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Examining the Relationship between Sectoral Stock Market Indices and Sectoral Gross Domestic Product: An Empirical Evidence from India

By Pooja Joshi & A K Giri

Birla Institiute of Science and Technology, India

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EXAMININGTHERELATIONSHIPBETWEENSECTORALSTOCKMARKETINDICESANDSECTORALGROSSDOMESTICPRODUCTANEMPIRICALEVIDENCEFROMINDIA

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Examining the Relationship between Sectoral Stock Market Indices and Sectoral Gross Domestic Product: An Empirical Evidence from India

Pooja Joshi [α] & A K Giri [σ]

Abstract- This paper aims to examine the relationship between gross domestic product and Indian stock market from a sectoral perspective by using quarterly time series data from 2003:Q4 to 2014:Q4. Ng-Perron unit root test is utilized to check the order of integration of the variables. The long run relationship is examined by implementing the ARDL bounds testing approach to co-integration. VECM method is used to test the short and long run causality and variance decomposition is used to predict long run exogenous shocks of the variables. The results of the ARDL bounds test confirm the existence of a cointegrating relationship between sectoral GDP and sectoral stock price in India. The results from long-run and short-run coefficient reveals that sectoral price indices are significantly influenced by changes in the respective sectoral GDP in the long-run, whereas, crude oil price is an important factor influencing the sectoral prices in the short-run. The granger causality test demonstrates a unidirectional short-run causality running from manufacturing sector GDP to aggregate stock price index of manufacturing sector. Further, the short-run causality running from electricity, gas and water supply sector GDP to respective sector stock price index. However, unidirectional short-run causality is absent in the service sector.

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I. Introduction

The claim that macroeconomic variables affect stock market is a well-established fact in the literature of financial economics and has been an area of intense interest among academicians, investors and stock market regulators since 1980s. Especially, in the past two decades, there has been growing efforts made by researchers to empirically estimate this relation. (Chen et al. (1986), Fama (1990, 1991), Mukherjee and Naka (1995), Nasseh and Strauss (2000), Ratanapakorn and Sharma (2007)). These studies conclude that stock prices do respond to the changes in macroeconomic fundamentals. However, a very few studies have been conducted on the relationship of macroeconomic variables and sectoral indices across the globe. Further, none of the study focused on the relationship of sectoral GDP explaining its impact on respective sectoral indices for an emerging economy like India.

It is a proved fact that aggregate GDP affects composite stock market indexes, but sometimes a change in aggregate GDP, for example, an increase in aggregate GDP cause composite index to increase, but an increase in composite index does not mean that all the sectors of the composite index or all the sectoral indices are increasing, a few of the sectors cannot perform well even if the GDP of the economy is increasing, while others can outperform the market. Further, it should also be noticed that, with the change in the GDP of a particular sector, it is not necessary that the stock market changes, but if any of the sector performs extremely well and attains a significant change in GDP than it can give a boost to the composite stock index. All these phenomena can be better understood with the help of sector wise study. Therefore, an attempt has been taken to study the impact of sectoral contribution of GDP in explaining the variation in the sectoral stock market index. Further, apart from sectoral GDP, few other macroeconomic variables are expected to influence the stock prices of a specific sector. Hence, the paper attains to identify the impact of sectoral GDP, along with certain controlled variables, on respective sectoral indices. The study uses three different sectors, viz-a-viz, manufacturing sector index, electricity, gas and water sector index and service sector index of BSE and the respective sectors of GDP are; (1) manufacturing sector share in GDP, (2) electricity, gas and water sector share in GDP and (3) service sector share in GDP. The three sectors have been chosen for the study because these three sectors are the fastest growing sectors in India. The service sector contributes maximum to the India's GDP with 57% share of GDP in 2013-14, up from 15% in 1950-51. Whereas, manufacturing sector contributes about 15.1% of India's GDP and 50% of the India's export, which shows that they are playing a

Author α: Research Scholar, Department of Economics and Finance, Birla Institute of Technology and Science (BITS), Pilani, India.
e-mail: poojajoshibits@gmail.com
Atuhor σ: Associate Professor, Department of Economics and Finance, Birla Institute of Technology and Science (BITS), Pilani, India.
e-mail: akgiri.bits@gmail.com

significant role in Indian economy. While the electricity, gas and water supply sector is also an important part of the Indian economy from an industrial point of view, as because these are the basic Necessitiies of any of the industry to develop. This sector constitutes a small portion of India's GDP with a 2.5% share of GDP, in 2013-14, up from 0.24% in 1950-51. The three indices (manufacturing index; electricity, gas and water supply index; and service index) are taken according to the sectoral contribution in GDP. It is a general belief that all the indices should be positively affected by the respective GDP, because the increase in the GDP of a particular sector gives confidence to investors which leads to increase in the index of that particular sector.

The prime objective of this paper is to analyze the impact of a predetermined set of macroeconomic factors and sectoral GDP on different sectors of BSE. However, unlike the conventional studies, in this paper, we employ the Auto Regressive Distributed Lag (ARDL) approach to examine the cointegration and long-run stability between the sectoral BSE indices with sectoral contribution in GDP along with other controlled variables. The study also uses VECM based granger causality to check the direction of causal relationships between variables. Variance Decomposition (VDC) is also used to explore the degree of exogeneity of the variables involved in this study. For the purpose of analysis quarterly data starting from the year 2003:Q4 to 2014:Q4 are used.

The rest of the paper is organized as follows: Section 2 presents the review of empirical literature on the relationship between selected sectoral GDP along with controlled variables and sectoral stock indices. 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 concluding remarks.

II. Literature Review

Several empirical studies have been conducted on the relationship between stock market development and economic growth with varying results while some of these studies support the positive relation between stock markets and growth, others reject it. Toda and Yamamoto (1995), Levine and Zervos (1996, 1998), Bencivenga, et al. (1996), Daferighe and Aje (2009) and Hsing (2011) found a positive link between financial development and economic growth. On the contrary, a number of studies also disagree with the view that stock markets promote growth, which includes Ram (1999), Singh (1997), Devereux and Smith (1994).

Adaramola (2011), Arodoye (2012), Fathi et al. (2012), Ray Sarbapriya (2012), Naik and Padhi (2012), Rafique et al. (2013) and Mazuruse Peter (2014) found a significant impact of exchange rate, oil prices, inflation rate, FDI, FII, Trade openness and interest and GDP on stock prices in both the short-run and long-run.

However, the literature examining the relation of macroeconomic variables on individual stock market indices is scarce. Ta and Teo (1985) observed high correlation among six Singapore sector indices in the period 1975 to 1984 and the overall SES market return. Sun and Brannman (1994) similarly found a single long-run relationship among the SES All-S Equities Industrial & Commercial, Finance, Hotel, and Property Index. Maysami et al. (2004) examined the co-movement between sectoral stock indices of the U.S. and Singapore, through examining whether the S&P 500 Electronics (Semiconductor) Price Index leads Stock Exchange of Singapore's Electronics Price Index. The results confirmed the long-term cointegration sectoral relationships. Maysami et al. (2004) examined the long-term equilibrium relationship between macroeconomics variables and the Singapore stock market index, also with the various Singapore Exchange Sector indices as an estimation model. The study showed that the Singapore stock market index and the property index have significant relationships with all macroeconomic variables identified, while the finance index and the hotel index meet significant relationships only with selected variables. Hancocks (2010) determined the effect of selected macroeconomic variables on stock market prices of the All-Share, Financial, Mining and Retail Indices. The results showed that certain macroeconomic variables had differing influences on each sector of the stock market. Impulse Response tests indicated that the selected macroeconomic variables caused a shock to the sectoral indices in the short-run. Chinzara (2011)analyzed how systematic risk emanating from the macro-economy is transmitted into stock market volatility. Aggregate stock market index and the four main sectors (Financial, industrial, mining and general retail) and macroeconomic variables were used for the study. It was found from the study that volatility transmission between the stock market and most of the macroeconomic variables and the stock market is bidirectional. Saeed (2012) examined the impact of macroeconomic variables on sectoral indices. Results revealed that only short term interest rate has a significant impact on returns of various sectors. Sharabati (2013) investigated the relationship between GDP and each stock market sector (Banks, Insurances, Services and Industries) in Amman Stock Exchange. The results suggested that among the four ASE sector only industrial sector showed a strong relationship with GDP.

Zaheer et al. (2009) analyzed the impact of macroeconomic variables on the returns of Textile and Banking sector. Observation showed that market index, few macroeconomic variables and individual industrial production played an important role in measuring the returns of industry as compared to the firm. Gabriel (2010) measured the impact of macroeconomic indicators on the leasing industry. The result indicated that GDP generally had a positive relationship in all significant cases. Yogaswari et al. (2012) found that the change in interest rate and inflation, giving negative impact to the stock price in the Jakarta Composite Index, agriculture sector, and basic industry sector. Zaighum (2014) studied the impact of a pre-specified set of macroeconomic factors on firm's stock returns for nine nonfinancial sectors listed in Karachi Stock Exchange. The results showed that all studied sectors firm's stock returns have a negative relationship with the consumer price index, money supply and risk free rate, whereas industrial production index and market returns indicates a positive relationship.

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 been no study conducted while taking into account the effects of the sectoral GDP, along with other controlled macroeconomic variables on sectoral indices using the ARDL approach for any of the economy. Most of the past studies investigated the impact of macroeconomic factors on stock returns at the aggregate; therefore, the study attempts to fill this gap by exploring the effects of variations in sectoral GDP and other macroeconomic variables towards sectoral stock price indices in India with the help of quarterly time series data.

III. Methodology and Data Description

a) *Model Specification and Data*

For the study, three models are framed, in which each of the sectoral stock price indices is placed as dependent variable and Crude Oil Price, REER, T-bill rates, Trade openness and WPI along with respective sectoral GDP worked as independent variables. The models are defined as:

MANI = f (GMAN, CO, REER, TB, TRADE,WPI)………….. Model I;

EGWI = f (GEGW, CO, REER, TB, TRADE, WPI)…………. Model II;

SERI = f (GSER, CO, REER, TB, TRADE, WPI)……………Model III

Principal component analysis is used in this study to construct the composite index of manufacturing index; electricity, gas and water supply index; and service index. Manufacturing index has been formulated by incorporating automobile index, consumer durables index, capital goods index, metal index and fast moving consumer goods index. Electricity, gas and water supply index has been formulated by incorporating oil and gas index and power sector index. Service index has been formulated by incorporating bank index, health care index, IPO index, information technology index and Telecom, Media, and Telecommunications index. All the three aggregate indexes were formulated following the guidelines of BSE.

The following general specification has been used in this study to empirically examine the effect of sectoral GDP and other controlled macroeconomic factors on respective sectoral indices.

$$Lx = \alpha_0 + \alpha_1 y_1 + \alpha_2 y_2 + \alpha_3 y_3 + \alpha_4 y_4 + \alpha_5 y_5 + \alpha_6 y_6 + \varepsilon_t \quad \text{….. (1)}$$

Here, x is considered as the dependent variable (LMANI, LEGWI, and LSERI) and y_1 (LGMAN, LGEGW, LGSER), y_2 (LCO), y_3 (LREER), y_4 (LTB), y_5 (LTRADE) and y_6 (LWPI) as the independent variables.

Where LMANI= Manufacturing index, LGMAN= manufacturing sector share in GDP, LEGWI= Electricity, gas and water index, LGEGW= electricity, gas and water supply sector in GDP, LSERI= Service sector index, LGSER= service sector share in GDP, LCO = Crude oil price, LREER= Real effective exchange rate, LTB= T-bill rates taken as proxy for interest rates, LTRADE= Trade Openness, and LWPI= Wholesale price index as a proxy for inflation variable in the general model specification above. All the indexes are listed on Bombay Stock Exchange (BSE)[i]. All the variables are taken in their natural logarithm.

The Study empirically estimated the effect of sectoral GDP and controlled macroeconomic variables on respective sectoral indices with the help of above described methodology in India. The study uses quarterly data covering the period from 2003:Q4 to 2014:Q4. 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 and BSE India.

b) *Co-integration with ARDL*

To empirically analyze the dynamic relationship of stock market sectoral indices with respective sectoral GDP and 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:

$$\Delta x = \delta_0 + \delta_1 T + \delta_2 y_{1_{t-1}} + \delta_3 y_{2_{t-1}} + \delta_4 y_{3_{t-1}} + \delta_5 y_{4_{t-1}} + \delta_6 y_{5_{t-1}} + \delta_7 y_{6_{t-1}} + \sum_{i=1}^{q} \alpha_i \Delta x_{t-i} + \sum_{i=1}^{q} \beta_i \Delta y_{1_{t-i}} + \sum_{i=1}^{q} \mu_i \Delta y_{2_{t-i}} + \sum_{i=1}^{q} \sigma_i \Delta y_{3_{t-i}} + \sum_{i=1}^{q} \omega_i \Delta y_{4_{t-i}} + \sum_{i=1}^{q} \partial_i \Delta y_{5_{t-i}} + \sum_{i=1}^{q} \varphi_i \Delta y_{6_{t-i}} + \varepsilon_t \quad \ldots (2)$$

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 , δ_5, δ_6 andδ_7 refer to the long-run coefficients and the second part with α, β, μ, σ, ω, ∂ and φ refers to the short-run coefficients. The null hypothesis of no co-integration $\mathrm{H}_0: \delta_1 = \delta_2 = \delta_3 = \delta_4 = \delta_5 = \delta_6 = \delta_7 = 0$ and the alternative hypothesis $\mathrm{H}_1: \delta_1 \neq \delta_2 \neq \delta_3 \neq \delta_4 \neq \delta_5 \neq \delta_6 \neq \delta_7 \neq 0$ implies co-integration among the series.

c) 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:

$$\Delta x = \alpha_0 + \sum_{i=1}^{q} \delta_1 x_{t-1} + \sum_{i=1}^{q} \delta_2 y_{1_{t-1}} + \sum_{i=1}^{q} \delta_3 y_{2_{t-1}} + \sum_{i=1}^{q} \delta_4 y_{3_{t-1}} + \sum_{i=1}^{q} \delta_5 y_{4_{t-1}} + \sum_{i=1}^{q} \delta_6 y_{5_{t-1}} + \sum_{i=1}^{q} \delta_7 y_{6_{t-1}} + \varepsilon_t \ldots\ldots (3)$$

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:

$$\Delta x = \mu + \sum_{i=1}^{q} \alpha_i \Delta x_{t-i} + \sum_{i=1}^{q1} \beta_i \Delta y_{1_{t-i}} + \sum_{i=1}^{q2} \mu_i \Delta y_{2_{t-i}} + \sum_{i=1}^{q3} \sigma_i \Delta y_{3_{t-i}} + \sum_{i=1}^{q4} \omega_i \Delta y_{4_{t-i}} + \sum_{i=1}^{q5} \partial_i \Delta y_{5_{t-i}} + \sum_{i=1}^{q6} \varphi_i \Delta y_{6_{t-i}} + \phi ECM_{t-1} + \varepsilon_t \quad \ldots. (4)$$

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

d) VECM based Granger Causality Test

The direction of causality between stock market sectoral indices and respective sectoral GDP along with controlled 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:

$$\begin{pmatrix} \Delta x_t \\ \Delta y_{1_t} \\ \Delta y_{2_t} \\ \Delta y_{3_t} \\ \Delta y_{4_t} \\ \Delta y_{5_t} \\ \Delta y_{6_t} \end{pmatrix} = \begin{pmatrix} C1 \\ C2 \\ C3 \\ C4 \\ C5 \\ C6 \\ C7 \end{pmatrix} + \sum_{i=1}^{p} \begin{bmatrix} \beta_{11i} & \beta_{12i} & \beta_{13i} & \beta_{14i} & \beta_{15i} & \beta_{16i} & \beta_{17i} \\ \beta_{21i} & \beta_{22i} & \beta_{23i} & \beta_{24i} & \beta_{25i} & \beta_{26i} & \beta_{27i} \\ \beta_{31i} & \beta_{32i} & \beta_{33i} & \beta_{34i} & \beta_{35i} & \beta_{36i} & \beta_{37i} \\ \beta_{41i} & \beta_{42i} & \beta_{43i} & \beta_{44i} & \beta_{45i} & \beta_{46i} & \beta_{47i} \\ \beta_{51i} & \beta_{52i} & \beta_{53i} & \beta_{54i} & \beta_{55i} & \beta_{56i} & \beta_{57i} \\ \beta_{61i} & \beta_{62i} & \beta_{63i} & \beta_{64i} & \beta_{65i} & \beta_{66i} & \beta_{67i} \\ \beta_{71i} & \beta_{72i} & \beta_{73i} & \beta_{74i} & \beta_{75i} & \beta_{76i} & \beta_{77i} \end{bmatrix} \begin{pmatrix} \Delta x_{t-i} \\ \Delta y_{1_{t-i}} \\ \Delta y_{2_{t-i}} \\ \Delta y_{3_{t-i}} \\ \Delta y_{4_{t-i}} \\ \Delta y_{5_{t-i}} \\ \Delta y_{6_{t-i}} \end{pmatrix} + \begin{pmatrix} \gamma_1 \\ \gamma_2 \\ \gamma_3 \\ \gamma_4 \\ \gamma_5 \\ \gamma_6 \\ \gamma_7 \end{pmatrix} ECM_{t-1} + \begin{pmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \\ \varepsilon_{3t} \\ \varepsilon_{4t} \\ \varepsilon_{5t} \\ \varepsilon_{6t} \\ \varepsilon_{7t} \end{pmatrix} \ldots. (5)$$

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 LGMAN variable does not Granger cause LMANI 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.

IV. Estimation Results

a) 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 other 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), except for LMANI, LGMAN, LGSER and LWPI. 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 SIC.

Table 1 : Unit root test: Ng-Perron Test

Variables	With constant and trend				Stationarity Status
	Mza	MZt	MSB	MPT	
LMANI	0.448	0.296	0.659	30.823	I (1)
ΔLMANI	-19.566	-3.127	0.159	1.252	
LEGWI	-0.719	-0.436	0.606	21.241	I (1)
ΔLEGWI	-20.365	-3.188	0.156	1.212	
LSERI	-0.215	-0.093	0.434	15.519	I (1)
ΔLSERI	-19.607	-3.125	0.159	1.268	
LGMAN	1.130	0.974	0.861	54.734	I (0)
ΔLGMAN	-3.362	-1.280	0.380	7.274	
LGEGW	-1.168	-0.464	0.397	12.057	I (1)
ΔLGEGW	-11.063	-2.339	0.211	2.261	
LGSER	1.757	1.549	0.881	63.651	I (0)
ΔLGSER	-1.128	-0.698	0.619	19.702	
LCO	-1.445	-0.780	0.540	15.364	I (1)
ΔLCO	-57.648	-5.265	0.091	0.669	
LREER	-5.578	-1.616	0.289	4.546	I (1)
ΔLREER	-21.008	-3.240	0.154	1.168	
LTB	-2.450	-0.899	0.367	8.926	I (1)
ΔLTB	-20.297	-3.178	0.156	1.232	
LTRADE	-3.771	-1.172	0.310	6.591	I (1)
ΔLTRADE	-21.423	-3.272	0.152	1.146	
LWPI	0.353	0.198	0.560	23.773	I (0)
ΔLWPI	-11.302	-2.374	0.210	2.179	

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*
Model I	4	802.817	58.391	5.33e-21*	-29.259*	-20.775	-26.169*
Model II	4	851.626	62.032	4.92e-22*	-31.640*	-23.156	-28.550*
Model III	4	839.183	80.389*	9.03e-22*	-31.033*	-22.549	-27.943*

** 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

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 9.4890, 10.3724 and 8.2299 for the model I, model II and model III respectively. 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 co-integrating relationship among the variables included in the models.

Table 3 : ARDL Bounds test

Panel I: Bound testing to co-integration:

Estimated Equation Model I : *LMANI = F (LGMAN LCO LREER LTB LTRADE LWPI)*

Model II :*LEGWI= F (LGEGW LCO LREER LTB LTRADE LWPI)*

Model III :*LSERI = F (LGSER LCO LREER LTB LTRADE LWPI)*

Indicators	Model I	Model II	Model III
Optimal-lags	01	01	01
F – Statistics	9.4890	10.3724	8.2299

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 of the model I show that the rise in LGMAN has a positive effect on LMANI. It is evident from the table that 1% increase LGMAN leads to 0.345% increase in the LMANI. This is due to the fact that with the rise in the manufacturing sector share in GDP, the expectations of investors increases, which gives a motivation to investors to invest in the shares of manufacturing sector. The investment leads to rise in manufacturing index.

The results of the model II show that the rise in LGEGW and LWPI has a positive effect on LEGWI. The coefficient of LGEGW and LWPI are statistically significant and positive at 1% level. It is evident from the table that 1% increase in LGEGW and LWPI leads to 1.043% and 0.771% increase in LEGWI, respectively. The rationale behind this explains the Fisher hypothesis (1911) for inflation. And the rise in the electricity, gas and water supply sector share in GDP gives a boost to investors' confidence to invest in the shares of electricity, gas and water supply sector.

The results of the model III show that the rise in LGSER and LTB has a positive effect on service index. The coefficient of LGSER and LTB are statistically significant and positive at 1% and 10% respectively. It is evident from the table that 1% increase in LGSER and 10% increase in LTB leads to 0.5% and 0.065% increase in the LSERI, respectively. The rationale behind this is the same as mentioned above for the rest two models for the relation of service sector share in GDP and service index.

Table 3 : Estimated Long-run Coefficients using ARDL Approach

(Dependent variable: LMANI, LEGWI, LSERI)

ARDL(1,0,0,0)

Regressors	Model I		Model II		Model III	
	Coefficient	*t- values*	*Coefficient*	*t- values*	*Coefficient*	*t- values*
LGMAN	0.345*	3.033	-	-	-	-
LGEGW	-	-	1.043*	3.193	-	-
LGSER	-	-	-	-	0.500**	2.164
LCO	-0.032	-0.555	-0.027	-0.340	-0.117	-1.334
LREER	0.052	0.471	0.087	0.515	0.099	0.753
LTB	0.031	1.042	0.052	0.896	0.065***	1.713
LTRADE	0.116	1.606	0.052	0.603	0.134	1.504
LWPI	-0.158	-1.609	0.771*	8.434	-0.431	-1.643
CONS	-0.502	-0.560	3.411	3.538	-1.619	-0.876
Robustness Indicators						
R^2	0.972		0.995		0.974	
Adjusted R^2	0.966		0.993		0.9690	
F Statistics	157.369		636.710		169.075	
D.W. Stat	2.971		-0.802		2.297	
Serial Correlation, F	6.120	[0.190]	9.201	[0.056]	6.067	[0.194]
Heteroskedasticity, F	0.240	[0.624]	0.008	[0.926]	0.018	[0.891]
Ramsey reset test, F	11.464	[0.001]	1.315	[0.251]	6.109	[0.013]

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

*(2) *, ** and *** indicate significant at 1, 5 and 10 percent level of significance, respectively. Values in [#] are probability values.*

The short-run relationship of the sectoral index with respective sectoral GDP along with some controlled variables is presented in Table 5. As can be seen from the table, for the model I LGMAN, LCO and LTRADE has a significant and positive impact on LMANI in the short-run at 1%, 1% and 5% level, respectively.

For the model II, unlike the long-run result, LGEGW is not significant to LEGWI in the short-run. But LCO and LREER has a significant and positive impact on the LEGWI in the short-run at 1% level. Whereas, LWPI is negatively significant to LEGWI at the 1% level.

For the model III, LGSER, LCO and LTB has a significant and positive impact on LSERI in the short-run at 1%, 1% and 10% level, respectively. Whereas, LWPI is negatively significant to LSERI at the 10% level 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 (-0.333), (-0.318) and (-0.215) are significant at the 1% level of significance for the model I, model II and model III, respectively. The coefficient implies that a deviation from the equilibrium level of stock market index in the current period will be corrected by 33% for model I, 31% for model II and 21% for model III, in the next period to resort the equilibrium.

Table 4 : Estimated Short-run Coefficients using ARDL Approach

(Dependent variable: LMANI, LEGWI, LSERI)

Regressors	Model I		Model II		Model III	
	Coefficient	*t- values*	*Coefficient*	*t- values*	*Coefficient*	*t- values*
ΔLGMAN	0.115*	2.744	-	-	-	-
ΔLGEGW	-	-	-0.181	-0.708	-	-
ΔLGSER	-	-	-	-	0.107*	2.801
ΔLCO	0.047*	3.520	0.082*	2.668	0.039*	3.455
ΔLREER	0.017	0.449	0.239*	2.640	0.021	0.731
ΔLTB	0.010	1.012	0.016	1.040	0.014***	1.737
ΔLTRADE	0.038**	1.943	0.016	0.639	0.028	1.618
ΔLWPI	-0.052	-1.474	-1.354*	-3.864	-0.092***	-1.863
CONS	-0.167	-0.574	1.087	1.747	-0.348	-1.070
ECM_{t-1}	-0.333	-2.860	-0.318	-2.373	-0.215	-2.313

	Robustness Indicators		
R^2	0.647	0.606	0.665
Adjusted R2	0.566	0.470	0.588
D.W. Stat	1.431	2.109	1.455
SE Regression	0.011	0.015	0.008
RSS	0.004	0.007	0.002
F Statistics	9.186 [0.000]	7.039 [0.000]	9.944 [0.000]

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

*(2) *, ** and *** indicate significant at the 1, 5 and 10 percent level of significance, respectively. Values in [#] are probability values.*

The results of table 5(a) indicate that there is causality running from LGMAN to LMANI in India, which shows that a change in manufacturing sector share in GDP causes a change in manufacturing index. It is also observed that the error correction term is statistically significant for specification with LMANI as the dependent variable which indicate that there exist a long-run causal relationship among the variables with LMANI as the dependent variable.

The results of table 5 (Model II) indicate that there is causality running from LGEGW and LWPIto LEGWI in India, which shows that a change in electricity, gas and water supply sector share in GDP and the change in inflation causes a change in electricity, gas and water index. It is also observed that the error correction term is statistically significant for specification with LEGWI as the dependent variable which indicate that there exist a long-run causal relationship among the variables with LEGWI as the dependent variable. Estimation results show a unidirectional causality running from LEGWI to LTRADE.

The results of table 5 (Model III) indicate that there is no causality running from any of the variables to LSERI in India. It is also observed that the error correction term is also not statistically significant for specification with LSERI as the dependent variable which indicate that there exist no long-run causal relationship among the variables with LSERI as the dependent variable.

Table 5 : Results of Vector Error Correction Model

Table 5(a): Results of Vector Error Correction Model (Model I)

Dependent variable	*Sources of Causation*							
	Short-run independent variables							*Long-run*
Model I	ΔLMANI	ΔLGMAN	ΔLCO	ΔLREER	ΔLTB	ΔLTRADE	ΔLWPI	$ECM_{(t-1)}$
ΔLMANI	-	-2.200**	0.126	-0.300	-0.889	0.916	-1.375	-2.724*
ΔLGMAN	-0.028	-	-0.659	0.594	-1.211	-0.208	-0.458	0.310
ΔLCO	-0.647	1.090	-	-1.132	-0.938	-0.605	-3.148*	-0.883
ΔLREER	-0.132	1.756***	-0.714	-	0.423	-1.824***	0.277	-0.832
ΔLTB	-0.787	2.010**	0.813	0.276	-	-0.072	0.365	-3.025*
ΔLTRADE	-0.136	0.407	2.357**	0.388	-1.310	-	-1.382	0.550
ΔLWPI	-0.210	-0.693	2.951*	0.113	-0.491	-1.327	-	-0.471
Model II	ΔLEGWI	ΔLGEGW	ΔLCO	ΔLREER	ΔLTB	ΔLTRADE	ΔLWPI	
ΔLEGWI	-	1.704***	0.492	0.289	0.441	1.074	-1.752***	-5.428*
ΔLGEGW	-1.594	-	-2.739*	-2.187**	-1.452	-1.470	-0.411	2.066
ΔLCO	-1.177	-0.674	-	-0.379	-0.373	0.031	-2.917*	0.170
ΔLREER	0.358	0.393	-0.645	-	-0.133	-1.499	0.242	-1.013
ΔLTB	0.914	-0.246	1.118	0.493	-	0.426	0.472	-1.827***
ΔLTRADE	-1.893***	-0.179	2.330**	1.142	0.039	-	-1.803***	1.663
ΔLWPI	-0.900	-0.420	3.013*	0.691	0.761	-0.361	-	2.147
Model III	ΔLSERI	ΔLGSR	ΔLCO	ΔLREER	ΔLTB	ΔLTRADE	ΔLWPI	
ΔLSERI	-	-0.873	0.004	0.217	-1.296	0.659	-0.444	-0.425
ΔLGSER	-0.119	-	-0.378	-0.223	-1.585	-0.043	0.584	-1.943**
ΔLCO	-0.439	-0.138	-	-1.189	-0.928	0.044	-3.051	0.757
ΔLREER	0.678	0.884	-0.579	-	0.508	-1.671	0.388	-0.205
ΔLTB	0.092	2.437**	0.198	0.646	-	-0.423	-0.602	-3.343*

ΔLTRADE	-0.187	-0.361	2.067**	0.107	-1.402	-	-1.343	-0.032
ΔLWPI	-0.588	-1.884**	3.237*	0.208	-0.174	-0.181	-	-0.641

, ** 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 long-run and short-run parameters which have an impact on the sectoral indices in case of India. This confirms that models seem to be steady and specified appropriate.

b) 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 for all the models are presented in table 6. The empirical evidence indicates that 39.63% of LMANI change is contributed by its own innovative shocks. Further, shock in LGMANI explains manufacturing index by 26.22%. Shock in LCO also explains LMANI by 23.48%, which shows that crude oil price also plays an important role in explaining manufacturing index. The share of other variables is minimal.

The empirical evidence for model II, indicates that 35.22% of LEGWI change is contributed by its own innovative shocks. Further, shock in LGEGW explains LEGWI by 5.21%. LCO contributes the maximum to LEGW by 43.32%.

The empirical evidence for model III, indicates that 34.45% of LSERI change is contributed by its own innovative shocks. Further, shock in LGSER explains LSERI by 18.05%. LCO contributes the maximum to LSERI by 38.53%.

Table 6 : Variance Decomposition (VDC) Analysis

Period	*S.E.*	*LMANI*	*LGMAN*	*LCO*	*LREER*	*LTB*	*LTRADE*	*LWPI*
Model I								
1	0.015	100.000	0.000	0.000	0.0000	0.000	0.000	0.000
5	0.032	54.845	19.741	22.374	0.008	0.152	2.768	0.109
10	0.037	42.114	26.777	24.579	0.661	1.754	2.831	1.280
15	0.038	39.632	26.223	23.481	1.852	3.000	2.899	2.909
Model II		*LEGWI*	*LGEGW*	*LCO*	*LREER*	*LTB*	*LTRADE*	*LWPI*
1	0.013	100.000	0.000	0.000	0.000	0.000	0.000	0.000
5	0.034	47.809	7.994	34.810	2.143	1.822	5.132	0.287
10	0.043	36.389	5.477	43.123	3.235	3.626	7.956	0.191
15	0.045	35.229	5.211	43.321	3.283	3.974	8.746	0.233
Model III		*LSERI*	*LGSER*	*LCO*	*LREER*	*LTB*	*LTRADE*	*LWPI*
1	0.012	100.000	0.000	0.000	0.000	0.000	0.000	0.000
5	0.027	51.364	13.502	33.333	0.611	0.925	0.003	0.259
10	0.033	36.791	19.070	39.573	0.501	1.905	0.035	2.122
15	0.034	34.453	18.052	38.538	0.633	3.096	0.390	4.835
Cholesky Ordering: LSERI LGSER LCO LREER LTB LTRADE LWPI								

V. Conclusion

This paper aims to examine the relationship between gross domestic product and stock prices from a sectoral perspective. Precisely, an effort has been made in this paper to investigate whether sectoral GDP, i.e. Manufacturing sector, electricity, gas and water supply sector and service sector share in GDP affect respective sectoral stock indices in India or not. Towards this effort, quarterly data from 2003:Q3 to 2014:Q4 for all the variables included in the estimation has been used. The bounds test used for the study, confirms that there exists a long-run co-integrating the relationship between sectoral GDP and sectoral stock indices in India. The long-run estimates of ARDL test for model I showed that positive and significant relationship exists between the manufacturing sector share in GDP with the manufacturing index. It also confirms that the manufacturing sector share in GDP, crude oil price and trade openness have a significant and positive impact on the manufacturing index in the short-run. For model II the results show that the electricity, gas and water supply sector share in GDP and inflation has a positive effect on electricity, gas and water supply index, unlike short-run. Crude oil price and real effective exchange rate has a significant and positive impact on the electricity, gas and water index in the short-run. For model III, results show that the service sector share in GDP and T-bills rate has a positive effect on service sector index in the long-run and in short-run as well along with crude oil price. The results suggest that sectoral indices are affected by changes in sectoral GDP in the long-run, whereas, all the three indices are sensitive to the change in crude oil price in the short-run. 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 (-0.333), (-0.318) and (-0.215). This term is significant at 1%, for the model I, model II and model III, respectively, again confirming the existence of cointegration that the derivation from the long-run equilibrium path is corrected 33%, 31% and 21%, respectively, per Quarter.

To determine the direction of causality VECM is used in the study and the result found unidirectional short-run causality running from sectoral GDP, crude oil price, REER, T-bill rates, trade openness and WPI to respective sectoral stock indices in India. Further, the result indicates the presence of long-run causality for the equation with manufacturing index and electricity, gas and water supply index as the dependent variable, but, except for the service sector index which shows no long-run causality running from any of the independent variables. The CUSUM and CUSUMSQ test results suggest the policy changes considering the explanatory variables of the sectoral stock indices equations will not cause major distortions in India. To predict the long-run and short-run shocks variance decomposition is used for the study, the result of VDC analysis, for all three models, show that a major percentage of sectoral indices are its own innovative shocks. Other than the respective sectoral GDP, crude oil price is a common variable which is playing a crucial role in explaining all three indices by contributing its maximum towards the shock, hence, reflecting maximum information about the movement of the indices.

Sectoral analysis is a better approach for both investors as well as regulators. In a sectoral study the impact of macroeconomic factors is studied on various sectors. The performance of different sectors in same economic conditions is different. This gives an idea of risk diversification to investors and enables them to design well diversified portfolios. The relationship of sectoral GDP with respective sectoral indices is a matter of interest to investors, institutions, researchers and policy makers.

For the purpose of comparison, our paper used the same set of macroeconomic variables to test for the relationships on the Sector indices. It may be useful for future studies to include other economic variables that might affect each sector specifically. It is also recommended to work out for research that compares results with other developing countries' under similar assessment and measurement.

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[i]National Stock Exchange (NSE) sectoral indices are not incorporated in the study due to unavailability of sectoral data.