration:

Estimated Equation: *LNSE = F (LIIP LFII LGOLD LTBR LWPI LCO LREER)*

Indicators	
Optimal lag	02
F – Statistics	5.25316

Panel II: Diagnostic Tests:

Diagnostic Tests Indicators	
Normality J-B value	0. 9011
Serial Correlation LM Test	1.4214
Heteroscedasticity Test (ARCH)	1.0215
Ramsey Reset Test	0.0694

The second step is to estimate the long and short-run estimates of ARDL test. The long run results are illustrated in Table 4. The results show that the coefficient of Crude oil prices (LCO) is statistically significant and negative at 5%. It is evident from the table that 5% increase in Crude oil price leads to 0.644% decrease in CNX nifty (LNSE). The findings are consistent with Valadkhani et al. (2009), Hosseini et al., (2011) (For India) and Kuwornu (2012). The result found in this study implies that, since India is an oil importer country, therefore, the increases in oil price would lead to increase the cost of production and, consequently, the expected cash flow would decrease and it is also evident that the increase in oil prices should result in higher costs and, hence, lower equity values.

Similarly, the coefficient of Inflation (LWPI) is negative and significant at 1%. It is evident from the table that 1% increase in Inflation leads to -0.328%, decrease in CNX nifty (LNSE). The findings of the study are consistent with Fama (1981), Mukherjee and Naka (1995), and Maysami and Koh (2000), who have found a negative correlation between inflation and stock prices. The negative relationship may be due to the reason that because inflation causes the value of money to decrease and consequently the purchasing power of the people decreases, which leads to a negative effect of saving and investment activities of the stock exchange.

Table 4. Estimated Long Run Coefficients using ARDL Approach (Dependent variable: LNSE)

Regressors	***ARDL(1,0,0,0)***		
	Coefficient	***t- values***	***Prob. Values***
LIIP	0 .082	0.948	[0.345]
LFII	-0.010	-0.466	[0.642]
LGOLD	0.293	0.309	[0.355]
LTBR	0.228	0.838	[0.403]
LWPI	-0.328***	2.919	[0.004]
LCO	-0.644**	1.928	[0.023]
LREER	0.428	0.339	[0.735]
CONS	-0.840	-0.112	[0.911]
Robustness Indicators			
R^2	0.988		
Adjusted R^2	0.987		
F Statistics	877.934 [0.000]		
D.W. Stat	1.845		
Serial Correlation, F	1.374 [0.189]		
Heteroskedasticity, F	2.899 [0.091]		
Rsamsey reset test, F	0.926 [0.338]		

Note: (1) The lag order of the model is based on Schwarz Bayesian Criterion (SBC).

(2) ** and *** indicate significant at 5 and 1 percent level of significance, respectively. Values in [#] are probability values.

The short-run relationship of the macroeconomic variables on the National Stock Exchange is presented in Table 5. As can be seen from the table, Inflation (LWPI) and Crude oil price (LCO) has a significant and negative impact on CNX nifty (LNSE) in the short run at 1% level of significance. One can say that 1% increase in inflation and crude oil price leads to 0.021% and 0.203%, decrease in CNX nifty. This may be due to the fact that investors are more sensitive towards the movements in crude oil price and inflation in the short run.

Whereas, Gold (LGOLD), T-bill rates (LTBR) and Real Effective Exchange Rate (LREER) are significantly positive at 10%, 10% and 1% level, respectively, in short-run. The positive impact of T-bill rates on the CNX nifty Index is to some extent consistent with Kuwornu (2012), implying that investors do not view Short Term T-bill rate with the associated interest rates as option to investment opportunities. Therefore, increases in T-bill rates lead to increased investment in stocks, causing stock returns to rise in India. The appreciation of the

Real Effective Exchange Rate in India would attract more investors to invest in the stock market in the short run. The short run adjustment process is examined from the ECM coefficient. The coefficient lies between 0 and -1, the equilibrium is converging to the long run equilibrium path, is responsive to any external shocks. However, if the value is positive, the equilibrium will be divergent from the reported values of ECM test. The coefficient of the lagged error-correction term (-0.0746) is significant at the 1% level of significance. The coefficient implies that a deviation from the equilibrium level of National Stock Exchange in the current period will be corrected by 7 percent in the next period to resort the equilibrium.

Table 5. Estimated Short Run Coefficients using ARDL Approach (Dependent variable: LNSE)

Regressors	***ARDL(1,0,0,0)***		
	Coefficient	***T – Ratio***	***Prob. Values***
LIIP	0.006	0.880	[0.381]
LFII	-0.745E-3	-0.471	[0.638]
LGOLD	0.0479*	1.724	[0.087]
LTBR	0.0669*	1.802	[0.074]
LWPI	-0.0217***	3.144	[0.002]
LCO	-0.2036***	3.913	[0.000]
LREER	1.391***	5.464	[0.000]
ΔCONS	-0.0623	-0.111	[0.911]
ECM $_{t-1}$	-0.0746	3.106	[0.002]
Robustness Indicators			
R^2	0.430		
Adjusted R2	0.374		
D.W. Stat	1.845		
SE Regression	0.047		
RSS	0.264		
F Statistics	10.163 [0.000]		

Note: (1) The lag order of the model is based on Schwarz Bayesian Criterion (SBC).

(2) * and *** indicate significant at 10 and 1 percent level of significance, respectively. Values in [#] are probability values.

4.3 VECM Based Causality

The results of table 6 indicate that there exists a short-run causality running from inflation and crude oil price to stock prices in India. Furthermore, a unidirectional causality is also running from stock prices to gold and inflation. Thus, it is clearly observed that bidirectional causality is running between inflation and CNX nifty index. It is also observed that error correction term is statistically significant for specification with LNSE as the dependent variable which indicate that there exist a long-run causal relationship between the variable with LNSE as the dependent variable. This result is also confirmed by the ARDL test statistics.

Table 6. Results of Vector Error Correction Model

Dependent variable				***Sources of Causation***					
	Short run independent variables								***Long run***
	ΔLNSE	**ΔLIIP**	**ΔLFII**	**ΔLGOLD**	**ΔLTBR**	**ΔLWPI**	**ΔLCO**	**ΔLREER**	***$ECM_{(t-1)}$***
ΔLNSE	-	0.380	0.530	1.612	2.090	6.833**	5.613**	0.897	1.664**
ΔLIIP	3.656	-	0.567	2.673	1.094	1.729	2.793	0.714	-0.364
ΔLFII	0.799	0.389	-	0.148	0.380	3.116	0.411	1.352	0.723***
ΔLGOLD	5.484**	1.504	1.577	-	1.187	1.336	0.282	0.078	-0.276
ΔLTBR	5.207*	0.860	2.689	1.492	-	1.921	1.493	0.257	-0.508
ΔLWPI	7.012**	0.024	3.813	0.037	3.690	-	6.250**	1.063	-1.817*
ΔLCO	1.200	0.204	1.779	0.738	3.265	0.321	-	0.182	-1.197
ΔLREER	2.696	7.242*	2.199	2.186	2.607	1.153	1.964	-	-0.356

*, ** and *** indicate significant at 10, 5 and 1 percent level of significance, respectively

The robustness of the short run result are investigated with the help of diagnostic and stability tests. The ARDL-VECM model passes the diagnostic against serial correlation, functional misspecification and non-normal error. The cumulative sum (CUSUM) and the cumulative sum of square (CUSUMSQ) tests have been employed in the present study to investigate the stability of a long run and short run parameters. The cumulative sum (CUSUM) and the cumulative sum of square (CUSUMSQ) plots (Figure 1) are between critical boundaries at 5% level of significance. This confirms the stability property of a long run and short run parameters which have an impact on the market index in case of India. This confirms that models seem to be steady and specified appropriate.

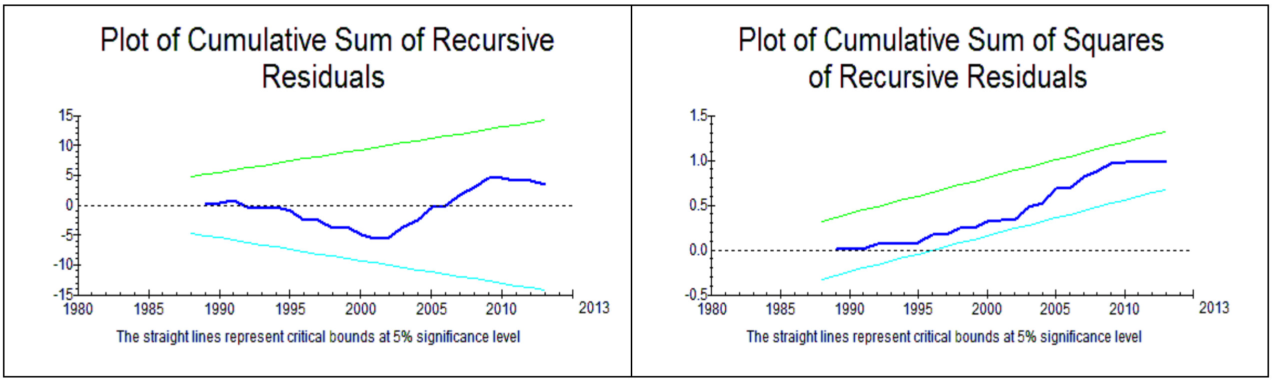

Figure 1. Plots of Stability Test

4.4 Variance Decomposition (VDC) Analysis

It is pointed out by Pesaran and Shin (2001) that the variable decomposition method shows the contribution in one variable due to innovation shocks stemming in the forcing variables. The variance decomposition indicates the amount of information each variable contributes to the other variables in the autoregression. It determines how much of the forecast error variance of each of the variables can be explained by exogenous shocks to the other variables. The main advantage of this approach as it is insensitive to the ordering of the variables. The results of the VDC are presented in table 7. The empirical evidence indicates that 71.85% of

CNX nifty index change is contributed by its own innovative shocks. Further shock in inflation explains CNX nifty index by 15.67%. Crude oil price contributes to the CNX nifty index by 9.24%, and the results are consistent with the results of VECM. Thus, it can be said that the most important macroeconomic variables that influence CNX nifty index in India are inflation and crude oil prices, though they are marginal at 15.67% and 9.24% respectively. From this analysis, it can be referred that the Indian Stock Market Returns can be predicted from the inflation and crude oil prices. The share of other variables is very minimal.

Table 7. Variance Decomposition (VDC) Analysis

Period	*S.E.*	*LNSE*	*LFII*	*LGOLD*	*LREER*	*LTBR*	*LIIP*	*LWPI*	*LCO*
1	0.054	100.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2	0.085	97.815	0.252	0.352	0.148	1.012	0.320	0.086	0.010
3	0.107	97.020	0.532	0.395	0.146	1.019	0.297	0.575	0.010
4	0.123	95.720	0.668	0.371	0.168	1.016	0.456	1.565	0.032
5	0.135	94.387	0.681	0.326	0.181	0.913	0.502	2.816	0.189
6	0.145	92.809	0.657	0.286	0.176	0.809	0.500	4.188	0.570
7	0.153	90.911	0.628	0.258	0.162	0.727	0.483	5.631	1.195
8	0.160	88.714	0.600	0.250	0.149	0.675	0.462	7.111	2.035
9	0.165	86.301	0.574	0.263	0.150	0.647	0.442	8.583	3.035
10	0.171	83.774	0.549	0.299	0.178	0.639	0.422	10.005	4.130
11	0.176	81.222	0.526	0.359	0.241	0.640	0.403	11.347	5.258
12	0.180	78.714	0.504	0.441	0.349	0.644	0.389	12.589	6.368
13	0.184	76.298	0.485	0.544	0.508	0.646	0.379	13.725	7.419
14	0.188	74.006	0.468	0.669	0.719	0.643	0.351	14.752	8.383
15	0.192	71.854	0.453	0.815	0.981	0.634	0.345	15.672	9.244
Cholesky Ordering: LNSE LFII LGOLD LREER LTBR LIIP LWPI LCO									

4.5 Impulse Response Function (IRF)

An impulse response refers to the reaction of any dynamic system in response to some external change. It helps to trace out the responsiveness of the dependent variables in the VAR to shocks to each of the variables. Table 8 presents the estimates from the impulse response function of stock market index as against its "own shocks" and the shocks of Foreign Institutional Investors, gold, Real Effective Exchange Rate, T-bill rates, the Index of Industrial Production, Inflation and crude oil prices. The result shows that the CNX nifty index has a negative relationship with its past on the long-run. In its response to the shocks of Index of Industrial Production, it is observed that there is a negative relationship throughout the period, whereas, a similar relationship is observed in the case of inflation and crude oil in the long run, except for the first three periods, i.e. it shows a positive relationship in the short run. Further, T-bill rates show a positive relationship in the long run, except for the second period, the result is consistent with the result of short run ARDL estimation. In its response to the shocks of Foreign Institutional Investors, it is also observed that there is a negative relation in second to sixth period, i.e. in the short run and thereafter it shows a positive relationship in the long run. Furthermore, in its response to the shocks of Real Effective Exchange rate and Gold the negative relationship starts from seventh and eighth period, respectively, but it shows a positive relationship in the short run. Also, in its response to the shocks of explanatory variables, CNX nifty does not respond in the first period. The evidences in favor of the explanations given in the table are also presented in graphical format in figure 3.

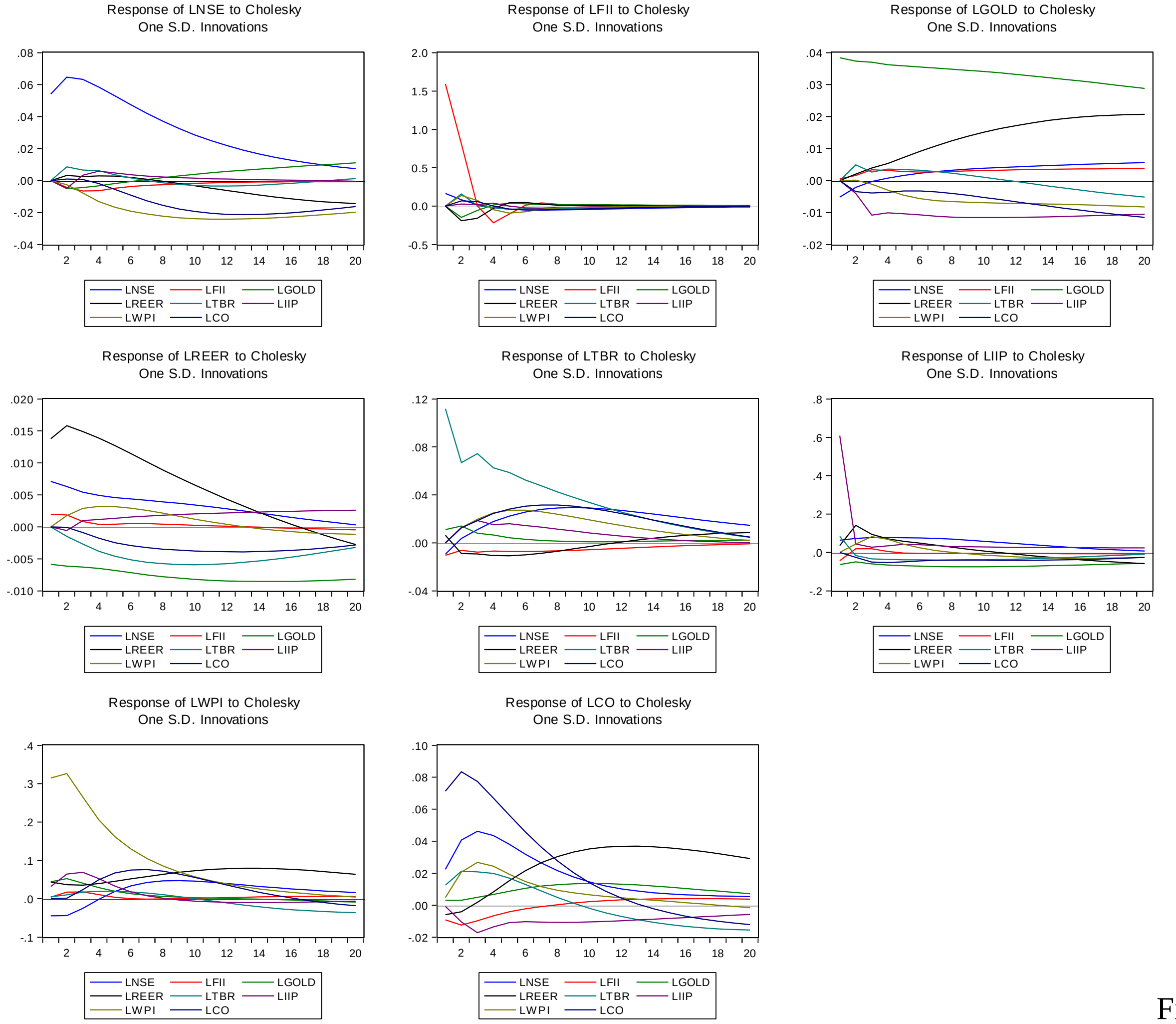

Figure 3. Impulse Response Function combined graph

Table 8. Impulse Response Function (IRF)

Period	*S.E.*	*LNSE*	*LFII*	*LGOLD*	*LREER*	*LTBR*	*LIIP*	*LWPI*	*LCO*
1	0.054	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2	0.064	-0.004	-0.005	0.003	0.008	-0.004	-0.002	0.000	0.000
3	0.063	-0.006	-0.004	0.002	0.006	0.003	-0.007	0.000	0.000
4	0.058	-0.006	-0.003	0.002	0.006	0.005	-0.013	-0.001	-0.001
5	0.052	-0.004	-0.001	0.002	0.003	0.004	-0.016	-0.005	-0.005
6	0.047	-0.003	-0.000	0.001	0.001	0.003	-0.019	-0.009	-0.009
7	0.041	-0.002	0.000	0.000	-0.000	0.002	-0.020	-0.012	-0.012
8	0.036	-0.002	0.001	-0.000	-0.001	0.002	-0.022	-0.015	-0.015
9	0.032	-0.002	0.002	-0.001	-0.002	0.001	-0.023	-0.017	-0.017
10	0.028	-0.001	0.003	-0.003	-0.003	0.001	-0.023	-0.019	-0.019
11	0.024	-0.001	0.004	-0.004	-0.003	0.001	-0.024	-0.020	-0.020
12	0.021	-0.001	0.005	-0.006	-0.003	0.000	-0.024	-0.021	-0.021
13	0.019	-0.001	0.006	-0.007	-0.003	0.000	-0.024	-0.021	-0.021
14	0.016	-0.000	0.007	-0.009	-0.002	0.000	-0.023	-0.021	-0.021
15	0.014	-0.000	0.007	-0.010	-0.002	0.000	-0.023	-0.020	-0.020
Cholesky Ordering: LMCAP LCAD LFD LGDP LCR LTO LEX									

5. Summary, Conclusions and Policy Implications

An effort has been made in this paper to investigate whether the fundamental macroeconomic variables affect the stock prices in India or not. Towards this effort, we use monthly data from April 2004 to July 2015 for the all the variables included in the estimation. The study used ARDL bounds testing approach to study the long-run and short-run co-integrating relationship among the variables. The bounds test confirms that there exists a long-run co-integrating relationship between different macroeconomic variables and the stock prices in India. The long-run estimates of ARDL test showed that negative and significant relationship exists between the crude oil prices (LCO) and stock prices (LNSE). Similarly, it also confirms a negative and significant relation exist between Inflation (WPI) and stock prices. The results of the influence of both the variables on stock prices are consistent in the short run as well.

Further, for short-run the study confirms positive and significant relationship for Gold, T-bill rates (TBR) and Real Effective Exchange Rate (LREER). The error correction model of ARDL approach reveals that the adjustment process from the short-run deviation is high. More precisely, it is found that the ECM_{t-1} term is -0.0746. This term is significant at 1%, again confirming the existence of cointegration that the derivation from the long run equilibrium path is corrected 7% per month.

To determine the direction of causality VECM is used in the study and the result found short run causality running from Inflation and crude oil price to National Stock Exchange in India. Additionally, a unidirectional causality is also running from national stock exchange to gold and inflation. Hence, it is observed that bidirectional causality is running between Inflation and CNX nifty index. Further, the result indicates the presence of long run causality for the equation with a CNX nifty index as the dependent variable. The CUSUM and CUSUMSQ test results suggest the policy changes considering the explanatory variables of the CNX nifty index equation will not cause major distortions in India. To predict the long-run and short-run shocks variance decomposition is used for the study, the results of VDC analysis and IRF show that a major percentage of stock prices change is its own innovative shocks.

World oil price is a powerful exogenous variable which influences the stock price index and the findings imply that increase in crude oil prices leads to decreased stock prices, creating an unfavorable investment climate; therefore, the rising crude oil prices should serve as the reminder for policy makers to monitor and control its effects on economic conditions. The study suggests that suitable policy measures should be taken by the proficient authorities for the purpose of controlling inflation, which ultimately leads to the control of volatility of the stock market. By implementing appropriate monetary policies and setting appropriate fiscal measures, the Indian government will be in the situation to control and regulate the rate of inflation, to promote a healthy growth of the stock markets in India. Therefore, the study suggests that the financial regulators and policymakers should consider the effect of these fundamental macroeconomic variables while formulating fiscal and economic policies.

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