IMPACT OF MACROECONOMIC VARIABLES ON STOCK MARKET

Abstract

Stock market and its indices are known as the barometer for any economy and India is no exception to it. Stock market is sensitive driven which is affected more or less by every movement in the economic parameters at world level in general and in India in particular. It remains the matter of concern for every Investor, Policy Makers, Economist, Government, etc., to know what are the factors that govern the movement of stock market? One of the biggest such factors (especially after 1991) is Foreign Institutional Investment (FIIs), therefore, the present study is conducted by taking BSE Sensex (as the proxy of Indian stock market) as dependent variable and FIIs as the prime independent variable. However, certain other independent factors are used as control variables viz. Index of Industrial Production (IIP), Consumer Price Index (CPI), Export, Exchange Rate (INR/USD). The study employs Auto Regressive Distributed Lags (ARDL) model to analyse cointegration among dependent and independent variables.

It is observed that the variables under study are co integrated with each other. FIIs, Export and CPI were found to be positive significant determinants, however, IIP and ER were the negative significant determinants of BSE Sensex in the long- run. Further, the study finds that ContEqu is -.959021 which signifies that the short-run results get convergence or will be monotonically adjusted in the long-run at the speed of 95%.

Keywords: Auto Regressive Distributed Lag Model, BSE Sensex, Augmented Dickey Fuller Test, FIIs, Serial Correlation.

1. INTRODUCTION

Stock market provides facilities for secondary market, i.e. transactions in existing securities. People desirous of converting of their cash into securities can go to the stock exchange and buy securities with the help of brokers there. Similarly, securities can be converted into cash by selling them in the market. Transactions in the secondary market reflect the investment climate of the economy. In the context of Indian financial market, the two pillars of stock market are Bombay Stock Exchange (BSE) and National Stock Exchange (NSE). In the present study stock market proxy is taken as BSE SENSEX. The BSE Index, SENSEX, is India's first and most popular Stock Market benchmark index.

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Inclusion of thirty large publicly listed companies on BSE turns out to make performance by the Sensex further relevant considering that it is the most relevant performance barometer of the Indian stock market. Ever since the first 1990s, stock exchanges have increasingly embraced electronic trading systems and order books to expedite trading, substituting it for traditional floor trading systems Rajendra Prasad & Subbarayudu (2023). Primary trading should be done only through the brokerage agencies

who are registered and institutional investors who are making the bulk transactions in BSE. Retail customers, on the opposite hand, don't must access to direct investment schemes and must make transactions through an authorized stock broker or a stock investing platform Ramnarayanan & Katoch (2021).Sensex is the widely followed index in Indian economy, but, at the same time it is very sensitive and is affected more or less by every movement of the economy both at national and international level. Several prominent factors are affecting this sensitive index chiefly foreign investment, exchange rates, growth in the economy, inflation, etc.

The present study is primarily carried out to know the impact that Foreign Institutional Investment exerts on BSE Sensex, however, in order to capture the wider picture certain control factors will also be considered in the study. Foreign Institutional Investors including foreign mutual funds, pension funds, hedge funds, and other investment vehicles are also gradually gaining importance in Indian financial markets in today's world. FII participation has always been considered as one of the most crucial determinants in comparison to other sources with respect to liquidity and volatility in price discovery in the market. Present study is an effort to enquire about the interconnectivity between the Sensex movement and investments made by FIIs in the Indian stock market over a period from 2018 to 2022. Apart from Net FIIs, few other variables will also be covered under the study as a control variable. However, there is no consensus on the direction of causality among these variables, which remained a source of ambiguity Sharma et al. (2011).This piece of research attempts to analyse the following pertinent issues and it is expected that the findings of the study would be useful for different stakeholders of the economy.

- Sensex movement Vs FIIs inflow over the time period of the study.
- Is Sensex dependent upon FIIs inflow in India, and if so then what is the direction of influence?
- Other extraneous variables influencing the Sensex.

2. OBJECTIVES OF THE RESEARCH

The present study which explores the short-run and long-run association between dependent variable i.e. BSE Sensex and independent variables viz. Foreign Institutional Investment (FII), Consumer Price Index (CPI), Index of Industrial Production (IIP), Export, Exchange Rate (INR/USD) is conducted with a view to obtain insights about the degree of impact (if any) of the independent variables on the dependent variable. In nutshell the study intends to achieve the following objectives from the findings of the study;

- To explore the degree of association between dependent and independent variables.
- To analyse Cointegration in the short and long-run, and to observe about the nature of shift in the impact from short to long-run.
- To observe the speed of adjustment towards equilibrium from short to long-run through Error Correction Model (ECM Model).

3. LITERATURE REVIEW

In order to know the present status of the research already conducted in the field of exploring the association between BSE SENSEX and other macroeconomic variables, and to

know the research gaps, many studies have contributed. One such study has found with the application of VECM model that long-run association exists between variables under study. This study concluded that domestic inflation is the severe deterrent of Indian stock market, whereas, domestic output growth is predominant driving force Naka et al. (1991). While investigating causal relationship between macroeconomic variables and Indian stock market with quarterly data from March 1995 to March 2007, it is noticed that there is a differential causal link between aggregate macroeconomic variables and stock indices in the long run. This study indicated that stock prices in India led economic activity except movement in interest rates (Ahmed, 2008).

Naik et al. (2012)have explored the relationship between BSE SENSEX and five macroeconomic variables through Johansen's Cointegration test and Vector Error Correction Model (VECM) and found that dependent and independent variables were co integrated in the long run. They further revealed that money supply and industrial production were positively influencing BSE, however, inflation was negative factor. Kumar (2013)had applied data reduction technique factor analysis and principal component technique and found that industrial performance plays a significant role in influencing stock market. Another study has also confirmed the relationship between macroeconomic variables and stock market Sangmi & Hassan (2013). In the application of regression analysis, it was found that WPI, IIP, FIIs and Effected Exchange Rates had positive influence on Sensex Dr.Venkatraja B (2014). However, exchange rate and FIIs were found to be insignificant determinants of Indian stock market Sivagnanasithi (2014). Joshi & Giri (2015)Conducted research titled "The impact of macroeconomic indicators on Indian Stock Prices: An Empirical Analysis". The motive of the study was to find the long and short-run association of stock prices with a set of macroeconomic variables of Indian economy for a period from 1979 to 2014. The study found that exchange rate, economic growth, and inflation were influencing stock prices positively, however, this impact was negative in case of crude oil prices. Further, a short-run relationship (unidirectional) was found from FDI and Economic Growth to Stock prices through VECM.

To bridge the gap in research, a total 190 published articles from 1961 to 2014 were analysed to know the exact relationship between macroeconomic variables and stock market. They concluded that there is a research gap as most of the studies are conducted for either developed nations or for developing nations and that too with repeated common variables. Therefore, there is a great scope for research in this area for underdeveloped countries with different set of variables Kaur et al. (2016). Kotha and Sahu conducted a study on "Macroeconomic factors and Indian Stock Market", for exploring long and short-run relationship. They concluded that wholesale Price Index (WPI), Industrial Productivity, and Money Supply was related to Indian Stock Market positively, while, Granger Causality test showed that WPI and Industrial Productivity causes Indian Stock Market to a great extent Kumar Kotha & Sahu (2016).Further, Nifty 50 was found to be significantly affected by US-GDP, S&P index, gold prices, WPI-India, fiscal deficit, IPI, and exchange rate Aggarwal & Saqib (2017). Gold prices was also found to be influencing NIFTY in ARDL model application in the long run V. N et al. (2017). Interest rates, money supply, and inflation had a positive relationship with the stock prices of Johannesburg stock exchange, South Africa. However, exchange rate had negative relation in this study Ndlovu et al. (2018).FIIs with lag 1 and 2, NEER with lag 3, BSE SENSEX, and IIP were found to be significant determinants

of FIIs in India through the application of ARCH LM Test, Granger Causality test, ARDL Model, etc. P. Arun Prakash (2018).Megaravalli & Sampagnaro (2018)conducted research to find long and short-run relationship between stock markets with exchange rate and inflation rate of three ASIAN economies viz. India, China, and Japan. The investigation revealed in the long-run exchange rate was positively significantly related to the stock market. However, in the short-run no significant relationship was established with any of the variable. Keswani & Wadhwa (2018) aimed at establishing association and cointegration among BSE stock return and Disposable Income (DI), Government Policies (GP), Interest Rate (IR), Exchange Rate (ER), and Inflation. They found long-run cointegration among BSE stock return and other macroeconomic variables under the study. However, in the short-run only inflation rate found negative significant determinant of BSE SENSEX return. In the application of ARDL model, industrial growth rate, foreign portfolio investment was found to be positively influencing stock market in India both in short and long-run Tanvi Bhalala (2019). Gopinathan & Durai (2019)Carried out a study on "stock market and macroeconomic variables: New Evidences from India". They observed that in standard co integrating test no relationship was found between variables. However, testing variables on conditional expectations algorithms, a strong non-linear long run cointegration exists between the variables i.e. stock prices and macroeconomic variables. Both FIIs and DIIs were found to have positive statistically significant influence on stock market return in India Kattookaran (2019)A causal relationship was found between the stock prices in Egypt and Tunisia with exchange rate, money supply, and interest rate Barakat et al. (2015). Indian stock market was found to be related with Indian interest rate Nayak & Barodawala (2020). VECM analysis confirmed the movement of BSE Sensex variable in a study to the previous period's gap from the output of the long-run equilibrium Baranidharan & Dhivya (2020). In a study "Macroeconomic variables and market expectations: Indian stock market", the long-run coefficients confirmed that Indian stock prices were positively influenced by FIIs, Volatility Index, and inflation. Whereas, it was negatively influenced by Crude Oil Prices, Gold Prices, Exchange Rate, Money Supply, Call Money Rate, and Gross Fiscal Deficit Gupta & Kumar (2020). Makol & Mittal (2021)Industrial Production, Interest rates, and Exchange Rates were having negative relationship with stock return in the long-run, however, inflation had negative relationship with stock returns in the short-run Deo (2021).The macroeconomic variables were found to be insignificant determinant of stock prices in the long-run, however, in the short-run inflation and FPI had positive impact on stock prices Kuntamalla & Maguluri (2022).The domestic institutional investors were found to be no beneficial impact on SENSEX since their investment had a short-run impact on stock prices JACOB et al. (2022). Yaashi (2023)Worked on "An Empirical Impact of GDP and Inflation on Indian Stock Market inclusive with Sensex". This study revealed that there existed bi-directional relationship causality between stock market and inflation.

After going through various studies, it is noticed that studies have concluded mix results depending upon objectives and time period of the study. Certain studies have established a strong association between macroeconomic factors and stock market, and some have not. However, the present study takes Foreign Institutional Investment on the one hand and other Macroeconomic Factors on the other hand, which makes the study more comprehensive. Further, the study applies ARDL model which facilitates short as well long-run association at the same time.

4. RESEARCH METHODOLOGY

Present study is based upon secondary data sourced from the websites of Bombay Stock Exchange, Reserve Bank of India (Handbook of Statistics), Security Exchange Board of India (SEBI Bulletins and Handbook of Statistics), etc. In this study a total of six macroeconomic variables are taken viz. BSE Sensex, Net Foreign Institutional Investment (Net FII), Index of Industrial Production (IIP), Export, Exchange Rate INR/USD (ER), and Consumer Price Index (CPI). In this study BSE Sensex is taken as dependent variable and Net FIIs in India is taken as independent variable. While other variables such as IIP, Export, ER and CPI are taken as control variables. For the analysis of relational patterns between variables monthly data is taken from April 2018 to March 2022 (Total 48 Observations). The data so collected is logged for smoothening purposes. For statistical estimation EViews software is used. The statistical analysis is carried out with the help of Auto Regressive Distributed Lag (ARDL) Model. Theoretical foundations of this model are underlined below.

4.1 Auto Regressive Distributed Lag (ARDL) Model

The Autoregressive Distributed Lag (ARDL) model is a statistical tool that looks at how variables relate over time, focusing on both short and long-term effects. It is good for situations where variables have different integration orders, like I (0) or I (1). The ARDL model finds both short and the long-term impacts between the dependent and independent variables within one equation. The appropriate lag length (in this study Akaike Information criteria -AIC) is decided by the EViews automatically) which is 4 Lags for LSENSEX, 2 lags LNETFII, 4 lags LIIP, 3 lags LEXPORT, 4 lags LER, and 4 lags for LCPI respectively. This method is a combination of two terms;

4.1.1 Auto Regressive (AR):

In an autoregressive model, the dependent variable is explained by its own past values. In the present study as the dependent variable is BSE Sensex, therefore, Auto Regressive implies that present value of BSE Sensex is affected by the values of Sensex of last year i.e. lag 1, or the values of last-to-last year i.e. Lag 2 and so on. The Auto Regressive equation for the present study taking BSE Sensex as independent variable is;

$$\mathrm{LSENSEX}_t = \alpha_0 + \sum_{i=1}^{4} \beta_i \mathrm{LSENSEX}_{t-i} + \varepsilon_t$$

4.1.2 Distributed Lag (DL):

In the distributed lag model, the dependent variable (LSENSEX) is influenced by the present and past values of the independent variables. It signifies that the present value of LSENSEX is the results of present values of the significant independent variables and at the same time the previous values of significant independent variables i.e. value of last year (Lag 1), Values of last-to-last year (Lag 2) and so on. The lag length for all the independent

variables will be decided by the EViews automatically (AIC). For present study the equation of distributed lags of all the independent variables impacting BSE Sensex is;

$$\text{LSENSEX}_t = \alpha_0 + \sum_{i=1}^{2} \gamma_i \text{LNETFII}_{t-i} + \sum_{i=1}^{4} \delta_i \text{LIIP}_{t-i} + \sum_{i=1}^{3} \lambda_i \text{LEXPORT}_{t-i} + \sum_{i=1}^{4} \theta_i \text{LER}_{t-i} + \sum_{i=1}^{4} \mu_i \text{LCPI}_{t-i} + \varepsilon_t$$

4.1.3 Autoregressive Distributed Lag (ARDL) Model

In an ARDL model, both past values of the dependent variable and independent variables are considered. This combines both the autoregressive and distributed lag structures. The combined equation for the present study is;

$$\text{LSENSEX}_t = \alpha_0 + \sum_{i=1}^{4} \beta_i \text{LSENSEX}_{t-i} + \sum_{i=1}^{2} \gamma_i \text{LNETFII}_{t-i} + \sum_{i=1}^{4} \delta_i \text{LIIP}_{t-i} + \sum_{i=1}^{3} \lambda_i \text{LEXPORT}_{t-i} + \sum_{i=1}^{4} \theta_i \text{LER}_{t-i} + \sum_{i=1}^{4} \mu_i \text{LCPI}_{t-i} + \varepsilon_t$$

This combined ARDL equation incorporates both autoregressive components (lagged values of **LSENSEX**) and distributed lags for the independent variables. The error term **ε** is the random disturbance term that accounts for unexplained variability. For the application of ARDL Model few conditions needs to be checked first before the finally deciding about the suitability of this model. These prerequisites are under lined here under:

4.2 Stationarity Testing (Unit Root Testing)

For the purpose of statistical modelling through ARDL model, it is a pre-condition to check the Stationarity of the data to be used in the study. Some of the variables must be stationary at the level I (0) and some should be stationary at first difference I (1). None of the variable should be stationary at second difference I (2). If any of the variable is stationary at second difference i.e. I (2) then ARDL Model cannot be applied. There are many statistical methods to check the Stationarity of the data. The present study focuses on Augmented Dickey Fuller Test for the purpose of finding the presence of Unit root among the variables. ADF equation for the variables will be:

$$y_t = d_t + \phi_1 y_{t-1} + \sum_{i=1}^{p-1} \gamma_i \Delta y_{t-i} + \varepsilon_t$$

4.3 Bounds Cointegration test

After finding the Stationarity of the data, the second step is to develop the ARDL equation and finding the cointegration between the variables. For this bound test is done and

the guidelines is to compare the value of F statistics with the upper and lower bound values provided by the software. There may be three probable situations:

- If the F value is > than the upper bound value: it signifies cointegration among the variables
- If the F value is < than the lower bound value: it signifies no cointegration among the variables
- If the F value is in between the lower and upper bound values: it signifies that the results are inconclusive.

After the establishment cointegration between the variables, the study further estimates the long and short-run relationship (Error Correction Term). The error correction term specifies the speed of equilibrium or adjustment from short to long-run.

4.4 Test Diagnostics

For the suitability or best fit criteria of ARDL model, certain diagnostic tests are prescribed. If these tests validate only then the ARDL Model is considered best fit and is deemed to provide the best explanation of the dependent variable. The present study undertakes the following diagnostic tests;

4.4.1 SERIAL CORRELATION TEST: This test is done to enquire whether the error term in the time series transfers from one period to another. For this purpose, the study conducts **Breusch-Godfrey Serial Correlation LM Test.**

4.4.2 RESET TEST: To know whether the functional form of the test is Appropriate. For this purpose, **Ramsey's Stability test** is conducted.

4.4.3 HETEROSKEDASTICITY TEST: This test is conducted to check Heteroskedasticity in the model i.e. whether the residuals of regression have a changing variance. The test conducted to check Homoskedasticity or Heteroskedasticity is **Breusch-Pagan-Godfrey test.**

4.4.4 NORMALITY TEST: Jarque-Bera test is conducted to know whether the residuals follow a normal distribution.

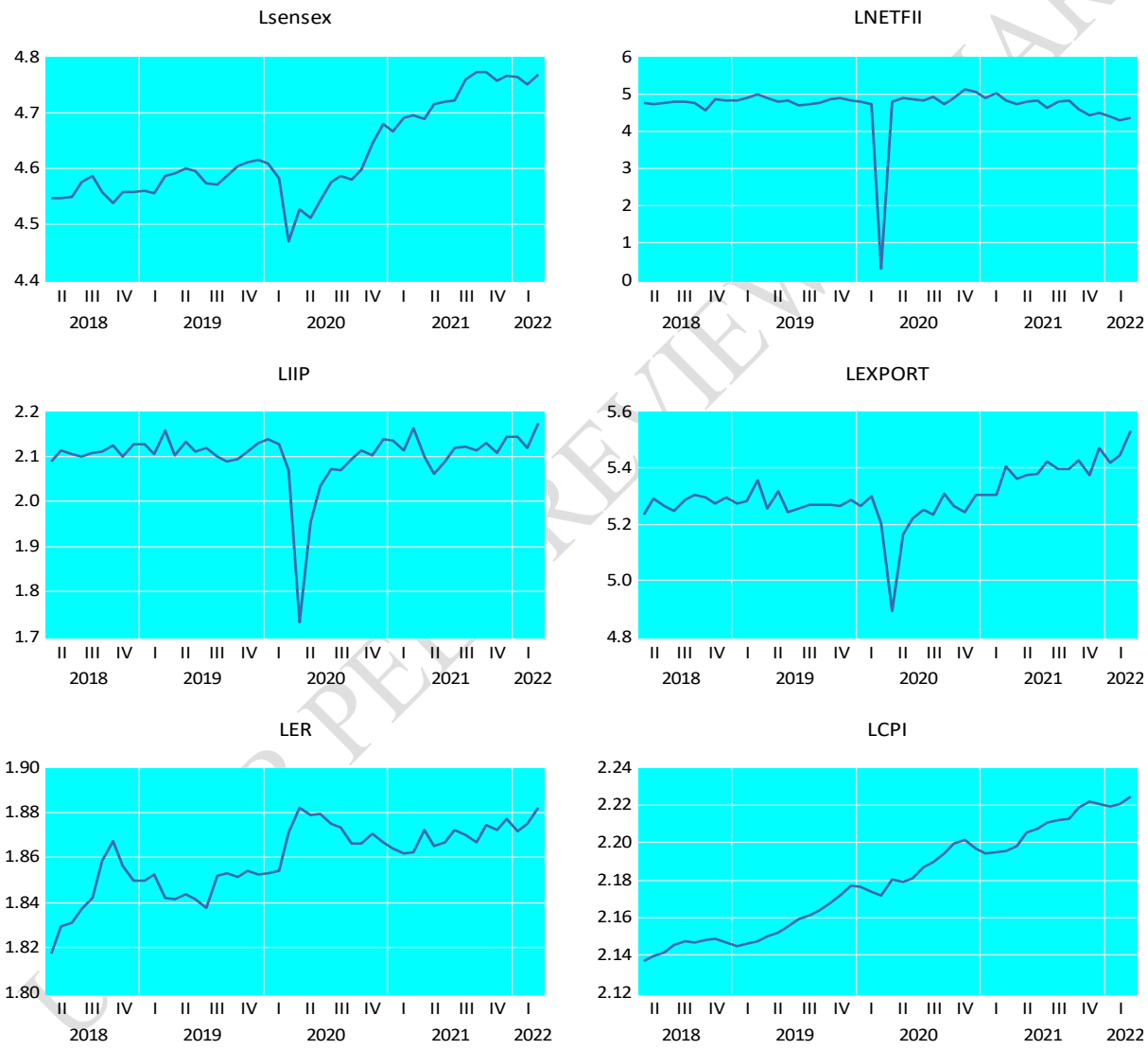
4.4.5 STABILITY OF COEFFICIENTS: CUSUM square test is done to check the stability of coefficients in a multiple linear model.

5 STATISTICAL INVESTIGATION

Present study undertook a statistical investigation to analyse the relational pattern between macroeconomic variables. For this purpose, the monthly logged values of Variables from April 2018 to March 2022 are taken. The dependent variable in the study is BSE Sensex

and the Independent Variables are Net FIIs, Index of Industrial Production (IIP), Export, Exchange rate INR/USD (ER), and Consumer Price Index (CPI). Primarily the study aims to enquire about the impact of Net FIIs on BSE Sensex, however, in order to explain the movement of dependent variable appropriately several control variables are also taken as independent variables. Following section deals with the results obtained through EViews. Below figure exhibits the logged values of variables used in the study.

Figure 1
Logged Variables of the study



Source: RBI, SEBI, BSE (Official websites) Logged conversion author's estimation

5.1 Augmented Dickey fuller (ADF) Test

The study has conducted ADF in order to enquire about the order of integration of variables or to analyse about the presence of unit root in the variables. Since ARDL requires that out of all the variables under consideration some should be of I (0) and the remaining

should be of I (1) and none should be stationary at I (2). The study has found that the variables are a mix of I (0) and I (1). Further, the test results show that no variable is stationary at I (2) i.e. stationary at 2nd difference. The underlying hypothesis of ADF test are as follows:

Ho: Null Hypothesis: The Series has Unit root.
H1: Alternate Hypothesis: The Series has no Unit root.

Table 1
Results of Augmented Dickey Fuller (ADF) Test

Variables	At Level I (0)		At First Difference I (1)		Stationarity
	t-Statistics	Probability	t-Statistics	Probability	
1. LSENSEX			-7.165740	.0000	I (1)
2. LCPI			-5.041199	.0001	I (1)
3. LIIP	-3.929546	.0038			I (0)
4. LNETFII	-6.465522	.0000			I (0)
5. LER			-6.265784	.0000	I (1)
6. LEXPORT			-9.269047	.0000	I (1)

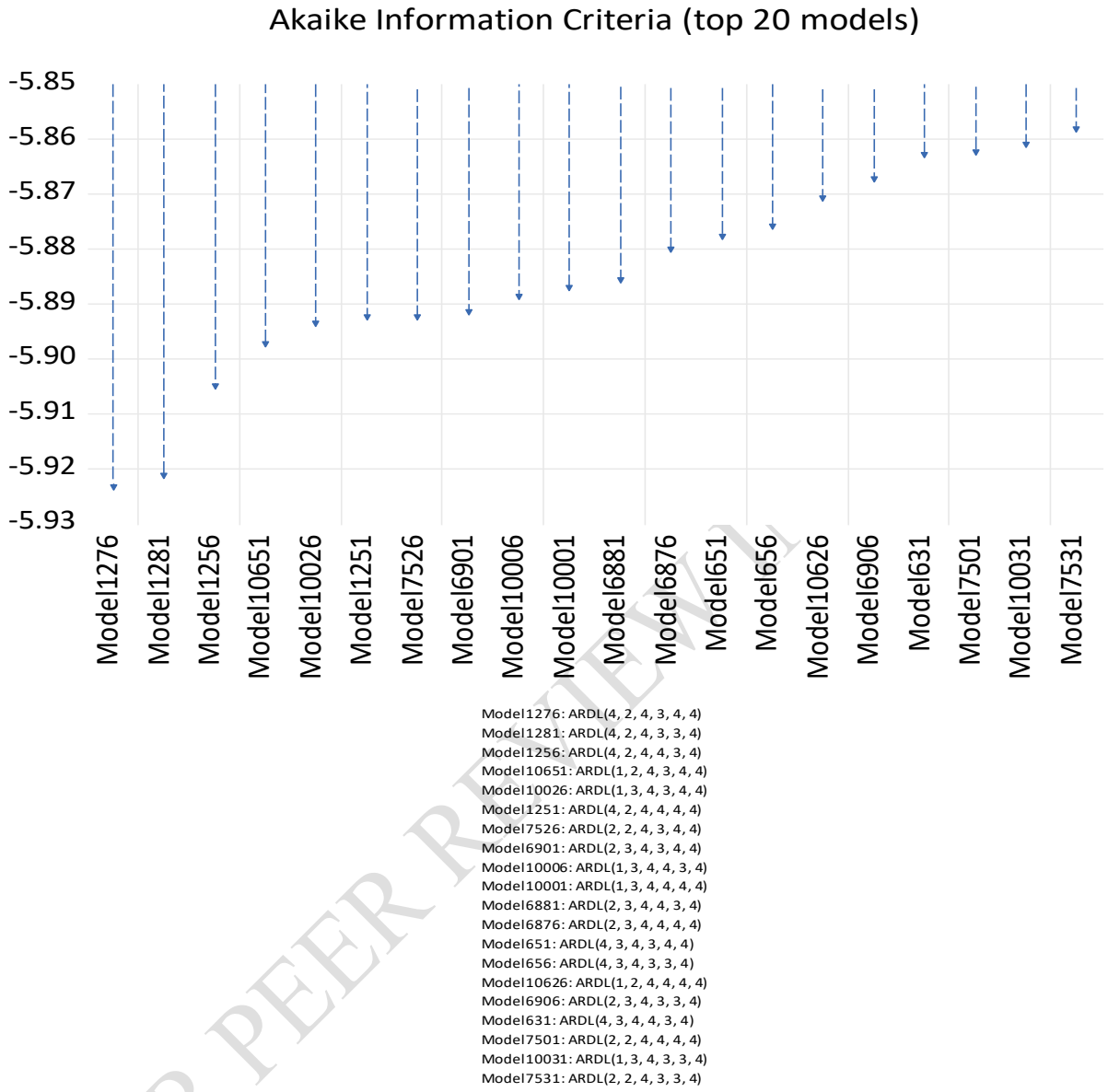
Source: Author Compilation from statistical investigation

It is evident from the results above that LIIP and LNETFII are stationary at level I (0) as the probabilities at levels are less than .05, therefore, we can reject null hypothesis of series having unit root. The other variables viz. LSENSEX, LCPI, LER, and LEXPORT are stationary at first difference because at I (1) the probabilities are less than (.05). The results are further verified with the values of computed t-statistics also, and in both the cases i.e. the variables which are stationary at level I (0) and at first difference I (1), the absolute value of t-statistics was found to be higher than the prescribed value of t-statistics at 5% level of significance. Therefore, it is concluded that some of the variables at stationary at level and some are at first difference, and no variable is stationary at 2nd difference (As is required in case of ARDL Model).

5.2 Estimation of Auto Regressive Distributed Lag (ARDL) Equation and Bounds Cointegration test

This study has used ARDL Equation for finding the relation between the dependent variable and independent variable. Before estimating this equation, the EViews software has selected the lags for different variables automatically by AIC method. In all it has evaluated 12500 models and the criteria for selection of optimum lag length was the model having minimum AIC value.

Figure 2
AIC - Top 20 Models (Selected Model 4,2,4,3,4,4)



Source: Author Compilation from statistical investigation

Based on optimum lag selection following ARDL equation is estimated for finding the degree of relationship between LSENSEX and other independent variables. Thereafter Bounds cointegration test is done. While performing the Bounds cointegration test the underlying hypothesis is as follows:

Ho: Null Hypothesis: There exists no cointegration among the variables.
H1: Alternate Hypothesis: There exists cointegration among the variables.

The results of bounds cointegration test are given in the table given below:

Table 2
Results of Bounds Cointegration Test

F-Bounds Test		Null Hypothesis: No levels relationship		
Test Statistic	Value	Signif.	I(0)	I(1)
			Asymptotic: n=1000	
F-statistic	5.637342	10%	2.08	3
k	5	5%	2.39	3.38
		2.5%	2.7	3.73
		1%	3.06	4.15
Actual Sample Size	44		Finite Sample: n=45	
		10%	2.276	3.297
		5%	2.694	3.829
		1%	3.674	5.019
			Finite Sample: n=40	
		10%	2.306	3.353
		5%	2.734	3.92
		1%	3.657	5.256

Source: Author Compilation from statistical investigation

The result of Bounds test shows that the value of F-statistics is 5.637342, and the guiding principle is that in order to have a cointegration among the variables the calculated value of F-statistics must be more than the prescribed upper bounds value. At 5% level of significance the prescribed upper Bounds value is 3.38 and the calculated F-statistics is 5.637342 which is more than prescribed upper bounds value. Hence, it is established that there exists a cointegration among the LSENSEX and other independent variables.

As it is established and evident that the variables under study have associated with each other. The next part is to study the nature of this association both in the long and short run. For this purpose, long-run results have been derived from the Bounds cointegration results which are as follows:

Table 3
Results of Long-Run Cointegration among the variables

Levels Equation
Case 2: Restricted Constant and No Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNETFII	0.097421	0.029536	3.298348	0.0042
LIIP	-0.711086	0.216669	-3.281891	0.0044
LEXPORT	0.678068	0.071432	9.492541	0.0000
LER	-3.238416	0.673971	-4.804979	0.0002
LCPI	3.264712	0.327453	9.970023	0.0000
C	1.006586	0.915008	1.100084	0.2866

EC = LSENSEX - (0.0974*LNETFII -0.7111*LIIP + 0.6781*LEXPORT
-3.2384*LER + 3.2647*LCPI + 1.0066)

Source: Author Compilation from statistical investigation

The results of long run cointegration among the variables have shown the robust findings and all the independent variables have found to be statistically significant

determinants of the LSENSEX. The Probability values of all the independent variables are less than (.05) which signifies that the movement of all the independent variables can explain the change in the LSENSEX, and thereby help the investors, policymakers and other stakeholders for decision making. The results depict that LNETFII, LEXPORT, LCPI are the positive significant determinants of LSENSEX, whereas, LIIP and LER are the negative significant determinants. Further, while making detailed analysis of the independent variables one by one the study has made few observations such as when the LNETFII increases by 1% the LSENSEX increases by .097%, and when the LEXPORT & LCPI increase by 1% each then the LSENSEX increases by .67% and 3.26% respectively. On the other hand, when LIIP and LER decrease by 1%, then the LSENSEX increases by .71% and 3.23%. The study found that the relationship between all the independent variables and dependent variable are as per the general macroeconomic beliefs except in case of LIIP.

After analysing the long-run relationship the next section deals with the short run cointegration between the variables. For this purpose, the study has developed the Error Correction form. Following are the results of short run error correction model (optimum lag selection as per AIC).

Table 4

Results of Error Correction Model for Short-run Analysis

ECM Regression
Case 2: Restricted Constant and No Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LSENSEX(-1))	0.084113	0.113417	0.741628	0.4684
D(LSENSEX(-2))	-0.032208	0.116508	-0.276446	0.7855
D(LSENSEX(-3))	-0.194748	0.094016	-2.071434	0.0538
D(LNETFII)	0.033072	0.003082	10.73042	0.0000
D(LNETFII(-1))	-0.035403	0.006801	-5.205595	0.0001
D(LIIP)	0.046934	0.107039	0.438470	0.6666
D(LIIP(-1))	0.323146	0.091745	3.522239	0.0026
D(LIIP(-2))	0.439275	0.109386	4.015813	0.0009
D(LIIP(-3))	-0.113999	0.039891	-2.857718	0.0109
D(LEXPORT)	-0.156751	0.084510	-1.854827	0.0810
D(LEXPORT(-1))	-0.531842	0.109480	-4.857907	0.0001
D(LEXPORT(-2))	-0.423202	0.095261	-4.442561	0.0004
D(LER)	-1.011684	0.300902	-3.362165	0.0037
D(LER(-1))	2.305888	0.411653	5.601539	0.0000
D(LER(-2))	1.199038	0.406269	2.951338	0.0089
D(LER(-3))	0.309185	0.276683	1.117468	0.2793
D(LCPI)	-0.026871	0.811224	-0.033124	0.9740
D(LCPI(-1))	-4.018815	1.413086	-2.844000	0.0112
D(LCPI(-2))	-2.815606	1.003241	-2.806511	0.0121
D(LCPI(-3))	-4.236697	1.239506	-3.418052	0.0033
CointEq(-1)*	-0.959021	0.131251	-7.306774	0.0000

R-squared	0.934322	Mean dependent var	0.004373
Adjusted R-squared	0.877210	S.D. dependent var	0.026750
S.E. of regression	0.009374	Akaike info criterion	-6.196003
Sum squared resid	0.002021	Schwarz criterion	-5.344458
Log likelihood	157.3121	Hannan-Quinn criter.	-5.880210
Durbin-Watson stat	2.181583		

* p-value incompatible with t-Bounds distribution.

Source: Author Compilation from statistical investigation

Above are the results of short run cointegration among the dependent and independent variables. At first the study observes that this model is best fit since the prime indicators of best fit are R-squared and Adjusted R-squared the value of which are .934322 and .877210 respectively. As a matter of general guiding principal whenever a model is fitted and it has R-Squared value of more than 60%, then the model is deemed as good fit. Hence, the short run model developed under the study is good fit. Further, one very important condition for the validation of this short run model is the value of CointEq. This equation must satisfy three important prerequisites viz.

- The coefficient of this equation must be negative (**It is evident from the above results that this coefficient is negative)**
- The value of this coefficient must range from 0-1 (It **is -.959021 i.e. within prescribed criteria of 0-1 range)**
- This coefficient should be statistically significant i.e. the p- value must be less than .05 **(it is .0000 as per the above results).**

Hence all the prerequisites of CointEq are satisfied which signifies that this model is appropriately fitted and justifies the movement of dependent and independent variables. The value of this equation is -.959021 which signifies that the short run results get convergence/ will be monotonically adjusted in the long run or move towards equilibrium at the speed of 95%.

Analysing short run relationship, except the auto regressive lags of LSENSEX, all other independent variables are influencing LSENSEX. Like LNETFII of current period is positively significantly affecting LSENSEX i.e. the direct relationship. However, with lag 1 i.e. LNETFII of last year has negative significant impact on LSENSEX. But, in the long-run this relation turned positive significant. Further, LIIP is a positive significant determinant of LSENSEX with Lag I and lag 2. However, with lag 3 this relationship turned to be negative significant. LEXPORT is showing negative significant relationship with LSENSEX with lag 1 and lag 2 (which is contrary to the general belief). While in the long run this relationship is positive significant, which implies that when export of country increases the LSENSEX also goes up. LER is showing positive significant relationship with LSENSEX with current period value of LER, with lag 1 and lag 2. However, in the long run this relationship is found to be negative significant. Lastly LCPI is exhibiting negative significant relationship with LSENSEX with Lag 1, lag 2 and lag 3 i.e. when inflation goes down the LSENSEX goes up. Whereas, in the long run this relationship is positive significant.

In the previous sections the study has conducted ADF test to check Stationarity of variables, thereafter developed ARDL equation and bounds cointegration test which validated the existence of association of dependent variables with independent. After this long run and short run relations were explored which also gave robust results.

5.3 Diagnostic Testing

However, to be best fit as a model certain conditions are specified for ARDL model to be fulfilled. The following section will deal with these conditions.

Table 5
Diagnostic Tests for ARDL Model

5.3.1	**SERIAL CORRELATION**	**BREUSCH-GODFREY SERIAL CORRELATION LM TEST**			
	Ho	Null Hypothesis	There is no Serial Correlation		
	H1	Alternate Hypothesis	There is a Serial Correlation		
	F-Statistics	0.364272	Prob F (2.15)	0.7007*	
	Obs* R-Squared	2.038075	Prob Chi-Squared	0.3609	
	The probability of F-Statistics is (.7007) which is more than (.05), therefore, Null hypothesis is accepted. ***THERE IS NO PROBLEM OF SERIAL CORRELATION IN THE SERIES***				
5.3.2	**RESET TEST**	**RAMSEY STABILITY TEST**			
	Ho	Null Hypothesis	The Functional form of the Model is fit		
	H1	Alternate Hypothesis	The Functional form is not fit		
	t-Statistic	0.521796	Probability (df 16)	.6090**	
	F-Statistic	0.272271	Probability (df 1.16)	.6090	
	Likelihood ratio	0.742447	Probability (df 1)	.3889	
	F-test summary				
	Test SSR	3.38E-05	Test SSR (Mean Square df 1)	3.38E-05	
	Restricted SSR ((Sum of Sq.))	0.002021	Restricted SSR (Mean Square df 17)	0.000119	
	Unrestricted SSR ((Sum of Sq.))	0.001987	Unrestricted SSR (Mean Square df 16)	0.000124	
	p value of t-statistic is .6090 which is more than .05, therefore, the study cannot reject Null hypothesis. ***THE FUNCTIONAL FORM OF THE MODEL IS FIT IS ACCEPTED.***				

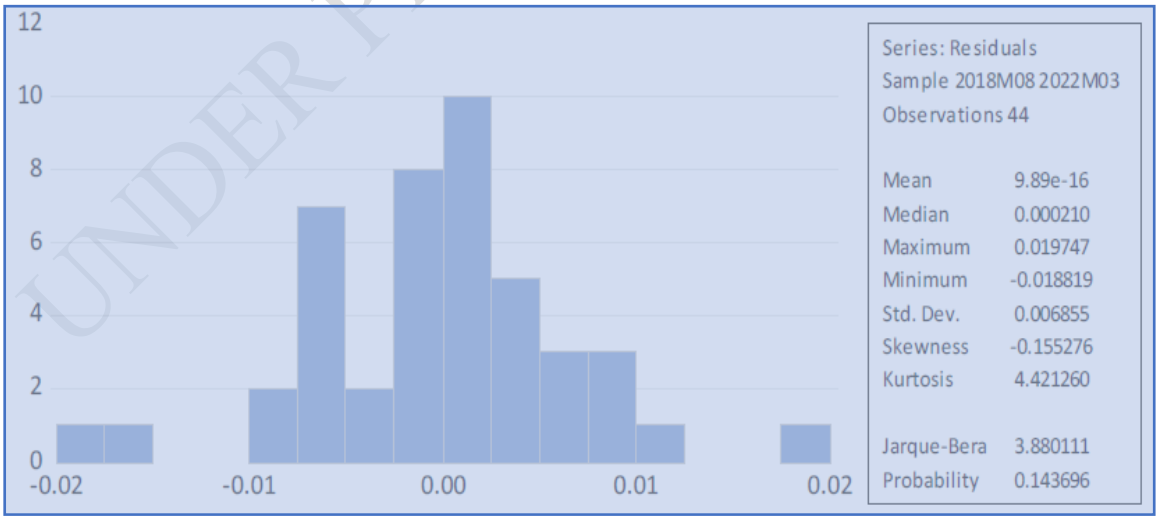
5.3.3	**HETEROSKEDASTICITY TEST**	**BREUSCH-PAGAN-GODFREY TEST**		
	Ho	Null Hypothesis	Residuals are Normally distributed	
	H1	Alternate Hypothesis	Residuals are not normally distributed	
	F-Statistic	1.137346	Prob F(26, 17)	0.3990***
	Obs* R-Squared	27.93850	Prob. Chi-Square (26)	0.3615
	Scaled explained SS	7.134307	Prob. Chi-Square (26)	0.9999
	Since the p value of F-statistic is .3990 which is more than .05, therefore, the study cannot reject Null hypothesis. In other words, the Null Hypothesis is accepted. ******NO PROBLEM OF HETEROSCEDASTICITY.***			

Source: Author Compilation from statistical investigation

5.3.4 Normality test: Jarque-Bera test is conducted to know whether the residuals follow a normal distribution

Ho: Null Hypothesis: Residuals are normally distributed
H1: Alternate Hypothesis: Residuals are not normally distributed

Figure 3
Normality test by Jarque-Bera



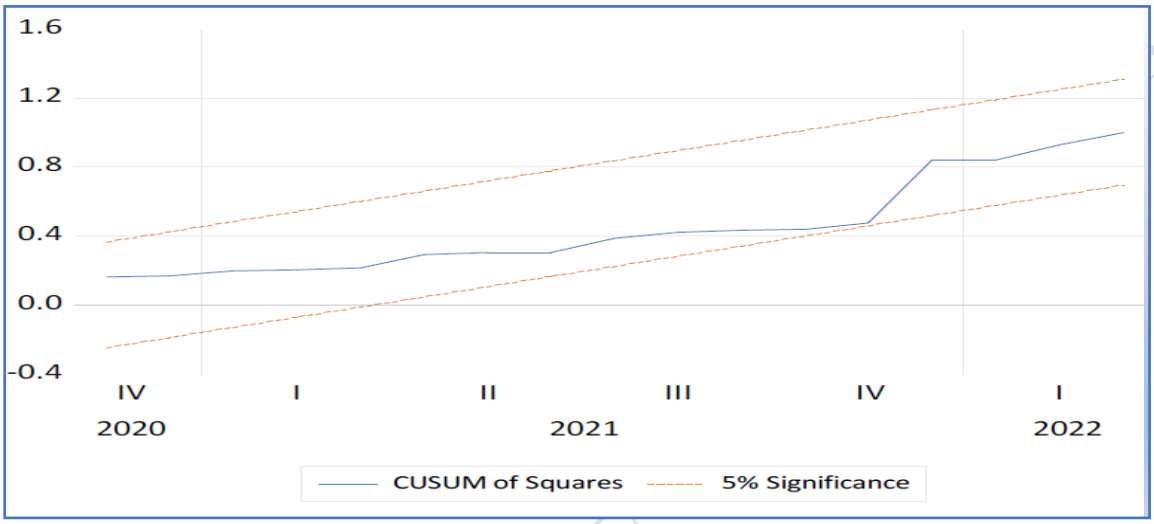
Source: Author Compilation from statistical investigation

Since the p value of Jarque-Bera test is .143696 which is more than .05, therefore, the study cannot reject Null hypothesis. In other words, the Null Hypothesis is accepted i.e. **the residuals are normally distributed.**

5.3.5 Stability of Coefficients: **CUSUM of Square test** is done to check the stability of coefficients in a multiple linear model.

Figure 4

CUSUM of Square Test



Source: Author Compilation from statistical investigation

Here red lines signify the 5% level of significance and blue line shows the CUSUM of squares. Here the guideline is that blue line must remain within red lines. As it is evident from the above figure that the blue line is well within red lines, therefore, the study can safely validate **that the coefficients are stable.**

6 CONCLUSION

It is quite necessary from the perspective of different stakeholders of the economy to know the factors responsible in the movement of stock market in the country. Since Crore of rupee are invested by the investors in the stock market daily and any uninformed decision to investment in stock market may prove futile, and hence may result in financial turmoil in the economy. Therefore, it is the need of the hour to analyse movement of different macroeconomic variables and their impact on stock market i.e. BSE SENSEX (Proxy of stock market). This type of analysis may act as a measure to check stock market's shocks/corrections and volatility. Present study which has used ARDL model to capture the cointegration among BSE SENSEX and other independent variables has found robust results. The study found that there exists a cointegration among BSE LSENSEX and other independent variables viz. LFII, LEXPORT, LCPI, LIIP, and LER. The table given below depicts the long-run and short-run cointegration (with lags selected automatically by AIC) among the dependent and independent variables.

Table 6

Short and Long-run Association among Dependent and Independent Variables

Independent Variables	Short-Run cointegration with LSENSEX				Long-Run cointegration with LSENSEX
	Cointegration in current period	**Cointegration with (Lag 1)**	**Cointegration with (Lag 2)**	**Cointegration with (Lag 3)**	-
LNETFII	Positive Significant	Negative Significant	-	-	**Positive Significant**
LIIP	Insignificant	Positive Significant	Positive Significant	Negative Significant	**Negative Significant**
LEXPORT	Insignificant	Negative Significant	Negative Significant	-	**Positive Significant**
LER	Positive Significant	Positive Significant	Positive Significant	Insignificant	**Negative Significant**
LCPI	Insignificant	Negative Significant	Negative Significant	Negative Significant	**Positive Significant**

Source: Author Compilation from statistical investigation

Explanation of short-run and long-run cointegration of LSENSEX with independent variables;

- **LSENSEX with LNETFII:** Short run cointegration was positive significant for current Period i.e. LNETFII and LSENSEX moved in the same direction, however, with lag 1 this association turned negative significant. Finally, in the long run both (LSENSEX and LNETFII) were positively associated i.e. they had direct relation with each other.
- **LSENSEX and LIIP:** The results were positive significant in the short-run with lag I and lag 2 i.e. when LIIP increases the LSENSEX also increases, however, in the long-run it turned to be negative significant (which is contrary to the general belief).
- **LSENSEX and LEXPORT:** In the short run the relationship between LSENSEX and LEXPORT was found negative significant. However, in the long run they move in the same direction i.e. whenever the Export increases the SENSEX also increases.
- **LSENSEX and LER**: In the short-run the relationship between LSENSEX and LER was positive significant, however, in the long-run it turned negative which means an appreciation in INR makes assets of India more attractive as foreign investors can expect better returns in terms of USD. Therefore, the foreign investors decide to invest in India and hence the SENSEX goes up.
- **LSENSEX and LCPI:** This relationship was negative in the short-run, however, in the long-run it turned to be positive significant, which means whenever inflation goes up SENSEX also goes up. Here it is important to mention that the increase in inflation must be moderate because moderate inflation may signify growing demand, higher GDP, higher spending power. Thus, increased BSE SENSEX.

In nutshell in the long run except Index of Industrial Production (IIP) all the results are as per the general economic belief.

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