IJBF

THE LONG RUN RELATIONSHIP BETWEEN STOCK INDICES AND MACROECONOMIC VARIABLES

Yogesh Maheshwari
KT Vigneswara Rao
Indian Institute of Management Indore

Abstract

Stock indices are considered to be the barometers of any economy. This study examines the long run equilibrium relationship between stock indices and macroeconomic variables by applying the Johansen and Juselius (1990) Vector Error Correction Framework. It considers sector indices of the Bombay Stock Exchange and select macroeconomic variables for this purpose. The empirical results reveal that the stock indices and the macroeconomic variables are cointegrated and possess a longrun equilibrium relationship. The relationship has been found to be significantly negative with the index of industrial production, rupee-dollar exchange rate, foreign exchange reserves and wholesale price index, but significantly positive with money supply. The results of the study would enable investors and traders in taking informed decisions. They would also help companies in developing a view on the economy so as to facilitate their financial planning process.

Keywords: Sector indices, macroeconomic variables, unit root test, Johansen cointegration test, vector error correction model, long run.
JEL Classification: C22, E44, G12, G14

1. Introduction

Stock prices have fascinated investors, traders and academicians alike, since times immemorial. Predicting their future values has always been a challenge and has tempted people to ascertain the variables on which the stock prices might depend, so that a causal relationship may be used to forecast stock prices. Fundamental analysis has been an important dimension of security analysis; the most common form of it being the E-I-C framework, wherein a company is considered to belong to an industry that, in turn, is a subset of the overall economy. Estimation of future stock prices, i.e. future performance of a company is then dependant on the way in which the industry and economy are believed to perform in future. Should this be the case, the stock prices are supposed to be a function of economic performance. It then makes sense to assess whether one

can establish a relationship between stock indices (representative of the stock prices of companies) and macroeconomic variables (representative of the health of the overall economy).

Stock prices are a function of both micro as well as macroeconomic variables. Stock indices are often considered to be the barometer of an economy or the sector to which they belong. The movement of market indices is greatly influenced by changes in the macroeconomic fundamentals. This impact may, however, vary across different sectors of the economy due to the difference in their sensitivity and the risk-return profile. There is a vast amount of literature in economics and finance that discusses the relationship between stock returns and macroeconomic variables in the context of both developed as well as emerging markets. The multi-factor asset pricing theories have motivated research on various macroeconomic factors and determinants of equity returns. While, analyzing the stock prices, it is very important to understand the dynamic relationship between equity returns and the underlying macroeconomic variables such as money supply, inflation, interest rate, exchange rate and industrial production as these can influence a firm's fundamental value drivers.

More of the extant literature has focused on the relationship between the macroeconomic variables and the broader market or composite index. However, the impact of the macroeconomic variables on sector indices may be quite different than that of broader or aggregate market index in terms of its magnitude and persistence due to the difference in risk associated with different industry sectors and the sensitivity of different sectors to a given change in the macroeconomic variables. For instance, a given change in interest rates or money supply may have a more pronounced impact on the interest rate sensitive sectors such as real estate, banking and automobiles, than other sectors or even the overall economy. This study aims at understanding such relationships and assess as to how different sector indices get impacted by the relevant macroeconomic variables in the long run. In India, there is an increasing popularity of sector mutual funds or thematic funds, which invest in specific sectors of the economy in order to leverage its growth potential in the economy. Investments in the stocks and bonds across different sectors of the economy, is an integral part of the overall portfolio allocation decision and risk diversification. Against this backdrop, this paper focuses on the impact of macroeconomic variables on the BSE sector indices. This study is relevant and has the implications for the policymakers, individual and institutional investors, portfolio managers and traders.

This study thus, aims at examining the long-run relationship between the BSE sector indices and the macroeconomic variables by using the Johansen and Juselius (1990) vector error correction framework. The rest of the paper is organized as follows: Section 2 discusses the relevant theoretical and empirical literature, which attempts to explain the relationship and linkage between the macroeconomic variables and equity prices. The data and methodology are dealt with in section 3. Section 4 lays down the results and discussions. Section 5 deals with the conclusion of the study.

2. Literature Review

The literature relating to this research has been reviewed in three segments of causal relationships. These include stock indices and macroeconomic variables, sector indices and macroeconomic variables, and finally stock as well as sector indices and macroeconomic variables.

2.1 Stock Indices and Macroeconomic Variables

For the first segment, which considers studies done on causal relationships between stock indices and macroeconomic variables, perhaps the earliest works exist in Chen, Roll and Ross (1986) that examined the influence of macroeconomic variables on the stock market returns in the US. Finding a significant relationship between them, the study suggested that despite this a stock market index has an insignificant influence on the expected returns when compared against the economic variables. Elton and Gruber (1988) used a four-factor model to understand the pricing of the macroeconomic factors and risk in Japan. The impact of these factors on returns was found to be reasonably stable over time. Mukherjee and Naka (1995) found the same market to be cointegrated with macroeconomic variables. The results remained robust to different combinations of macroeconomic variables in six-dimension systems and two sub-periods.

Ibrahim (1999) followed this up with a study on stock prices and macroeconomic variables in Malaysia, using cointegration and granger causality tests. The bivariate analysis observed informational market inefficiency with evidence of strong cointegration between the stock prices and consumer prices, credit aggregates and official reserves. The results got further strengthened in multivariate settings. Stock prices were found to be granger-caused by changes in the official reserves and exchange rates in the short run. In the same year, Kwon and Shin (1999) did a similar study in Korea. The results suggested that stock indices were cointegrated with production index, exchange rate, trade balance, and money supply. These variables exhibited a direct long-run equilibrium relationship with the stock indices. However, the stock indices were not found to be leading indicators for these variables.

Maysami and Koh (2000) investigated the relationship between the stock index and macroeconomic variables in Singapore in the long run, as well as among the stock indices of Singapore, Japan, and the US. The results found that changes in two measures of real economic activities, industrial production and trade, were not cointegrated with the stock index, which otherwise had a cointegrating relationship with changes in price levels, money supply, interest rates, and exchange rates. While the relationship with interest and exchange rates were significant, those with price levels and money supply were not. The stock markets in the three countries were also found to be significantly and positively cointegrated. Extending their study to six European economies, Nasseh and Strauss (2000) found a significant long-run relationship between stock prices

and domestic as well as international economic activity. The study ascertained stock prices to be significantly related to industrial production, business surveys of manufacturing orders, interest rates as well as foreign stock prices, short-term interest rates and production.

Intrigued by the concurrent growth in some ASEAN stock markets and their economies, Wongbangpo and Sharma (2002) investigated the role of gross national product, consumer price index, money supply, interest rate, and exchange rate on the stock prices in Indonesia, Malaysia, Philippines, Singapore, and Thailand. They were found to have both long-as well as short-run relationships. Moreover, the macroeconomic variables in these countries caused and were caused by stock prices in the granger sense. Al-Sharkas (2004) examined the impact of real economic activity, money supply, inflation, and interest rate on the stock prices in Jordan and found a long-run equilibrium relationship to exist between them.

Focusing on the Australian market, Chaudhuri and Smiles (2004) found evidence of long- run relationship between stock prices and real gross domestic product, real private consumption, real money and the real price of oil. When the multivariate cointegration method was used, the results also revealed more than other sources of return variations such as term spread, growth of gross domestic product or shocks to term spread. Gunasekarage, Pisedtasalasai and Power (2004) showed that the lagged values of consumer price index, money supply and treasury bill rate had significant influence on the stock index in Sri Lanka. However, the vice versa did not hold true, except for the treasury bill rate. The results posed little support to the explanation of the forecast variance error of the market index by the shocks to the economic variables.

Patra and Poshakwale (2006) established short-as well as long-run equilibrium relationship between inflation, money supply and trading volume, and stock returns in Greece. However, no such relationship existed between the exchange rates and stock prices. Investigating the long-as well as short-run relationship between the stock index and macroeconomic variables in the US, Ratanapakorn and Sharma (2007) ascertained that the stock prices related negatively to the long-term interest rate, but positively to the money supply, industrial production, inflation, exchange rate and the short-term interest rate. Each of these variables granger-caused the stock prices in the long but not the short run. The stock prices were found to be relatively exogenous in relation to these variables.

With a view to investigate the relationship between economic growth and stock market, Agrawalla and Tuteja (2008) studied the stock index and money supply, credit to the private sector, exchange rate, wholesale price index, and money market rate. The economic growth with industrial production as its proxy was found to cause stock index. Taking two stock indices in India, Ahmed (2008) studied the relationship between them and the index of industrial production, exports, foreign direct investment, money supply, exchange rate and interest rate. The paper determined differential causal links in the long as well as the short run. Stock prices were found to lead economic activity except

interest rate. Interest rate led the stock prices. The study indicated that stock prices were driven not only by actual performance but also by expected potential performance of the economy.

Within the framework of a standard discounted value model, Humpe and Macmillan (2009) applied cointegration analysis to model the longrun relationship between industrial production, consumer price index, money supply, long-term interest rates and stock prices in the US and Japan. In the case of the US, the data was found to be consistent with a single cointegrating vector, where stock prices were positively related to industrial production, and negatively to consumer price index and long-term interest rate. The stock prices also related positively to money supply, but this was insignificant. The data for Japan had two cointegrating vectors. While for one vector the stock prices got influenced positively by industrial production and negatively by money supply, for the other the industrial production was negatively influenced by consumer price index and long-term interest rate. Pilinkus (2009) employed granger causality tests to estimate the relationship between the stock index and the macroeconomic variables in Lithuania and arrived at a mixed outcome. While the gross domestic product deflator, net exports, and foreign direct investment were found to lead the stock index, others including gross domestic product, material investment, and construction volume index were led by it. It was also derived that some macroeconomic indices like money supply and balance of payments and the stock market returns granger-cause each other.

Sohail and Hussain (2009) analyzed the relationship in Pakistan and found a negative impact of consumer price index on stock returns, while industrial production index, real effective exchange rate, and money supply had a significant positive effect on the stock returns in the long run. The coefficients of both error correction terms were found to be significant with negative signs and showed high speed of adjustment. Using time-series analysis to investigate the relationship between the stock prices and macroeconomic variables in Malaysia, Rasiah and Ratneswary (2010) showed positive longrun relationships between real stock returns and industrial production, consumer price index, money supply and real exchange rate. Evidence of the dominant influence of consumer price index, money supply and real exchange rate in forecasting stock price variance was found. Kumar (2011) studied the relationship of stock index with real effective economic rate, foreign exchange reserves, balance of trade, foreign direct investment, index of industrial production, and wholesale price index in India. No cointegration was found between stock index and any of these variables except wholesale price index.

Unlike most of the other studies, Pal and Mittal (2011) worked on quarterly time series data to examine the long-run and short-run statistical dynamics. The results suggested cointegration between macroeconomic variables and stock indices in India in the long run. The stock indices were found to be dependent on macroeconomic variables even though this was not statistically significant in all the cases. Srinivasan (2011) explored the long-run relationships between stock index and index of industrial production, money supply, interest rate,

exchange rate, and consumer price index. The short-run causal nexus was also examined. The stock index exhibited a significant positive relationship with money supply, interest rate, and index of industrial production and a significant negative relationship with exchange rate in the long run. Besides this, there was significant short-run causality between money supply and interest rate, and inflation and money supply.

Hussain et al. (2012) found long-run association between macroeconomics variables and stock prices in Pakistan. While foreign exchange reserves, interest rate, imports, money supply and wholesale price index showed a positive and significant relationship, the industrial production index had a negative but significant relationship with stock prices. The results showed that money supply and wholesale price index had a bi-directional relationship while exchange rate, foreign exchange reserves and imports had a unidirectional relationship with the stock prices, and industrial production index, interest rate and exports had no casual relationship. Trivedi and Behera (2012) attempted to investigate the long-run as well as the short-run relationship of stock index in India with the index of industrial production, wholesale price index, interest rates, money supply, and foreign institutional investment.

2.2 Sector Indices and Macroeconomic Variables

The second section that comprised of studies relating to sector indices and macroeconomic variables just had limited papers to review. Eryiğit (2009) considered oil prices to be an important element of the real economic activity in Turkey. Using an extended market model to determine the effects of the oil price in dollars changes on market indices, he found that oil price changes had significant effects on electricity, wholesale and retail trade, insurance, holding, investment, wood, paper, printing, basic metal, metal products, machinery and non-metal and mineral products indices.

Believing that aggregate index could lead to misleading interpretation of the actual performance of each sector of the economy, Pyeman and Ahmad (2009) focused on the issue of long-run and short-run relationship between sector indices and macroeconomic variables in Malaysia. The sectoral indices selected for this study were construction, plantation, consumer product, finance, industrial product, mining, hotel, property and trading, and services. The macroeconomic variables considered were real economic activity, interest rate, inflation rate, money supply and exchange rate. The results suggested that macroeconomic variables had causal relationships with some sector indices, the effects differing mainly in terms of speed of adjustments towards equilibrium level in the long run. Schätz (2010) provided empirical evidence of the dynamic relationship of international macroeconomic variables with ten emerging market sector indices. Each country was examined separately using the supranational sector analysis. The study determined the sensibility of each sector index to macroeconomic influences in the emerging markets. Contrary to theoretical expectations, the majority of sectors benefited from increasing commodity prices.

2.3 Stock & Sector Indices and Macroeconomic Variables

The third section concerning the relationship of both stock as well as sector indices and macroeconomic variables included Maysami, Lee and Hamzah (2005) that examined the long-run equilibrium relationships between selected macroeconomic variables and the stock as well as some sector indices such as finance index, property index, and the hotel index in Singapore. The stock index and property index were found to be cointegrated with changes in the interest rates, industrial production, price levels, exchange rate and money supply.

Aydemir and Demirhan (2009) investigated the causal relationship between stock prices and exchange rates in Turkey. In this study, national 100, services, financials, industrials, and technology indices were taken as stock price indices. The results indicated a bi-directional causal relationship between exchange rate and all indices. While the causality from national 100, services, financials and industrials indices to exchange rate was negative, that from technology indices to exchange rate was positive. On the other hand, a negative causal relationship existed from exchange rate to all the indices. Samsi, Yusof and Cheong (2012) explored the dynamic interaction between the real sector and the financial sector in Malaysia. The parsimonious error correction model suggested the existence of a long-run relationship between the two. The causality tests determined that real output had a strong relationship with real estate and the banking sector. While the banking sector contributed more than the other financial indices, real estate contributed the same percentage to the output growth.

The review of the extant literature discussed above shows that the relationship between stock indices and macroeconomic variables has been extensively worked upon. However, very limited studies have examined the sector indices. Even out of these, no studies have been found to establish the causal relationship between sector indices and macroeconomic variables in India. This became the primary motivation for us to undertake the present study.

3. Data and Methodology

The present study was based on secondary data and used a monthly time series. Data was been obtained from April 1999 to December 2012, and included 165 observations. The data on stock indices and macroeconomic variables were sourced from the websites of the Bombay Stock Exchange (BSE) and the Reserve Bank of India (RBI) respectively. While the eight sector indices of BSE were Automobiles (AUTO), Capital Goods (CG), Consumer Durables (CD), Fast Moving Consumer Goods (FMCG), Health Care (HC), Information Technology (IT), Metals (METAL) and Oil & Gas (O&G) indices, the eight macroeconomic variables included Balance of Trade (BOT), Foreign Institutional Investment in Indian Equity Markets (FII), Foreign Exchange Reserves (FOREX RES), Broad Money Supply (M3), Index of Industrial Production (IIP), Wholesale Price

Index (WPI), monthly average Rupee-US Dollar Exchange Rate (USDER), and Weighted Average Call Money Rate (WACMR). All the variables of the study were converted into a series of natural logarithms except for BOT, FII, USDER, and WACMR. This study employed the Johansen and Juselius (1990) vector error correction model (VECM) to test the long-run relationship between the BSE sector indices and select macroeconomic variables. The process first used the Unit root test to determine the order of integration of the variables, and was then followed up by the Johansen cointegration test. Consider a general vector auto regressive (VAR) model with Gaussian errors written in the following error correction form:

$$\Delta X_t = \mu + \sum_{i=1}^{k-1} \Gamma_i \Delta X_{t-i} + \Pi X_{t-k} + \Phi D_t + \varepsilon_t$$

where ε_t is a sequence of zero-mean, p-dimensional white noise vectors and D_t are seasonal dummies. The term X_t includes the variables and is a p x 1 vector. The parameters are a p x p matrix, $\Gamma\Gamma\Gamma$ and $\Pi\Pi\Pi$ denote this matrix that contains information about the rank and hence, the long-run relationship among the variables. The Johansen cointegration test includes both the trace statistic and the maximum eigenvalue statistic. The summary of models used for the study is presented in Table 1.

Table 1: Summary of Cointegration Models

Model	Variables
Model 1	BSE AUTO Index, LNM3, LNIIP, LNWPI, LNFOREX_RES, USDER
Model 2	BSE CG Index, LNIIP, LNM3, LNWPI, LNFOREX_RES, USDER
Model 3	BSE CD Index, LNM3, LNIIP, LNWPI, LNFOREX_RES, USDER
Model 4	BSE FMCG Index, LNWPI, LNM3, LNIIP, LNFOREX_RES, USDER
Model 5	BSE HC Index, LNM3, LNIIP, LNWPI, LNFOREX_RES, USDER
Model 6	BSE IT Index, USDER, LNFOREX_RES, LNIIP, LNM3, LNFOREX_ RES
Model 7	BSE METAL Index, LNIIP, LNM3, LNWPI, LNFOREX_RES, USDER
Model 8	BSE O&G Index, LNM3, LNWPI, LNIIP, LNFOREX_RES, USDER

4. Results and Discussions

The descriptive statistics for the sector indices and macroeconomic variables are presented in Tables 2 and 3 respectively. Based on the standard deviations of sector indices, it can be inferred that the BSE CG, METAL, and O&G indices are more volatile than the BSE IT and HC indices. Among the macroeconomic variables, the values of FII, and BOT are more volatile than WPI, IIP, and M3.

All the time series variables under investigation have significant coefficients of Jarque-Bera statistics, which indicates that the frequency distributions of these variables are not normal.

Table 2: Descriptive Statistics of BSE Sector Indices

	BSE AUTO	BSE CD	BSE CG	BSE FMCG	BSE HC	BSE IT	BSE METAL	BSE O&G
Mean	7.97	7.65	8.24	7.43	7.94	8.03	8.54	8.22
Median	8.08	7.74	8.74	7.46	8.01	8.12	8.75	8.42
Maximum	9.34	8.99	9.89	8.71	9.00	8.83	9.90	9.50
Minimum	6.30	6.12	6.26	6.58	7.02	6.86	6.79	6.68
Std. Dev.	0.91	0.84	1.20	0.58	0.59	0.55	0.96	0.92
Skewness	-0.25	-0.09	-0.32	0.40	-0.06	-0.38	-0.38	-0.34
Kurtosis	1.74	1.62	1.48	1.98	1.77	1.86	1.66	1.56
Jarque-Bera	12.62	13.25	18.71	11.54	10.52	13.00	16.36	17.32
Probability	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00
Sum	1315.68	1261.75	1360.02	1225.66	1310.68	1324.65	1409.65	1355.84
Sum Sq. Dev.	135.14	114.65	237.84	55.27	57.97	48.92	152.54	137.85
Observations	165	165	165	165	165	165	165	165

Table 3: Descriptive Statistics of Macroeconomic Variables

	BOT	FII	LNFOR-EX RES	LNIIP	LNM3	LNWPI	USDER	WAC-MR
Mean	-269.75	3278.78	8.71	4.73	10.24	4.70	46.08	6.51
Median	-173.26	1552.40	8.79	4.74	10.15	4.66	45.78	6.62
Maximum	11.06	28562.90	9.70	5.26	11.29	5.13	56.03	14.07
Minimum	-1161.96	-15347.30	7.24	4.23	9.20	4.35	39.37	0.73
Std. Dev.	270.95	7090.94	0.80	0.31	0.63	0.22	3.24	2.08
Skewness	-1.11	1.05	-0.45	-0.05	0.10	0.31	0.65	0.36
Kurtosis	3.36	5.20	1.82	1.50	1.72	1.98	4.17	3.63
Jarque-Bera	35.05	63.39	15.23	15.60	11.47	9.75	21.14	6.35
Probability	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.04
Sum	-44508	540998	1437	780	1689	776	7603	1074
Sum Sq. Dev.	12040298	825000000	104.84	16.21	66.00	8.14	1718.35	709.63
Observations	165	165	165	165	165	165	165	165

The graphical analysis of the sector indices and macroeconomic variables has indicated that they are time varying. This may imply that each series is not stationary. Furthermore, all series except BOT, FII, and WACMR seem to display a positive upward trend with an intercept. Since only integrated variables of the same order or I(1) can be cointegrated, the first step is to determine the order of integration of the relevant variables by using the unit root test. This study has employed the augmented dickey-fuller (ADF) and the phillips-perron (PP) tests for this purpose. These test results are presented in Tables 4 and 5 respectively.

Table 4: Augmented Dickey-Fuller (ADF) Test Results

	Level		First differences	
Variables	Intercept	Intercept & Trend	Intercept	Intercept & Trend
LNFOREX_RES	-1.995(1)	-0.384(1)	-10.219(0)***	-10.493(0)***
LNIIP	-0.744(12)	-1.322(12)	-23.448(0)***	-23.378(0)***
LNWPI	1.540(0)	-1.051(0)	-9.360(0)***	-9.434(0)***
LNM3	0.201(0)	-1.908(0)	-12.872(0)***	-12.837(0)***
BOT	-1.268(0)	-4.587(0)**	-18.250(0)***	-18.316(0)***
FII	-4.430(2)***	-5.029(2)***	-8.318(5)***	-18.449(0)***
USDER	-0.653(0)	-0.935(0)	-8.944(0)***	-8.947(0)***
WACMR	-2.414(4)	-4.113(0)**	-9.261(0)***	-16.429(0)***
BSE AUTO	-0.439(2)	-3.105(3)	-7.033(1)***	-7.040(1)***
BSE CD	-0.449(1)	-2.543(1)	-10.972(0)***	-11.002(0)***
BSE CG	-0.922(1)	-1.288(1)	-10.488(0)***	-10.469(0)***
BSE FMCG	0.779(0)	-1.879(0)	-13.029(0)***	-13.316(0)***
BSE HC	-0.483(0)	-2.254(0)	-11.347(0)***	-11.326(0)***
BSE IT	-1.404(11)	-4.540(11) ***	-11.291(0)***	-11.262(0)***
BSE METAL	-1.920	-1.974(1)	-10.545(0)***	-10.554(0)***
BSE O&G	-1.412(0)	-1.224(0)	-11.706(0)***	-11.695(0)***

Entries in parenthesis stand for the optimal lag length chosen by AIC with the maximum lag set to be 12.

*** Significance at 5% level.*

**** Significance at 1% level.*

The empirical results show that all the variables except BOT, FII, and WACMR are non-stationary in levels and stationary in first differences, indicating that they are I(1) processes or variables. The results of the Johansen cointegration test performed thereafter and the error correction term estimates of all the models used in the study are presented in Table 6.

Table 5: Phillips-Perron (PP) Test Results

	Level		First differences	
Variables	Intercept	Intercept & Trend	Intercept	Intercept & Trend
LNFOREX_RES	-2.426(0)	-0.192(1)	-10.219(0)***	-10.423(4)***
LNIIP	-0.731(28)	-1.295(4)	-40.146(11)***	-40.352(11)***
LNWPI	1.164 (2)	-1.507(3)	-9.471(3)***	-9.501(4)***
LNM3	0.271(14)	-1.692(10)	-13.024(14)***	-13.001(0)***
BOT	-0.278 (2)	-4.504(6)**	-21.824(8)***	-24.485(10)***
FII	-8.554(4)***	-9.107(3)***	-50.345(87)***	-59.845(95)***
USDER	-1.042(1)	-1.302(1)	-8.926(12)***	-8.833(13)***
WACMR	-3.944(7)**	-3.956(7)**	-24.079(41)***	-28.974(44)***
BSE AUTO	-0.565(6)	-2.349(6)	-11.021(5)***	-11.002(5)***
BSE CD	-0.545(6)	-2.381(6)	-11.029(5)***	-11.043(5)***
BSE CG	-1.027(6)	-1.347(6)	-10.594(5)***	-10.578(5)***
BSE FMCG	0.856(2)	-1.809(3)	-13.029(0)***	-13.396(4)***
BSE HC	-0.624(4)	-2.654(5)	-11.352(2)***	-11.330(5)***
BSE IT	-2.077(3)	-2.640(4)	-11.289(1)***	-11.262(0)***
BSE METAL	-1.662(6)	-2.142(6)	-10.670(5)***	-10.663(4)***
BSE O&G	-1.406(6)	-1.541(6)	-11.709(6)***	-11.704(5)***

This test is based on the Newey–West (1994) bandwidth using the Bartlett kernel.
Entries in parenthesis stand for the optimal lag length chosen.
*** Significance at 5% level.*
**** Significance at 1% level.*

Table 6: Summary of Cointegration Test Results and Error Correction Terms

Cointegration Test for	No. of lags based on AIC	Trace test No. of vectors	Max Eigenvalues	Cointegration Relationship	Error Correction Term
Model 1	11	4	5	YES	-0.021***
Model 2	11	4	2	YES	-0.093*
Model 3	10	5	2	YES	-0.100*
Model 4	12	4	3	YES	-0.003
Model 5	12	4	4	YES	-0.157
Model 6	12	4	3	YES	-0.309*
Model 7	5	2	1	YES	-0.107**
Model 8	10	5	3	YES	-0.094*

, ** and * represent significance at 1%, 5% and 10% levels respectively.*

The Johansen cointegration test results are sensitive to a given lag length and the assumptions of the underlying model. Hence, the lag length has been selected on the basis of the akaike information criteria (AIC) and a linear deterministic trend is assumed for these tests. With monthly data being used, a maximum lag order of 12 is set for unit root. The results reveal that there exists a long-run equilibrium relationship between the sector indices and the macroeconomic variables. After normalization of the cointegrated vector, the normalized cointegrated coefficients for the models are shown in Table 7. The selection of lag order for the models can be seen in Table 6. It was found that the trace statistic has identified four cointegrated vectors in models 1, 2, 4, 5 and 6, and a maximum of five cointegrated vectors in models 3 and 8. In contrast, the maximum eigenvalue has identified five cointegrated vectors in model 1, three in models 4, 6 and 8, two in models 2 and 3, four in model 5 and one in model 7.

Table 7: Normalized Cointegrated Coefficients of the Models

BSE AUTO	LNM3	LNIIP	LNWPI	LNFOREX_RES	USDER
1	-9.138	38.552	-17.209	-3.739	-0.146
Standard error	(-8.326)	(-10.730)	(-10.811)	(-1.267)	(-0.155)
t-values	1.097	-3.593*	1.592	2.950*	0.940
BSE CG	LNIIP	LNM3	LNFOREX_RES	LNWPI	USDER
1	2.170	5.341	-2.861	-12.329	-0.088
Standard error	(-3.309)	(-2.599)	(-0.515)	(-3.546)	(-0.057)
t-values	-0.656	-2.055**	5.558*	3.477*	1.544
BSE CD	LNIIP	LNM3	LNFOREX_RES	LNWPI	USDER
1	0.649	9.014	-1.960	-22.144	-0.136
Standard error	(-4.171)	(-3.247)	(-0.536)	(-4.282)	(-0.066)
t-values	-0.156	-2.776*	3.657*	5.172*	2.069**
BSE FMCG	LNWPI	LNM3	LNIIP	LNFOREX_RES	USDER
1	12.426	-2.188	-13.808	2.899	0.038
Standard error	(-4.068)	(-2.921)	(-3.820)	(-0.566)	(-0.063)
t-values	-3.055*	0.749	3.614*	-5.127*	-0.610
BSE HC	LNIIP	LNM3	LNWPI	LNFOREX_RES	USDER
1	-1.585	2.860	-7.206	-0.359	0.021
Standard error	(-0.576)	(-0.450)	(-0.576)	(-0.078)	(-0.010)
t-values	2.753*	-6.362*	12.517*	4.587*	-2.173**
BSE_IT	USDER	LNFOREX_RES	LNIIP	LNM3	LNWPI
1	-0.010	0.363	-5.484	5.667	-10.938
Standard error	(-0.020)	(-0.146)	(-1.153)	(-0.912)	(-1.213)
t-values	0.525	-2.480**	4.755*	-6.211*	9.021*

(continued)

BSE AUTO	LNM3	LNIIP	LNWPI	LNFOREX_RES	USDER
BSE METAL	LNIIP	LNM3	LNWPI	LNFOREX_RES	USDER
1	2.922	-0.504	-3.521	-0.873	0.096
Standard error	(-1.354)	(-1.059)	(-1.730)	(-0.199)	(-0.023)
t-values	-2.158**	0.477	2.035**	4.384*	-4.272*
BSE O&G	LNIIP	LNM3	LNFOREX_RES	LNWPI	USDER
1	5.167	6.685	-3.738	-15.589	-0.187
Standard error	(-4.739)	(-3.723)	(-0.655)	(-5.051)	(-0.078)
t-values	-1.090	-1.796***	5.706*	3.087*	2.389**

According to the normalized equation, the BSE FMCG, HC, and IT indices show a significant negative relationship, while the BSE AUTO and METAL indices show a significant positive relationship with the IIP in the long run. The positive impact of IIP on the sector indices may be explained by the fact that an upsurge in real economic activity advances the corporate earnings and profits, which in turn causes an increase in the stock prices. Besides, there is a significant positive relationship between M3 and the BSE CG, CD, HC and IT indices in the long run.

In addition, a significant negative relationship was found between the BSE AUTO, CD, HC, METAL, and O&G indices and the USDER in the long run. Likewise, a significant negative association was also found between the BSE CG, CD, HC, IT, METAL and O&G indices and the WPI. On the contrary, there was a significant positive relationship of the BSE FMCG index with the WPI in the long run. Furthermore, the empirical results revealed that there was significant negative relationship between the BSE AUTO, CG, CD, FMCG, HC, METAL and O&G indices and the FER in the long run. On the contrary, the BSE IT and FMCG indices had a significant positive relationship with the FER. The USDER did not have any significant influence on the BSE AUTO, CG, IT and FMCG indices. Similarly, M3 was also found to have an insignificant influence on the BSE AUTO, FMCG and METAL indices.

The next step was the determination of the error correction term. The estimated coefficients of the error correction term for the cointegrated sector indices are presented in Table 2. The empirical results revealed that cointegrated indices had a significant error correction term with a negative sign at different significance levels, except for the BSE FMCG and HC indices. Among the BSE sector indices, BSE IT index had a maximum estimated coefficient of -0.309 implying that about 30.9% of its short-run deviations got corrected within a month. In other words, the BSE IT index adjusted relatively quickly to correct its disequilibrium. On the contrary, the BSE AUTO index had a minimum estimated coefficient of -0.021 suggesting that about 2.1% of its short-run deviations would be adjusted each month towards the long-run equilibrium level.

5. Conclusion

Macroeconomic variables reflect the level of real economic activity and stock indices are considered to be the barometers of economic performance. With this backdrop, the purpose of the present study was to investigate the long-run relationship between sector indices and macroeconomic variables in India. Based on the unit root test results and the order of integration of the variables, five macroeconomic variables (index of industrial production, wholesale price index, money supply, rupee-dollar exchange rate, and foreign exchange reserves) and eight sector indices (auto, capital goods, consumer durables, fast moving consumer goods, information technology, healthcare, metal, and oil & gas) were considered.

The Johansen vector error correction model results enabled us to conclude that there was a long-run equilibrium relationship between the sector indices and the macroeconomic variables. The empirical results revealed that the consumer durables, healthcare, metal and oil & gas indices show a significant negative relationship with the exchange rate, wholesale price index, and forex reserves. Other such relationships included that of auto index with exchange rate and forex reserves, consumer goods index with wholesale price index and forex reserves, and fast-moving consumer goods index with index of industrial production and forex reserves. On the contrary, a significant positive relationship was found to exist between auto and metal indices and index of industrial production, fast-moving consumer goods index and wholesale price index and forex reserves, information technology index and money supply and forex reserves, and capital goods and consumer durable goods indices and money supply.

The error-correction terms were estimated for all the cointegrated indices. Except for the fast-moving consumer goods and healthcare indices, the remaining sector indices showed the significant negative coefficients with a value less than one, which further confirmed the existence of a long-run stable equilibrium. The study therefore, concluded that there was a long-run relationship between the sector indices and the macroeconomic variables.

The results of the study would enable investors and traders in taking informed decisions. They would also help companies in developing a view on the economy so as to facilitate their financial planning process. Further research can be taken up in exploring the short-run causal relationship dynamics of sector indices using the innovation accounting and variance decomposition analysis framework. In addition, an extension can also be made to the scope of the study by considering more sector indices and relevant macroeconomic variables, both domestic as well as global.

References

Agrawalla, R. K., & Tuteja, S. K. (2008). Share prices and macroeconomic variables in India: An approach to investigate the relationship between stock markets and economic growth. *Journal of Management Research, 8(*3), 136-146.

Ahmed, S. (2008). Aggregate economic variables and stock markets in India. *International Research Journal of Finance and Economics, 14*, 141-164.

Al-Sharkas, A. (2004). The dynamic relationship between macroeconomic factors and the Jordanian stock market. *International Journal of Applied Econometrics and Quantitative Studies, 1*(1), 97-114.

Aydemir, O., & Demirhan, E. (2009). The relationship between stock prices and exchange rates evidence from Turkey. *International Research Journal of Finance and Economics, 23*, 207-215.

Chaudhuri, K., & Smiles, S. (2004). Stock market and aggregate economic activity: Evidence from Australia. *Applied Financial Economics, 14*(2), 121-129.

Chen, N., Roll, R., & Ross, S. A. (1986). Economic forces and the stock market. *The Journal of Business, 59*(3), 383-403.

Elton, E. J., & Gruber, M. J. (1988). A multi-index risk model of the Japanese stock market. *Japan and the World Economy, 1*, 21-44.

Eryiğit, M. (2009). Effects of oil price changes on the sector indices of Istanbul Stock Exchange. *International Research Journal of Finance and Economics, 25*; 209-216.

Gunasekarage, A., Pisedtasalasai, A., & Power, D. M. (2004). Macroeconomic influence on the stock market: Evidence from an emerging market in South Asia. *Journal of Emerging Market Finance, 3*(3), 285-304.

Humpe, A., & Macmillan, P. (2009). Can macroeconomic variables explain long-term stock market movements? A comparison of the US and Japan. *Applied Financial Economics, 19*(2), 111-119.

Hussain, M. M., Aamir, M., Rasool, N., Fayyaz, M., & Mumtaz, M. (2012). The impact of macroeconomic variables on stock prices: An empirical analysis of the Karachi Stock Exchange. *Mediterranean Journal of Social Sciences, 3*(3), 295-312.

Ibrahim, M. (1999). Macroeconomic variables and stock prices in Malaysia: An empirical analysis. *Asian Economic Journal, 13*(2), 219-231.

Kumar, A. (2011). An empirical analysis of causal relationship between stock market and macroeconomic variables in India. *International Journal of Computer Science and Management Studies, 11*(1); 8-14.

Kwon, C. S., & Shin, T. S. (1999). Cointegration and causality between macroeconomic variables and stock market returns. *Global Finance Journal, 10*(1), 71-81.

Maysami, R. C., & Koh, T. S. (2000). A vector error correction model of the Singapore stock market. *International Review of Economics and Finance, 9*(1), 79-96

Maysami, R. C., Lee, C. H., & Hamzah, M. A. (2005). Relationship between macroeconomic variables and stock market indices: Cointegration

evidence from the stock exchange of Singapore's All-S sector indices. *Journal Pengurusan*, *24*, 47-77.

Mukherjee, T. K., & Naka, A. (1995). Dynamic relations between macroeconomic variables and the Japanese stock market: An application of a vector error correction model. *Journal of Financial Research, 18*(2), 223-37.

Nasseh, A. & Strauss, J. (2000). Stock prices and domestic and international macroeconomic activity: A cointegration approach. *The Quarterly Review of Economics and Finance, 40*(2), 229-245.

Pal, K., & Mittal, R. (2011). Impact of macroeconomic indicators on Indian capital markets. *Journal of Risk Finance, 12*(2), 84-97.

Patra, T., and Poshakwale, S. (2006). Economic variables and stock market returns: evidence from the Athens Stock Exchange. *Applied Financial Economics, 16*(13), 993-1005.

Pilinkus, D. (2009). Stock market and macroeconomic variables: Evidence from Lithuania. *Economics and Management,* 14, 884-891.

Pyeman, J., & Ahmad, I. (2009). Dynamic relationship between sector indices and macroeconomic fundamentals. *Malaysian Accounting Review, 8*(1); 81-100.

Rasiah, V., & Ratneswary, R. (2010). Macroeconomic activity and the Malaysian stock market: Empirical evidence of dynamic relations. *The International Journal of Business and Finance Research, 4*(2), 59-69.

Ratanapakorn, O., & Sharma, S. C. (2007). Dynamic analysis between the US stock returns and the macroeconomic variables. *Applied Financial Economics, 17*(5), 369-377.

Samsi, S. M., Yusof, Z., & Cheong, K. C. (2012). Linkages between the real sector and the financial sector: The case of Malaysia. *Asian Academy of Management Journal of Accounting and Finance, 8*, 93-113.

Schätz, A. (2010). Macroeconomic effects on emerging market sector indices. *Journal of Emerging Market Finance, 9*(2), 131-169.

Sohail, N., & Hussain, Z. (2009). Long-run and short-run relationship between macroeconomic variables and stock prices in Pakistan: The case of the Lahore Stock Exchange. *Pakistan Economic and Social Review, 47*(2), 183-198.

Srinivasan, P. (2011). Causal nexus between stock market return and selected macroeconomic variables in India: Evidence from the National Stock Exchange (NSE). *The IUP Journal of Financial Risk Management, 8*(4), 7-24.

Trivedi, P., & Behera, S. (2012). Macroeconomic fundamentals as determinants of equity prices: An empirical analysis for India. *The IUP Journal of Applied Finance,* 18(3), 5-30.

Wongbangpo, P., & Sharma, S. C. (2002). Stock market and macroeconomic fundamental dynamic interactions: ASEAN-5 countries. *Journal of Asian Economics, 13*(1), 27-51.