Can Select Macroeconomic Variables Explain Long - Run Price Movements of Indian Stock Indices ?

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Abstract

This study was an attempt to find the cointegration and causality among select macroeconomic variables namely foreign direct investment (FDI), exports, and imports and select stock indices of India like Nifty 50, Nifty FMCG, and Nifty Pharma over the period from January 2001 - December 2015. Nifty 50 and sectoral stock indices were considered as dependent variables, and select macroeconomic variables were considered as independent variables. In this study, appropriate econometric tools such as Augmented Dickey-Fuller (ADF) unit root test, Phillips - Perron (PP) unit root test, Karl Pearson's correlation coefficient, Johansen's cointegration test, vector error correction model (VECM), Granger causality test, variance decomposition index, and impulse response function were applied to analyse the linkages between select time series data. From the analysis, it was found that all the study variables were cointegrated and it was determined that select macroeconomic variables had the ability to correct the disequilibrium in the price movements of select stock indices. Granger causality test resulted in unidirectional causality between the study variables. Furthermore, it was found that sectoral stock indices responded and fluctuated with shocks to FDI, exports, and imports at a certain level of variation.

***Keywords* : macroeconomic variables, sectoral stock indices, unit root tests, Johansen's cointegration test, VECM, Granger causality test, variance decomposition index, impulse response function**

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Knowledge of stock market sensitivity to macroeconomic behaviour and vice-versa is important in many areas of investments and finance (Khan & Zaman, 2012). Although there are numerous papers that analyzed the relationship, long-run equilibrium, and causality between macroeconomic variables and broad stock market prices, previous literature that analyzed the impact of macroeconomic variables on sectoral stock index prices are meagre. Therefore, macroeconomic variables like FDI, exports and imports, and both broad (Nifty 50) and sectoral stock indices (Nifty FMCG, and Nifty Pharma) are considered in this study. During the period from 1991 - 1998, FDI and FPI (foreign portfolio investment) comprised of 90% of the total capital flow to developing countries. Global FDI flows decreased significantly from 2007 - 2009 due to the financial crisis and finally started rising again in 2010. Hence, FDI contributes to a larger extent to the recent phenomenon of globalization. FDI can contribute significantly to the economic growth and development of the recipient country by reducing shocks arising from low domestic savings and investments (Adam & Tweneboah, 2008a). Dunning (1973) identified market size, price, and growth as a major determinant of FDI. It was also postulated that an increase in FDI would positively affect stock market prices and vice versa (Issahaku, Ustarz, &

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Domanban, 2013). Thus, FDI is the primary focus of today's economic development. Higher amount of FDI equity inflows were from Mauritius, Singapore, United Kingdom, Japan, and the USA to the tune of ₹ 4,80,363.08 crores (33.24%), ₹ 2,56,666.81 crores (15.90%), ₹ 1,15,591.93 crores (8.01%), ₹ 1,10,671.35 crores (7.27%), and ₹ 94,574.89 crores (6.22%), respectively between April 2000 and March 2016. The remaining 29.36% of the FDI equity inflows were from other countries.

In terms of the stock market, a prolonged trade deficit can have adverse effects. A country essentially goes into debt when its exports to other countries decline over a period of time. This results in a decline in spending on domestically produced goods, which can hurt domestic producers and their stock prices. Given enough time, investors would realize very few investment opportunities domestically and thus, they start to invest in foreign stock markets, as prospects in those markets would be much better. This lowers demand in the domestic stock market which causes a decline in domestic market prices. However, during the past four years, India's exports have risen by 44%. According to statistical reports, India's total GDP accumulated more than U.S. $7.9 trillion in 2015, and it is evident that India is one of the fastest growing economies in the world. Thus, Indian export raises the degree of integration of its domestic market in an international environment (Andrei & Andrei, 2015). Also, the importance of export stability stimulates economic growth by lowering uncertainty (Lensink, Bo, & Sterken, 1999).

Reizman, Summers, and Whiteman (1996) emphasised the role of imports and argued that imports could be instrumental in explaining economic growth. Exports could provide foreign exchange that allows imports of intermediate goods which in turn raises capital formation and thus stimulates output growth. Endogenous growth models show that imports can be a channel for long-run economic and capital growth because it provides domestic firms with access to needed intermediate factors and foreign technology (Coe, Helpman, & Hoffmaister, 2009). Growth in imports could serve as a medium for the transfer of growth-enhancing foreign R&D knowledge from developed to developing countries (Lawrence & Weinstein, 1999 ; Mazumdar, 2001). Theoretically, a country is fundamentally going into debt when its imports are higher than its exports, and this leads to a deficit in the balance of trade and decrease in stock prices of domestic products. Accordingly, India's imports dipped by 15.46%, that is, U.S. $324.52 billion during April - January 2014 - 15 ("Economic Survey 2016: India's exports may pick up from next fiscal," 2016).

Nifty 50 is a diversified 50 stock index accounting for 13 sectors of the economy. It represents about 65% of the free float market capitalization of the stocks listed on NSE as on March 31, 2016. The total traded value of Nifty 50 index constituents for the six months from October 2015 to March 2016 was approximately 46% of the traded value of all stocks on the NSE. Nifty FMCG Index was selected for this study because the Indian FMCG sector has grown at an annual average of about 11% over the last decade. The overall FMCG market is expected to increase at a CAGR (cumulative annual growth rate) of 14.7% to touch U.S. $110.4 billion during 2012 - 2020, with the rural FMCG market anticipated to increase at a CAGR of 17.7% to reach U.S. $100 billion during 2012 - 2025. The Nifty FMCG index represents about 8.6% of the free float market capitalization of the stocks listed on NSE and 80.4% of the free float market capitalization of the stocks forming part of the FMCG universe as on March 31, 2016. In the case of Nifty Pharma Index, the Indian pharmaceutical sector accounts for about 2.4% of the global pharmaceutical industry in value terms and 10% in volume terms, and it is expected to expand at a CAGR of 15.92% to U.S. $55 billion by 2020 from U.S. $20 billion in 2015. The Nifty Pharma index represents about 6.1% of the free float market capitalization of the stocks listed on NSE and 79.9% of the free float market capitalization of the stocks forming part of the pharmaceutical sector universe as on March 31, 2016.

Most of the researchers have studied the cointegration and causality between macroeconomic variables and broad stock indices like Nifty 50 of National Stock Exchange (NSE), Sensex of Bombay Stock Exchange (BSE), and so on. There are several studies in India that have examined the relationship between stock prices and macroeconomic variables.

Budhedeo (2015) examined the association between savings and economic growth in India and found bidirectional mutual causality between savings and income in the short-run and unidirectional causality from nominal national income to gross domestic savings. Agrawal and Srivastava (2011) found bidirectional causality between exchange rate and stock indices. Kassim, Majid, and Hamid (2011) found the absence of a cointegrating relationship between stock market indices during the financial crisis period. Chakrabarty and Ghosh (2011) investigated the causality and long-run equilibrium relationship between the Indian stock market and the stock market indices of USA and UK. They showed that USA and UK market factors influenced the Indian stock market in the long-run.

Padhan (2007) found that both the stock price and industrial production index (IPI) were cointegrated, and bidirectional causality exists between them. Pranik and Vina (2003) observed that interest rate, output, money supply, inflation rate, and the exchange rate had considerable influence on the stock market movement. Naka, Mukherjee, and Tufte (1998) found that long-term equilibrium relationship exists among IPI, inflation, money supply, interest rate, and the Indian stock market. Past literature that has focused on the sectoral stock indices of stock exchanges are very few. Therefore, the current study focuses on determining the impact of select macroeconomic variables on the broad stock index Nifty 50 and the select sectoral stock indices of NSE namely, Nifty FMCG and Nifty Pharma stock indices. The impact on macroeconomic variables on select sectoral stock indices is studied separately in this study. Identifying the impact of macroeconomic variables on sectoral stock indices may help the researcher in finding out the level of linkages and influence by macroeconomic variables on different sectoral stock indices.

Data and Methodology

The data of study variables were collected from secondary sources. The period of this study was from January 2001 to December 2015. FDI (in INR millions), exports (in INR millions), imports (in INR millions) were collected from Trading Economics database (http://www.tradingeconomics.com/analytics/plans.aspx?source=chart). Data of variables namely Nifty FMCG stock prices (INR) and Nifty Pharma stock prices (INR) were collected from NSE database (NSE, n.d.). In this study, the following tools were used for analysing the data of the study variables. Analysis of the study was conducted using Eviews 7 software.

Objectives and Hypotheses

(1) Objectives

- To find the relationship between select macroeconomic indicators and select sectoral stock indices.
- To predict the future movements in the select sectoral stock indices based on the variations in select macroeconomic variables.

(2) Hypotheses : The following hypotheses are set to be empirically tested to study the above-mentioned objectives :

- **H_1:** The study variables namely Nifty FMCG stock prices, Nifty Pharma stock prices, FDI, exports and imports are not normally distributed.
- **H_2:** Unit root exists (i.e. non-stationarity) in the study variables.
- **H_3:** There is no structural break in the study variables.
- **H_4:** There is no long-run equilibrium between the study variables.

S.No.	Methods Employed	Formulae Used	Purpose
1	Normality Test: Jarque-Bera (JB) Test	$JB = n\,[\frac{skewness^2}{6} + \frac{(kurtosis - 3)^2}{24}]$	This test is used to test whether the variables follow a normal distribution.
2	Unit Root Test (Stationarity Test)	$\Delta y_t = \alpha + \pi + \delta y_{t-1} + \sum_{i=1}^{m} \beta_i\, \Delta y_{t-1} + \varepsilon_t$	The empirical study is based on time series data which is assumed to be stationary. If a time series data is stationary, it means that the variance in data is constant, that is, non-changing over a period of time. Unit root test is applied to check whether the data series is stationary are not. In this study, ADF and PP tests are used to test the data for stationarity.
3	Pearson's Correlation Coefficient Test	$r = \frac{n\,(\Sigma xy) - (\Sigma x)\,(\Sigma y)}{\sqrt{(n\Sigma x^2 - (\Sigma x)^2\,)\,(n\Sigma y^2 - (\Sigma y)^2))}}$	This test is used to measure the correlating relationship between select macroeconomic variables and select sectoral stock indices.
4	Johansen Cointegration Test	Trace Test Statistic $\lambda_{trace}(r) = -T \sum_{i=r+1}^{n} \ln\,(1 - \lambda_i)$ Maximum Eigenvalue Test Statistic $\lambda_{max}(r,\, r+1) = -T1n(1 - \lambda_{r+1})$	This test is applied to test the presence of long-run equilibrium between two or more time series. This test was introduced by Johansen (1988) and Johansen and Juselius (1990). In this study, the cointegration test is used to test the presence of long-run equilibrium between select sectoral stock indices (Nifty FMCG and Nifty Pharma) and FDI, exports, and imports.
5	Vector Error Correction Model (VECM)	$\Delta x_t = \alpha_1\,(y_{t-1} - \beta x_{t-1}) + \gamma_{11}\Delta x_{t-1} + \gamma_{12}\Delta y_{t-1} + \varepsilon_{1t}$ $\Delta y_t = \alpha_2\,(y_{t-1} - \beta x_{t-1}) + \gamma_{21}\Delta x_{t-1} + \gamma_{22}\Delta y_{t-1} + \varepsilon_{2t}$	VECM is used to analyse the disequilibrium to find whether error correction mechanism takes place if any disturbance or variations occur in the equilibrium. VECM is applied to analyse disequilibrium between select sectoral stock indices (Nifty FMCG and Nifty Pharma) and FDI, exports, and imports.
6	Granger Causality Test	$y_t = \alpha_0 + \sum_{i=1}^{m} \alpha_i y_{t-i} + \sum_{j=1}^{n} \beta_j x_{t-1} + \varepsilon_t$ $x_t = \omega_0 + \sum_{i=1}^{m} \gamma_i y_{t-i} + \sum_{j=1}^{n} \theta_j x_{t-1} + \varepsilon_t$	Granger causality test is applied to find out the direction of causality and short-run relationship between two or more time series data. In this study, this Granger causality test is used to find the direction of causality and short-run relationship between select sectoral stock indices and select macroeconomic variables.
7	Variance Decomposition Model (VDM)	$y_t = \bar{y} + \sum_{i=1}^{\infty} Ø_{11}\varepsilon_{yt-i} + \sum_{i=1}^{\infty} Ø_{12} + \varepsilon_{zt-i}$ $z_t = \bar{z} + \sum_{i=1}^{\infty} Ø_{21}\varepsilon_{yt-i} + \sum_{i=1}^{\infty} Ø_{22} + \varepsilon_{zt-i}$	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.
8	Impulse Response Function	$\begin{bmatrix} y_t \\ z_t \end{bmatrix} = \begin{bmatrix} \bar{Y} \\ \bar{Z} \end{bmatrix} + \sum_{i=0}^{\infty} \begin{bmatrix} \theta^i_{11} & \theta^i_{12} \\ \theta^i_{21} & \theta^i_{22} \end{bmatrix}^i \begin{bmatrix} \varepsilon_{yt-i} \\ \varepsilon_{zt-i} \end{bmatrix}$ $X_t = \mu + \sum_{i=0}^{\infty} \theta_i \varepsilon_{t-i}$	IRF tests the reaction of any dynamic system in response to some external change. The impulse response describes the reaction of the system as a function of time or possibly as a function of some other independent variable that parameterizes the dynamic behaviour of the system. Generally, the impulse response of the variables is represented in graphs and figures.

➯ **H_5:** There is no causality existing between the study variables.
➯ **H_{5a}:** There is no causality existing between Nifty 50 stock prices and FDI, exports, and imports.
➯ **H_{5b}**: There is no causality existing between Nifty FMCG stock prices and FDI, exports, and imports.
➯ **H_{5c}**: There is no causality existing between Nifty Pharma stock prices and FDI, exports, and imports.

Analysis and Results

This section discusses the preliminary analysis which includes descriptive statistics, correlation matrix, and unit roots. Subsequently, the results from the detailed system analysis are being discussed, which include co-integration test, vector error correction model (VECM), Granger causality test, variance decomposition model (VDM), and impulse response function (IRF). In the analysis part, the study variables are termed as *N50, NFMCG, NPharma, FDI, EX, and IM* for Nifty 50, Nifty FMCG, Nifty Pharma, FDI, exports, and imports, respectively.

(1) Descriptive Statistics : The descriptive statistics of the study variables for the study period are presented in the Table 1. The table shows that there is a large difference between the minimum and maximum values of the study variables. It also indicates that there is fluctuation in the movement of study variables and their index points and prices have grown rapidly during the study period.

The skewness is positive for all the study variables, which indicates that the upper tail of the distribution is thicker than the lower tail. This implies that the study variables do not decline more often. It further suggests that the study variables are exhibiting rational and systematic returns. The kurtosis coefficient values for *NPharma* are positive and are found to be greater than 3, which indicates that the distribution is leptokurtic. The kurtosis coefficient values for *N50, NFMCG, FDI, EX, IM* are positive and less than 3, which indicates that the distribution is platykurtic with fewer and less extreme outliers. Subsequently, the Jarque-Bera test statistics suggest that all variables are not normally distributed. Thus, hypothesis H_1 is accepted and it can be inferred that all the study variables namely, Nifty FMCG stock prices, Nifty Pharma stock prices, FDI, exports, and imports are not normally distributed.

Table 1. Descriptive Statistics of the Study Variables

Particulars	*N50*	*NFMCG*	*NPharma*	*FDI*	*EX*	*IM*
Mean	4097.70	8053.08	4017.92	75867.11	770076.00	1152906.00
Median	4317.58	5533.95	2767.48	79407.78	663893.40	1033155.00
Maximum	8284.79	20290.79	12261.14	196226.20	1630556.00	2347340.00
Minimum	1056.00	2259.70	918.70	7968.69	170438.20	198189.40
Standard Deviation	2275.25	6141.53	3209.95	58138.67	519555.00	800193.50
Skewness	0.15	0.88	1.35	0.41	0.43	0.30
Kurtosis	2.04	2.38	4.03	2.21	1.69	1.56
Jarque-Bera	0.63	2.17	5.25	0.82	1.54	1.52
Probability	0.73	0.34	0.07	0.66	0.46	0.47
Observations	15.00	15.00	15.00	15.00	15.00	15.00

(2) Testing the Data for Stationarity : The results of the ADF and PP unit root test for checking stationarity of the data are presented in the Table 2. From the results, it is identified that all the study variables are found to be non-stationary series at level form, but are found to be stationary at first difference. Hence, all the time series data are

Table 2. Results of ADF and PP Unit Root Tests

Time Series Data	ADF Unit Root Test		PP Unit Root Test	
	Level	First Difference	Level	First Difference
N50	-3.05	-10.75***	-3.08	-10.81***
NFMCG	-1.73	-15.24***	-1.69	-15.21***
NPharma	-0.58	-11.47***	-0.66	-11.45***
FDI	-6.38***	-10.67***	-10.21***	-66.20***
EX	-2.27	-3.18*	-3.76**	-25.65***
IM	-2.60	-21.08***	-3.90***	-21.23***

*** Significant at 1% level, ** Significant at 5% level, * Significant at 10% level

Figure 1(a). Line Chart of *N50* Stock Prices *I*(1)

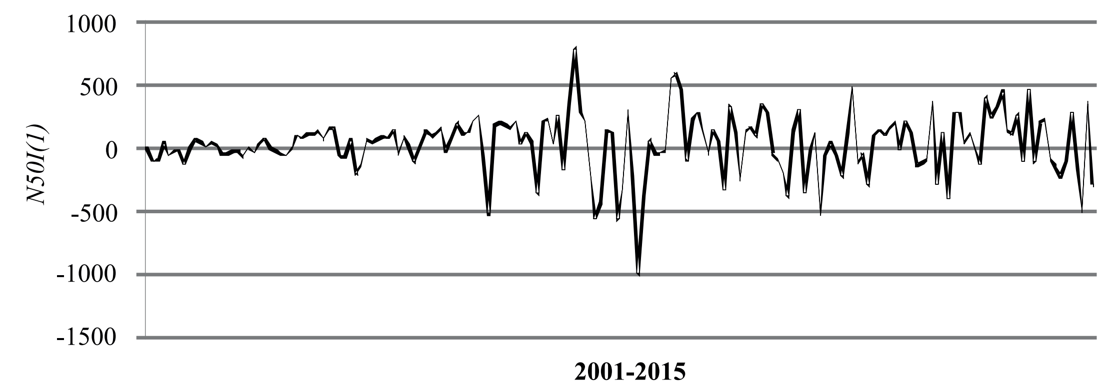
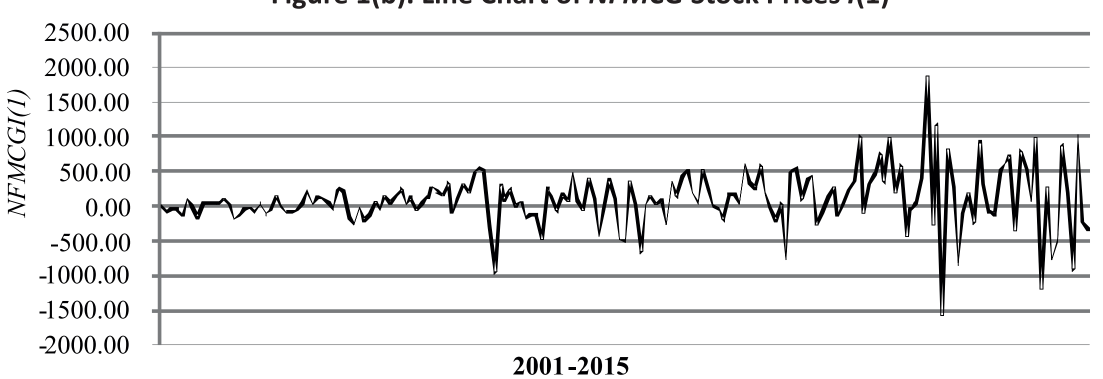


Figure 1(b). Line Chart of *NFMCG* Stock Prices *I*(1)



statistically significant and integrated at order *I*(1). Therefore, hypothesis H_2 is rejected, and it is understood that the sample data taken for this study are stationary, that is, predictable. The results are found to be in line with the results of Issahaku, Ustarz, and Domanban (2013) ; Adam and Tweneboah (2008b) ; and Anoruo and Ramchander (2000). The generated graphical representations of the first-differenced stationary time series data are presented in the figures Figure 1(a) to Figure 1(f).

Figure 1(c). Line Chart of *NPharma* Stock Prices *I*(1)

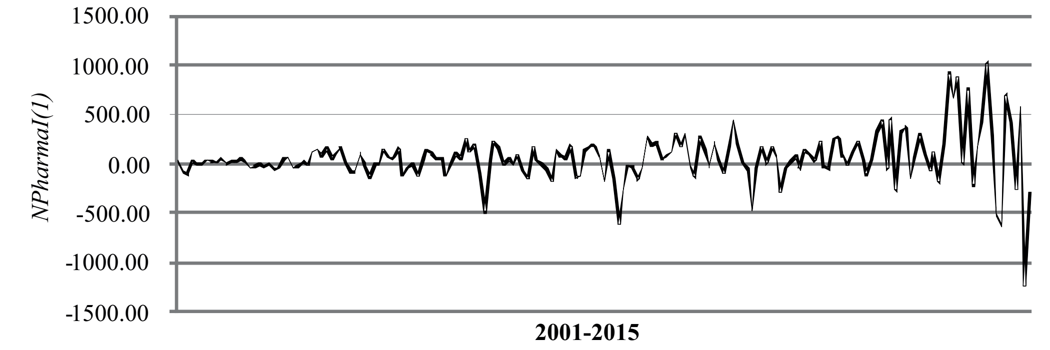


Figure 1(d). Line Chart of *FDI I*(1)

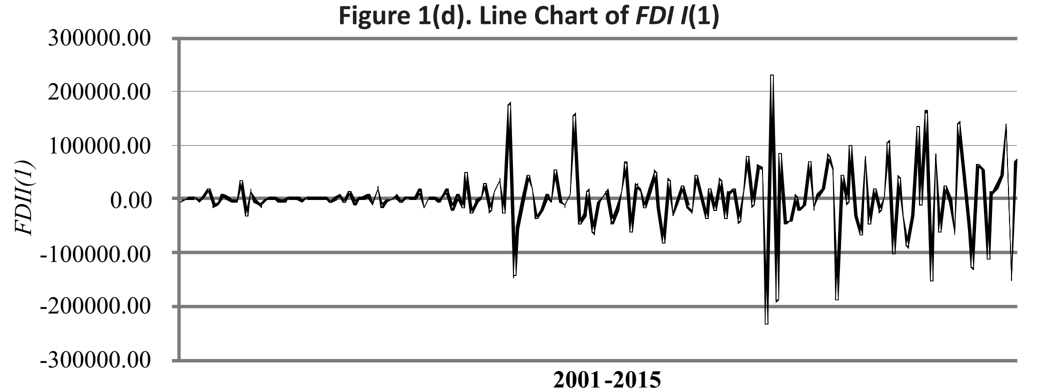


Figure 1(e).Line Chart of *EX I*(1)

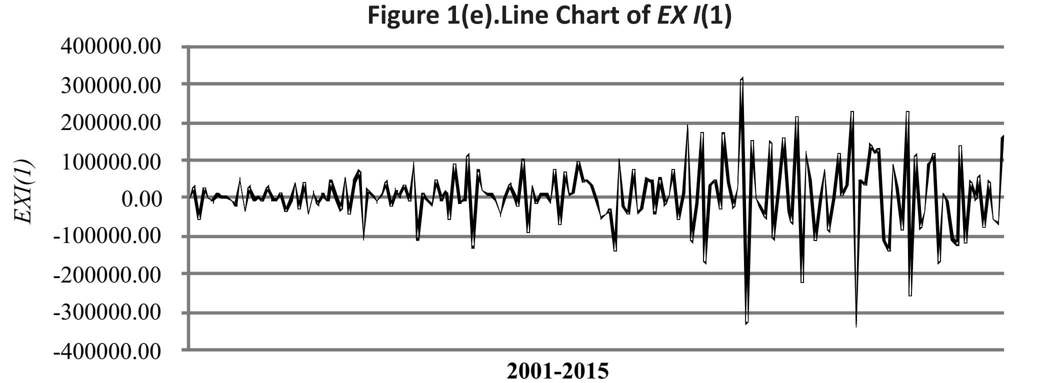


Figure 1(f).Line Chart of *IM I*(1)

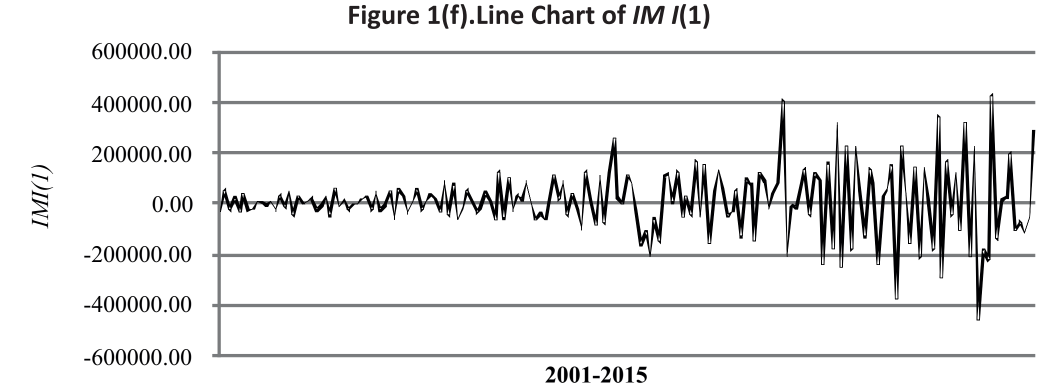


Table 3. Results of Karl Pearson's Correlation Test

Particulars	*N50*	*NFMCG*	*NPharma*	*FDI*	*EX*	*IM*
N50	1					
NFMCG	0.924**	1				
NPharma	0.918**	0.970**	1			
FDI	0.935**	0.884**	0.889**	1		
EX	0.924**	0.959**	0.886**	0.870**	1	
IM	0.923**	0.939**	0.862**	0.866**	0.995**	1

** Significant at the 1% level (2 tailed)

(3) Testing the Relationship Between the Study Variables: To find the linear relationship between the study variables, Karl Pearson's correlation test is applied. The result of correlation test is presented in the Table 3.

The correlation coefficient analysis provides information regarding the linear and short-run relationship between the study variables. Thus, they provide useful information to the prospective investors about the interaction amongst the study variables. From the Table 3, it is inferred that the relationship between the study variables is found to be positively correlated and significant at the 0.01 level. All the study variables are highly correlated with each other. Therefore, it is found that there is a significant linear relationship between the study variables.

(4) Testing of Structural Breaks : Chow breakpoint test is applied to determine the presence of any structural breaks in the movement of variables during the period from 2008 - 2009. The period from 2008-2009 is selected to determine the structural breaks because of the financial crises that happened during that period. The Chow test results in Table 4 shows that the p value is insignificant, that is, ($p > 0.05$). Therefore, hypothesis H_3 is accepted, which means that there is no structural break in the study variables during the period from 2008 - 2009.

(5) Testing for Existence of Long - Run Equilibrium Relationship: Johansen's cointegration test is applied to find

Table 4. Results of Chow Test for Testing Structural Breaks

Variables	Breakpoint Period	*F* - value	*p* - value
FDI, EX, and *IM* → *N50*	2008-2009	1.37	0.21
FDI, EX, and *IM* → *NFMCG*	2008-2009	0.70	0.69
FDI, EX, and *IM* → *NPharma*	2008-2009	1.28	0.26

Table 5. Results of Johansen's Cointegration Test

H_0	*N50*		*NFMCG*		*NPharma*		5% Critical Value	
	Trace Value	Maximum Eigen Value	Trace Value	Maximum Eigen Value	Trace Value	Maximum Eigen Value	Trace Value	Maximum Eigen Value
$r = 0$	189.69**	106.04**	179.56**	131.81**	175.87**	94.92**	47.86	27.58
$r \leq 1$	83.65**	63.65**	47.75**	36.45**	80.94**	45.56**	29.80	21.13
$r \leq 2$	20.00**	19.95**	11.30	11.19	35.38**	27.50**	15.49	14.26
$r \leq 3$	0.06	0.06	0.11	0.11	7.89**	7.89**	3.84	3.84

Note: 1 to 4 is taken as lag length for first difference of time series data.

** Significant at 1% level (*c* estimated probability values).

the stationary linear combination and long-run cointegrating equilibrium among the non-stationary variables of the same order. The results of trace test and maximum eigenvalue test are presented in the Table 5.

Johansen's cointegration test is adapted to determine the integration properties among the study variables. The Table 5 reports the results of the cointegration tests, which indicate the existence of long-run equilibrium relationship among the study variables. Three cointegrating vector equations are found between *N50* and select macroeconomic variables. Two cointegrating vector equations are found between *NFMCG* and select macroeconomic variables. Four cointegrating vector equations are found between *NPharma* and select macroeconomic variables. All the cointegrating equations found between the stock prices and macroeconomic variables are significant at the 1% level in both trace test and maximum eigenvalue test. Therefore, hypothesis H_4 is rejected, and it is inferred that there exists the long-run equilibrium relationship between the study variables, which means that the select variables can be forecasted on the basis of past values of other variables considered for the study. The result of this analysis is found to be similar to the results of Jothi and Suresh (2016) and Chakraborty and Basu (2002).

(6) Error Correction Model (ECM) Estimation : This model is used to estimate the long-term effects of one time series on another. This model is constructed using the equilibrium relationship between non-stationary study variables. It also helps in estimating an extent at which a dependent variable returns to equilibrium after a change in independent variables. The results of ECM are given in Table 6(a), Table 6(b), and Table 6(c).

Tables 6(a), 6(b), and 6(c) show the results of ECM for select macroeconomic variables and *N50, NFMCG,* and *NPharma*. The coefficient of error correction term (ECT) for Δ*N*50 is found to be negative (-0.12) and

Table 6(a). Results of Error Correction Model (*N50 - FDI, EX,* and *IM*)

Exchanges	Variables	Δ*N50*		
		Coefficient	***t* - value**	***p* - value**
N50 → *FDI, EX,* and *IM*	Error Correction Term (ECT)	-0.12	-2.96	0.04**
	Δ*N50* (-1)	-0.46	-6.43	0.00***
	Δ*FDI* (-1)	-0.00	-1.77	0.08*
	Δ*EX* (-1)	-0.00	-0.17	0.87
	Δ*IM* (-1)	0.00	0.85	0.39
	Constant	-0.38	-0.02	0.98
	F - Statistics	8.41***		

*** Significant at 1% level, ** Significant at 5% level, * Significant at 10% level

Table 6(b). Results of Error Correction Model (*NFMCG - FDI, EX,* and *IM*)

Exchanges	Variables	Δ*NFMCG*		
		Coefficient	***t* - value**	***p* - value**
NFMCG → *FDI, EX, and IM*	Error Correction Term (ECT)	-0.17	-4.38	0.00***
	Δ*NFMCG* (-1)	0.10	1.15	0.25
	Δ*FDI* (-1)	0.00	3.28	0.00***
	Δ*EX* (-1)	-0.00	-3.95	0.00***
	Δ*IM* (-1)	0.00	2.34	0.02**
	Constant	272.52	3.98	0.00***
	F - Statistics		2.39***	

*** Significant at 1% level ** Significant at 5% level

Table 6(c). Results of Error Correction Model (*NPharma - FDI, EX,* and *IM*)

Exchanges	Variables	ΔNPharma		
		Coefficient	*t* - value	*p* - value
NPharma → *FDI, EX, and IM*	Error Correction Term (ECT)	-0.15	-3.80	0.00***
	Δ*NPharma* (-1)	0.37	4.06	0.00***
	Δ*FDI* (-1)	-0.00	-2.67	0.01***
	Δ*EX* (-1)	-0.00	-3.52	0.00***
	Δ*IM* (-1)	0.00	2.51	0.01***
	Constant	73.30	2.50	0.01***
	F - Statistics		3.44***	

*** Significant at 1% level

statistically significant at the 1% level with *t* - value (-2.96) than the critical value (1.96) at the 5% level. The coefficient of ECT is found to be negative (-0.17) and statistically significant at the 1% level with a greater *t* - value (- 4.38) than the critical value (1.96) at 5% level in the case of Δ*NFMCG*. In the case of Δ*NPharma*, the coefficient of ECT is found to be negative (-0.15) and statistically significant at the 1% level with greater *t* - value (-3.80) than the critical value (1.96) at the 5% level. This implies that *N50*, *NFMCG*, and *NPharma* respond significantly to the changes in *FDI*, *EX*, and *IM* and establish the equilibrium relationship once variation in movement occurs. Thus, the statistically significant negative ECT confirms the long-run equilibrium relationship between the study variables and indicates that the *FDI* inflows, *EX*, and *IM* correct the disequilibrium in the long-term relationship between *N50, NFMCG*, and *NPharma*. Further, it is inferred that changes in *N50, NFMCG,* and *NPharma* stock price movements are due to fluctuations in select macroeconomic variables, but to a limited extent.

(7) Testing for Causality : Granger causality test is used in this study to determine the causality between the study variables, that is, to check whether one variable is useful in forecasting the other variable and also helps in determining the short-run equilibrium relationship. For instance: variable *X* might Granger cause variable *Y* if past values of variable *X* explain variable *Y*. Similarly, variable *Y* Granger causes variable *X* if past values of variable *Y* explain variable *X*. The results of Granger causality test for variables: *N50, FDI, EX*, and *IM, NFMCG*, *FDI, EX*, and *IM* and for the variables: *NPharma, FDI, EX*, and *IM* are given in the Tables 7(a), Tables 7(b), and Tables 7(c), respectively.

The direction of causality is found to be unidirectional and significant in the following cases *N50* → *FDI*, *EX* → *N50*, and *IM* → *N50*. Therefore, hypothesis H_{5a} is rejected and it is inferred that causality and short-run

Table 7(a). Results of Granger Causality Test (Variables: *N50, FDI, EX,* and *IM*)

Null Hypotheses	*F* - value	*p* - value	Results
N50 does not Granger cause *FDI*	7.01	0.01***	Reject H_{5a}
FDI does not Granger cause *N50*	0.49	0.63	Accept H_{5a}
N50 does not Granger cause *EX*	0.35	0.72	Accept H_{5a}
EX does not Granger cause *N50*	3.13	0.09*	Reject H_{5a}
N50 does not Granger cause *IM*	0.53	0.61	Accept H_{5a}
IM does not Granger cause *N50*	5.39	0.03**	Reject H_{5a}

*** Significant at 1% level, ** Significant at 5% level, * Significant at 10% level

Table 7(b). Results of Granger Causality Test (Variables : *NFMCG, FDI, EX,* and *IM*)

Null Hypotheses	*F* - value	*p* - value	Results
NFMCG does not Granger cause *FDI*	2.35	0.16	Accept H_{5b}
FDI does not Granger cause *NFMCG*	1.73	0.23	Accept H_{5b}
NFMCG does not Granger cause *EX*	4.37	0.05**	Reject H_{5b}
EX does not Granger cause *NFMCG*	9.63	0.00***	Reject H_{5b}
NFMCG does not Granger cause *IM*	1.43	0.29	Accept H_{5b}
IM does not Granger cause *NFMCG*	4.48	0.04**	Reject H_{5b}

*** Significant at 1% level, ** Significant at 5% level

Table 7(c). Results of Granger Causality Test (Variables: *NPharma, FDI, EX,* and *IM*)

Null Hypotheses	*F* - value	*p* - value	Results
NPharma does not Granger cause *FDI*	2.96	0.10*	Reject H_{5c}
FDI does not Granger cause *NPharma*	0.58	0.58	Accept H_{5c}
NPharma does not Granger cause *EX*	2.79	0.12	Accept H_{5c}
EX does not Granger cause *NPharma*	9.30	0.00***	Reject H_{5c}
NPharma does not Granger cause *IM*	0.84	0.46	Accept H_{5c}
IM does not Granger cause *NPharma*	12.27	0.00***	Reject H_{5c}

*** Significant at 1% level, * Significant at 10% level

relationship is found between *N50* and select macroeconomic variables.

The direction of causality is found to be bidirectional and significant in the cases of $NFMCG \rightarrow EX$ and vice versa. Unidirectional causality is found between *IM* and *NFMCG*. Therefore, hypothesis H_{5b} is rejected, and it is inferred that causality and short-run relationship is found between *NFMCG* and select macroeconomic variables except *FDI*.

The direction of causality is found to be unidirectional and significant in the following cases of $NPharma \rightarrow FDI$, $EX \rightarrow NPharma$, and $IM \rightarrow NPharma$. Therefore, hypothesis H_{5c} is rejected, and it is inferred that causality and short-run relationship is found between *NPharma* and select macroeconomic variables.

(8) Testing for Post-Sample Period Interactions Between the Study Variables : In this study, post-sample period interactions between study variables are tested using the variance decomposition method. It is explained with the

Table 8(a). Results of Variance Decomposition Index for *N50 - FDI, EX,* and *IM*

Period		*N50 - FDI, EX,* and *IM*			
		N50	*FDI*	Exports	Imports
Short-Run Period	1 month	100.00	0.00	0.00	0.00
	6 months	94.78	0.26	2.64	2.33
	1 year	91.56	0.66	5.38	2.40
	2 years	87.00	1.12	10.21	1.67
Long-Run Period	3 years	82.81	1.39	14.43	1.37
	4 years	79.16	1.59	17.91	1.34
	5 years	76.12	1.73	20.73	1.42

Table 8(b). Results of Variance Decomposition Index for *NFMCG - FDI, EX, and IM*

Period		*NFMCG - FDI, EX, and IM*			
		NFMCG	*FDI*	*EX*	*IM*
Short-Run Period	1 month	100.00	0.00	0.00	0.00
	6 months	95.54	2.88	0.81	0.78
	1 year	79.07	7.91	11.54	1.49
	2 years	44.41	6.56	44.73	4.30
Long-Run Period	3 years	25.87	3.77	63.96	6.40
	4 years	17.06	2.38	73.03	7.54
	5 years	12.48	1.71	77.63	8.17

Table 8(c). Results of Variance Decomposition Index for *NPharma - FDI, EX, and IM*

Period		*NPharma - FDI, EX, and IM*			
		NPharma	*FDI*	*EX*	*IM*
Short-Run Period	1 month	100.00	0.00	0.00	0.00
	6 months	89.62	1.53	0.38	8.46
	1 year	84.85	0.90	2.78	11.48
	2 years	74.50	0.49	15.65	9.36
Long-Run Period	3 years	59.11	0.46	34.01	6.41
	4 years	43.88	0.65	49.88	5.59
	5 years	32.33	0.91	60.44	6.33

help of variances in the previous behaviour of the dependent variable and the behaviour of other variables considered for the study. The results of variance decomposition of the study variables for 5 years (60 lags, i.e. 60 months) are presented in Table 8(a), Table 8(b), and Table 8(c).

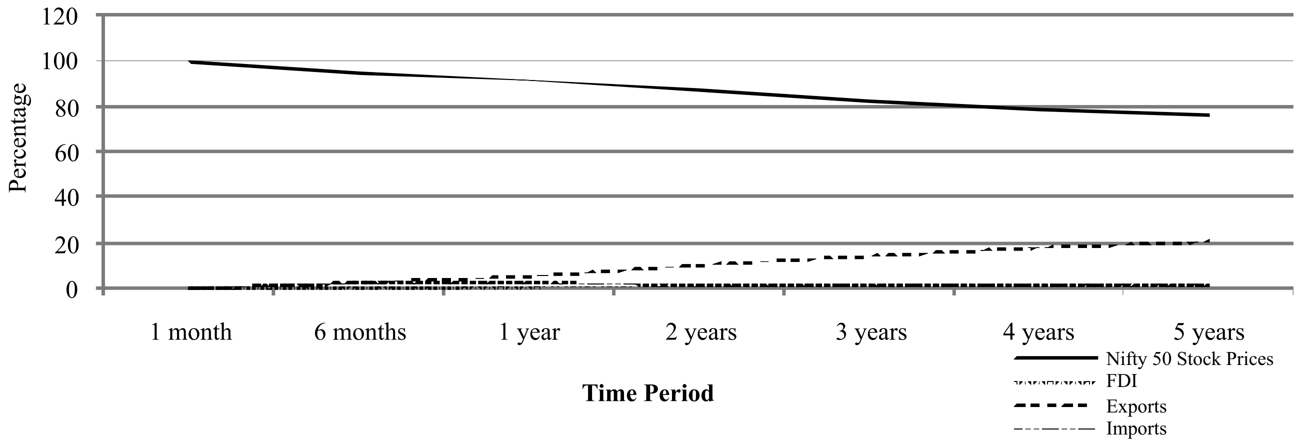
From the results, it is identified that in the short - run, that is, in immediate 1 month, 6 months, 1 year, and 2 years period, the shock to *N50* can cause 100%, 94.78%, 91.56%, and 87.00% variation of the fluctuation in *N50*, respectively (this is also called own shock). In the long-run, that is, in 3^{rd}, 4^{th}, and 5^{th} year periods, the shock to *N50* can cause 82.81%, 79.16%, and 76.12% variation of the fluctuation in *N50*, respectively. It is forecasted that the own shock to *N50* is slightly decreasing in trend and it is also inferred that the shocks to other study variables might cause fluctuation in *N50*'s future stock prices.

The shock to FDI in short-run can cause an average of 0.51% variation of the fluctuation in *N50*, which is very meagre. In the case of long-run, the shock to *FDI* can cause an average of 1.57% variation of the fluctuation in *N50*. Though the percentage of variation caused by *FDI* is very less, it is found that the shock to *FDI* affects the fluctuation in *N50* during the long-run period compared to the short-run period.

The shock to *EX* in short-run can cause an average of 4.56% variation of the fluctuation in *N50*. In the case of long-run, the shock to *EX* can cause an average of 17.69% variation of the fluctuation in *N50*. Compared to the percentage of variation caused by *FDI*, the percentage of variation caused by *EX* is very high. Furthermore, it is inferred that the shock to *EX* affects the fluctuation in *N50* during the long-run period.

The shock to *IM* in the short-run can cause an average of 1.60% variation of the fluctuation in *N50*. In the case of long-run, the shock to *IM* can cause an average of 1.38% variation of the fluctuation in *N50*. It is found that the shock to *IM* affects the fluctuation in *N50* to a very limited extent during both short and long-run periods. The generated graphical representation of the variance decomposition index for *N50 - FDI, EX,* and *IM* is presented in the Figure 2(a).

Figure 2(a). Graphical Representation of Variance Decomposition Index for *N50 - FDI, EX, and IM*



From the results, it is identified that in the short-run, that is, in the immediate 1 month, 6 months, 1 year, and 2 year periods, the shock to *NFMCG* causes 100%, 95.54%, 79.07%, and 44.41% variation of the fluctuation in *NFMCG*, respectively (this is also called own shock). In the long-run, that is, in 3rd, 4th, and 5th year periods, the shock to *NFMCG* causes 25.87%, 17.06%, and 12.48% variation of the fluctuation in *NFMCG*, respectively. It is forecasted that the own shock to *NFMCG* is decreasing in trend, and it also inferred that the shocks to other study variables might cause a considerable percentage of fluctuation in *NFMCG*'s future stock prices.

The shock to *FDI* in the short-run causes an average of 4.34% variation of the fluctuation in *NFMCG*. In the case of long - run, the shock to *FDI* can cause an average of 2.62% variation of the fluctuation in *NFMCG*. Though the percentage of variation caused by *FDI* is very less, it is found that shock to *FDI* affects the fluctuation in *NFMCG* during the short-run period compared to the long-run period.

The shock to *EX* in the short-run could cause an average of 14.27% variation of the fluctuation in *NFMCG*. In the case of long-run, the shock to *EX* could cause in an average of 71.54% variation of the fluctuation in *NFMCG*. Compared to the percentage of variation caused by *FDI*, the percentage of variation caused by *EX* is quite higher. Further, it is inferred that shock to *EX* affects the fluctuation in *NFMCG* during the long-run period compared to the short - run period.

The shock to *IM* in the short-run causes an average of 1.64% variation of the fluctuation in *NFMCG*. In the case of long-run, the shock to *IM* could cause in an average of 7.37% variation of the fluctuation in *NFMCG*. It is found that the shock to *IM* affects the fluctuation in *NFMCG* during the long-run period compared to the short-run period. The generated graphical representation of the variance decomposition index for *NFMCG - FDI, EX,* and *IM* is presented in Figure 2(b).

From the results shown in Table 8©, it is identified that in the short-run, that is, in immediate 1 month, 6 months, 1 year, and 2 years period, the shock to *NPharma* causes an average of 87.24% variation of the fluctuation in *NPharma* (this is also called own shock). In the long-run, that is, in 3rd, 4th , and 5th year periods, the shock to *NPharma* causes an average of 45.11% variation of the fluctuation in *NPharma*. It is forecasted that the own shock to *NPharma* is decreasing in trend and it is also inferred that the shocks to other study variables might cause a considerable percentage of fluctuation in *NPharma's* future stock prices.

The shock to *FDI* in the short-run causes an average of 0.73% variation of the fluctuation in *NPharma*. In the case of long-run, the shock to *FDI* causes an average of 0.67% variation of the fluctuation in *NPharma*. It is found that shock to *FDI* affects the fluctuation in *NPharma* stock prices in a very negligible amount.

The shock to *EX* in short-run can cause, on an average, a 4.70% variation of the fluctuation in *NPharma*. In the case of the long-run, the shock to *EX* can cause an average of 48.11% variation of the fluctuation in *NPharma*.

Figure 2(b). Graphical Representation of Variance Decomposition Index for *NFMCG - FDI, EX,* and *IM*

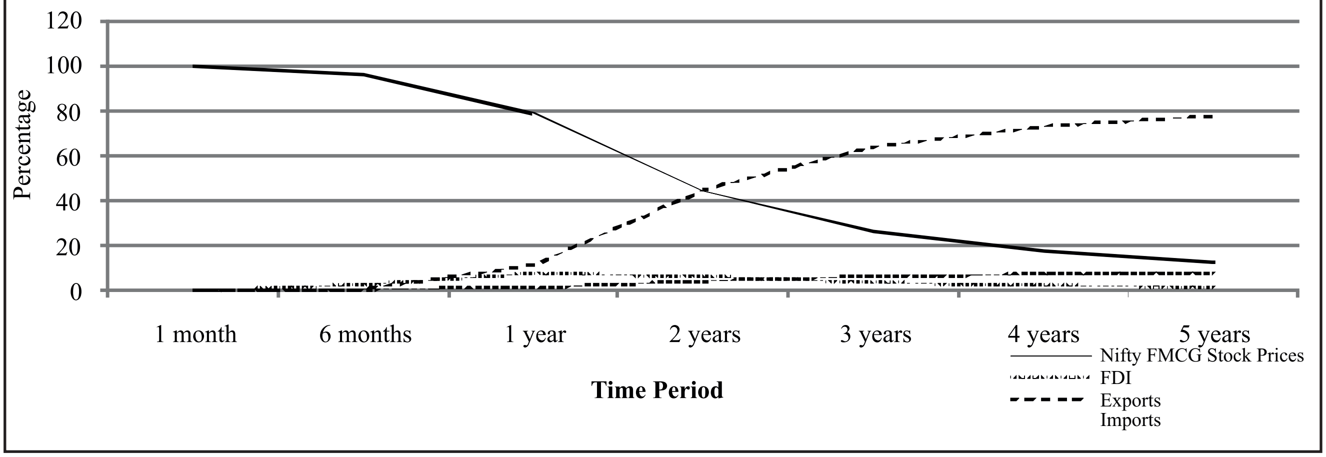
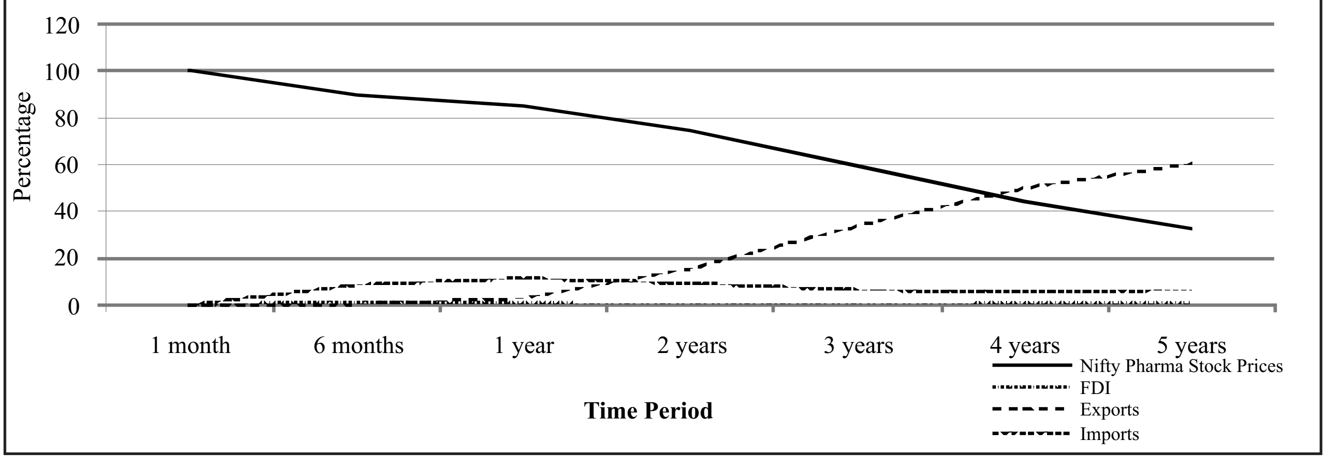


Figure 2(c). Graphical Representation of Variance Decomposition Index for *NPharma - FDI, EX,* and *IM*



Compared to the percentage of variation caused by *FDI*, the percentage of variation caused by *EX* is much higher. Further, it is inferred that shock to *EX* affects the fluctuation in *NPharma* during the long-run period compared to the short-run period.

The shock to *IM* in short-run causes an average of 7.32% variation of the fluctuation in *NPharma*. In the case of long-run, the shock to *IM* can cause an average of 6.11% variation of the fluctuation in *NPharma.* It is found that shock to *IM* affects the fluctuation in *NPharma* during the short-run period as compared to the long-run period. The generated graphical representation of the variance decomposition index for *NPharma - FDI, EX,* and *IM* is presented in Figure 2(c).

To conclude the results of variance decomposition method, *N50, NFMCG,* and *NPharma* stock prices fluctuate to the shocks to *FDI, EX,* and *IM* at a certain level of variation, but all the stock prices react to a larger extent to the *EX* shocks, particularly in the long-run period. Fluctuation in *NFMCG* to the shocks to *EX* is higher (71.54%) than the fluctuation in *NPharma* to the shocks to *EX* (48.11%).

(9) Impulse Response Function : It explains the responsiveness of dependent variable (endogenous variable) to the shock of the other endogenous variables in the system. The graphical representations of Impulse Response Function of *N50 - FDI, EX,* and *IM* are shown in Figures 3(a) - Figures 3(d).

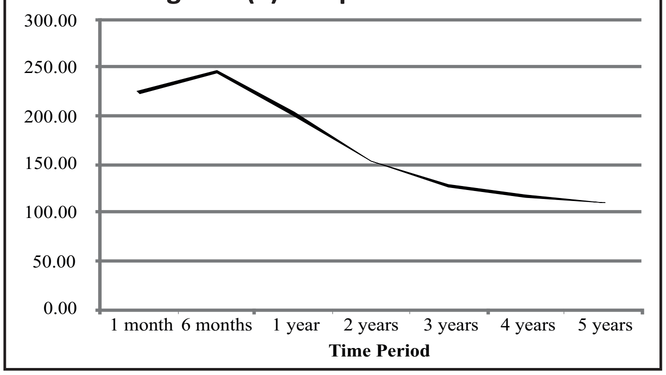


Figure 3(a). Response of *N50* to *N50*

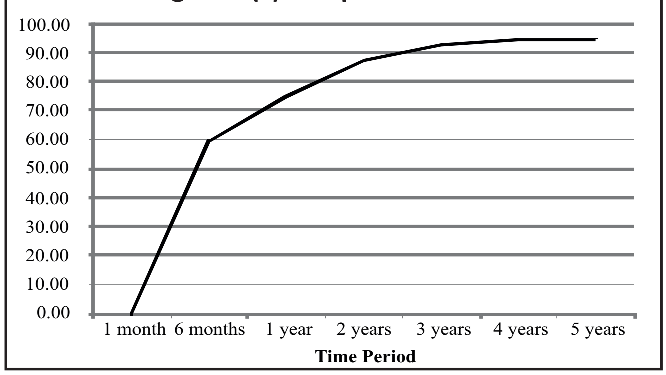


Figure 3(c). Response of *N50* to *EX*

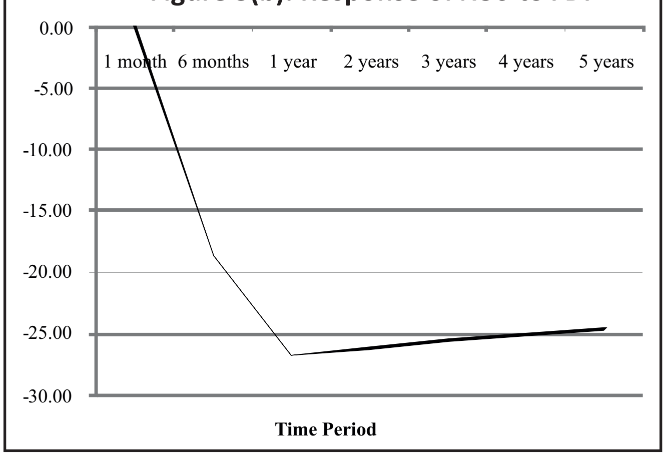


Figure 3(b). Response of *N50* to *FDI*

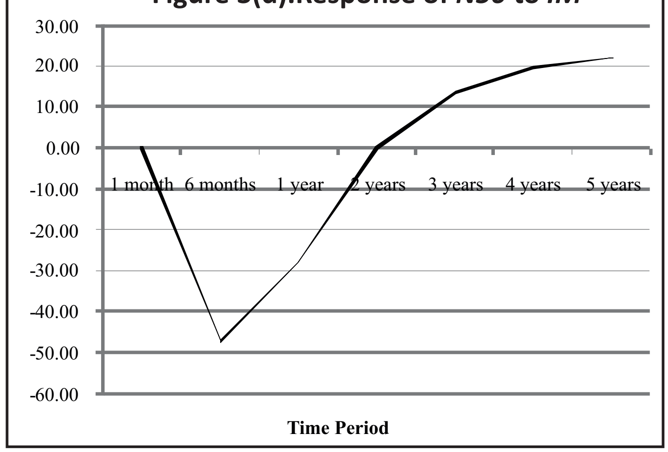


Figure 3(d).Response of *N50* to *IM*

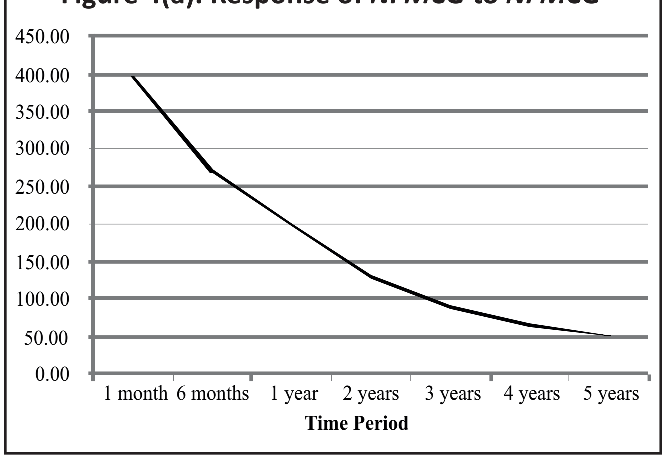


Figure 4(a). Response of *NFMCG* to *NFMCG*

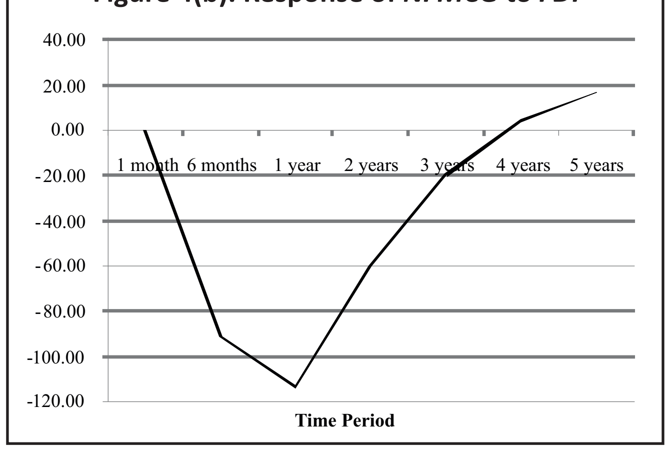


Figure 4(b). Response of *NFMCG* to *FDI*

The figures Figure 4(a) to Figure 4(d) shows the impulse response function of *NFMCG - FDI, EX,* and *IM.* The Figures 5(a) to Figures 5(d) show the impulse response function of *NPharma - FDI, EX,* and *IM.* The generated impulse response function graphs show that there is higher and significant response of *N50, NFMCG,* and *NPharma* to the shocks of *FDI, EX,* and *IM.*

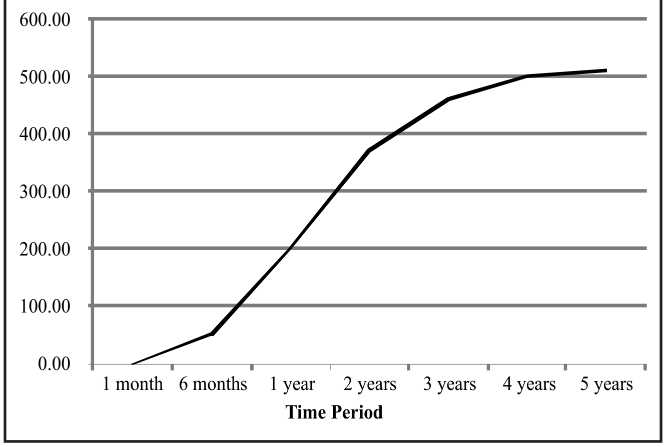


Figure 4(c). Response of *NFMCG* to *EX*

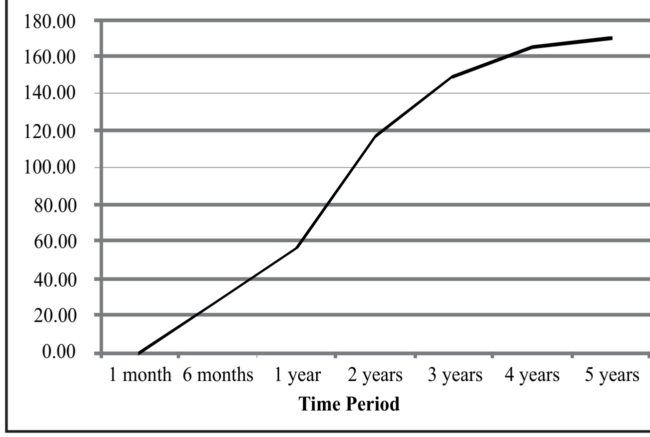


Figure 4(d). Response of *NFMCG* to *IM*

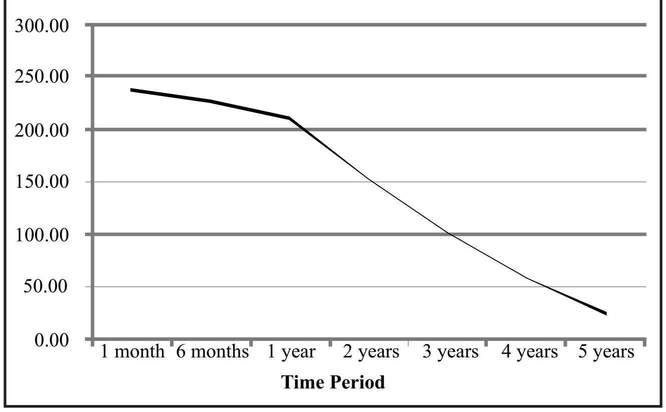


Figure 5(a). Response of *NPharma* to *NPharma*

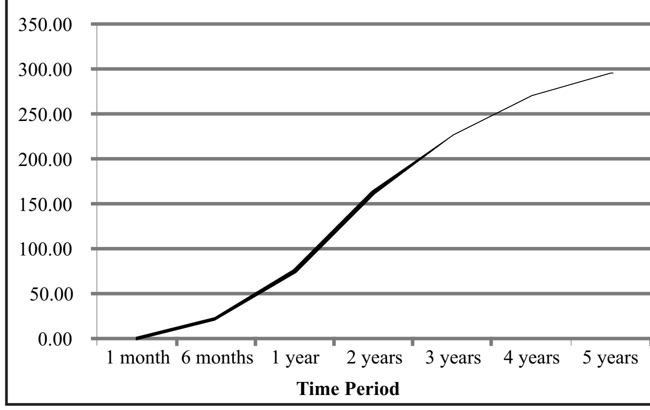


Figure 5(c). Response of *NPharma* to *EX*

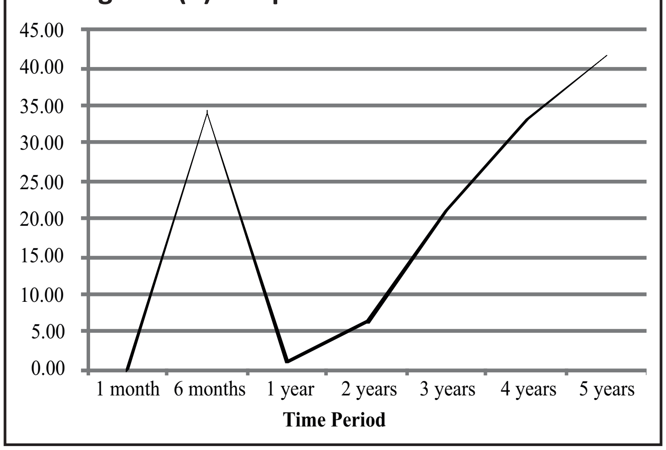


Figure 5(b). Response of *NPharma* to *FDI*

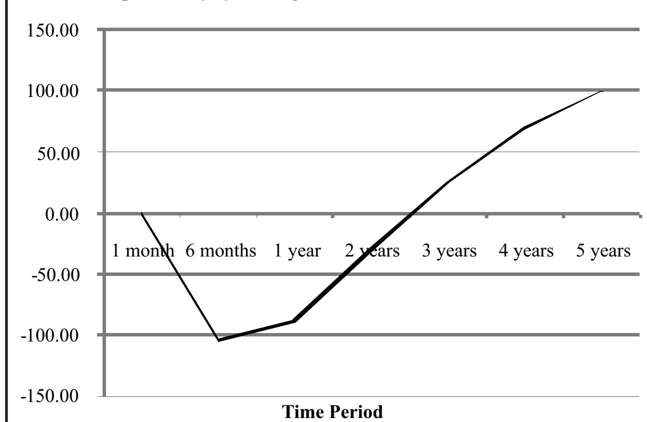


Figure 5(d). Response of *NPharma* to *IM*

Discussion and Conclusion

The study examines the cointegrating and causal relationship between select macroeconomic variables (FDI, exports, and imports), Nifty 50 stock prices, and select sectoral stock indices in NSE (Nifty FMCG and Nifty

Pharma stock prices) for the period from January 2001 - December 2015. The data series of the study variables are non-stationary and become stationary series at first difference. Hence, all the study variables are integrated at order $I(1)$. Karl Pearson's correlation test results in statistically significant and positive relationship between all the study variables. Johansen cointegration test exhibits the presence of a long-run relationship between Nifty 50 stock prices, Nifty FMCG stock prices, Nifty Pharma stock prices, and select macroeconomic variables. Error correction mechanism exists between the study variables and restores the equilibrium relationship whenever disequilibrium takes place between select stock prices and FDI, exports, and imports. In this study, it is the movements in select macroeconomic variables which correct the disequilibrium with select sectoral stock indices prices in the market. By applying Granger causality test, unidirectional causality is found from the select macroeconomic variables to select sectoral stock prices. The direction of causality flows from select sectoral stock prices to FDI, exports, and imports. Therefore, it is concluded that this study partially supports McKinnon's (1973) 'complementarity hypothesis'.

Variance decomposition method describes the percentage of forecasting error, which can be explained with the help of variances in the previous behaviour of the dependent variable, and the previous behaviour of other variables considered for the study. Nifty 50, Nifty FMCG, and Nifty Pharma stock prices fluctuate to the shocks to FDI, exports, and imports at a certain level of variation, but all the stock prices react at a larger extent to the export shocks, particularly in the long-run period. Fluctuation in Nifty FMCG stock prices to the shocks to exports is higher than the fluctuation in Nifty Pharma stock prices to the shocks to exports. Impulse response function also shows that there is a significant response of select macroeconomic variables on select sectoral stock indices prices.

Implications, Limitations of the Study, and Scope for Further Research

The implications of this present study are that the movements of select macroeconomic variables determine the flow of select sectoral stock indices prices in India during the period of the study. Any new information about the Indian economy is captured by select macroeconomic variables, which in turn affect the prices of select sectoral stock indices, which is referred to as the error correction mechanism. The study also establishes that all the policies favour FDI, exports, and imports and will have an immediate change in the behaviour of sectoral stock prices in India. In the present study, the selections of stock indices are limited to Nifty 50 stock index and select sectoral stock indices of NSE of India. The studies in the future may also focus on NSE's thematic indices, strategy indices, customised indices, or fixed income indices for a better understanding of the country's economic growth.

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