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Contributions to books

- Sharma T., Kwatra, G. (2008) Effectiveness of Social Advertising: A Study of Selected Campaigns, Corporate Social Responsibility, Edited by David Crowther & Nicholas Capaldi, Ashgate Research Companion to Corporate Social Responsibility, Chapter 15, pp 287-303.

Journal and other articles

- Schemenner, R.W., Huber, J.C. and Cook, R.L. (1987), "Geographic Differences and the Location of New Manufacturing Facilities," Journal of Urban Economics, Vol. 21, No. 1, pp. 83-104.

Conference papers

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- Kumar S. (2006): "Customer Value: A Comparative Study of Rural and Urban Customers," Thesis, Kurukshetra University, Kurukshetra.

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- Kelkar V. (2009): Towards a New Natural Gas Policy, Economic and Political Weekly, Viewed on February 17, 2011 http://epw.in/epw/user/viewabstract.jsp

FORECASTING MONTHLY FOREIGN INSTITUTIONAL INVESTMENTS IN BSE AND NSE EQUITY MARKET USING ARIMA MODEL

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ABSTRACT

One of the important features of the development of Stock Market in India in the last 18 years has been the growing participation of Institutional Investors, especially foreign institutional investors. This paper attempts to forecast the monthly cumulative Foreign Institutional Investments in BSE and NSE equity market using Auto Regressive Integrated Moving Average (ARIMA) model. The actual results of the cumulative FIIs in BSE and NSE equity market show the positive trend but it shows the decreasing pattern. This positive and fluctuating trend in cumulative FIIs in BSE and NSE equity market will occur in future if the same market conditions exist.

KEYWORDS

Foreign Institutional Investment, Auto Regressive Integrated Moving Average (ARIMA) model, Bombay Stock Exchange, National Stock Exchange.

INTRODUCTION

In this age of transnational capitalism, significant amounts of capital are flowing from developed world to emerging economies. Positive fundamentals combined with fast growing markets have made India an attractive destination for Foreign Institutional Investors (FIIs). Portfolio investments channeled via foreign institutional investors have been the most dynamic source of capital to emerging markets in 1990s. FIIs have gained a significant role in India's capital markets. Foreign Investment refers to investments made by residents of a country in financial assets and production process of another country. After the opening up of the borders for capital movement, these investments have grown in leaps and bounds. But it had varied effects across the countries. It can affect the productivity factor of the recipient country and can also affect the balance of payments.

India, being a capital scarce country, has taken many measures to attract foreign investment since the beginning of reforms in 1991. India opened its doors to foreign investors in September 1992 and received portfolio investment from foreigners in the form of foreign institutional investment in equities in 1993. This has become one of the main channels of Foreign Institutional Investments in India for foreigners. Foreign Institutional Investors are an entity established or incorporated outside India, which proposes to make investment in India. Initially Pension Funds, Mutual Funds, Insurance Companies, Investment Trusts, Banks, University Funds, Endowments, Foundations and Charitable Trusts or Charitable Societies were eligible to get registered as Foreign Institutional Investors (FIIs). Later, Asset management companies, Institutional portfolio managers, Trustees and Power of Attorney holders were also declared as eligible to get registered as FIIs.

Today, Bombay Stock Exchange (BSE) has the greatest number of listed companies in the world with 4700 listed as of August 2007[1], around 6000 Indian companies were listed on the stock exchange[2]. The Bombay Stock Exchange Sensitive Index (SENSEX) consists of the thirty largest and most actively traded stocks of thirteen various sectors on the BSE and it is regarded to be the pulse of the Indian stock market. The equity market capitalisation of the companies listed on Bombay Stock Exchange of India was at USD 1.79 trillion as on December 2007, making it the largest stock exchange in South Asia and the 12th largest in the world[3]. The National Stock Exchange of India (NSE) is the largest stock exchange in India in terms of daily turnover and number of trades for equities. The Standard & Poor' CRISIL NSE Index 50 (S&P CNX Nifty or simply Nifty) is an index of fifty major stocks of twenty one sectors on National Stock Exchange of India.

RESEARCH DESIGN

Foreign capital provides liquidity to the stock market of the country. At the same time there is unease over the volatility in FII flows and its impact on the stock market and the Indian economy. Firms are interested in attracting foreign capital because it helps them to create liquidity for their stock in the market. In the past few years, the Indian capital markets have been in the news for too many reasons. On one hand, the markets were scaling newer heights every day and at the same time, speculations on FII movements are getting stronger. As the Indian equity market is growing, the trend and future prospects in FIIs has become a topic of great concern. Hence, this section attempts to forecast the FIIs in BSE and NSE equity market with the help of ARIMA (Auto Regressive Integrated Moving Average) model.

OBJECTIVE OF THE STUDY

The main objective of the study is to forecast the monthly Foreign Institutional Investments in BSE and NSE equity market.

DATA AND SOURCES OF DATA

The data collected for the present study is secondary one. The monthly FIIs data of BSE and NSE equity market are collected from the eminent website www.bseindia.com.

1 BSE SENSEX - http://www.bseindia.com/about/st_key/list_cap_raised.asp
2 BSE SENSEX - http://www.bseindia.com/about/st_key/list_cap_raised.asp
3 BSE - http://www.articles2u.com/investments/sensex-bombay-stock-exchange-bse/

PERIOD OF THE STUDY

The present study is conducted for a period of eight years from 1st April 2000 to 31st March 2008. The monthly equity investments of Foreign Institutional Investors' time series data have been collected for the study period of eight years which consists of 96 observations for forecasting the FIIs in BSE and NSE equity.

FRAMEWORK OF ANALYSIS

Autoregressive Integrated Moving Average (ARIMA) model has been used to forecast the monthly Foreign Institutional Investments (FIIs) in BSE and NSE equity market.

(I) ARIMA (AUTO REGRESSIVE INTEGRATED MOVING AVERAGE) MODEL

The cumulative Foreign Institutional Investments time series data for this study were collected from www.bseindia.com website to forecast the monthly FIIs in BSE and NSE equity market. Box and Jenkins[4] (1976) linear time series model was applied. Auto Regressive Integrated Moving Average (ARIMA) is the most general class of models for forecasting a time series. Different series appearing in the forecasting equations are called "Auto-Regressive" process. Appearance of lags of the forecast errors in the model is called "moving average" process. The ARIMA model is denoted by ARIMA (p,d,q), where "p" stands for the order of the auto regressive process, 'd' is the order of the data stationary and 'q' is the order of the moving average process. The general form of the ARIMA (p, d, q) can be written as described by Judge, *et al*. (1988)[5].

$\Delta^d y_t = \delta + \theta_1 \Delta^d y_{t-1} + \theta_2 \Delta^d y_{t-2} + \text{----- } + \theta_p \Delta^p y_{t-p} + e_t + \alpha_1 e_{t-1} + \alpha_2 e_{t-2} + \alpha_p e_{t-p}$ --- (1)

Where, Δ^d denotes differencing of order d, i.e., $\Delta^d y_t = y_t - y_{t-1}$, $\Delta^2 y_t = \Delta y_t - \Delta y_{t-1}$ and so forth, $y_{t-1} \ldots y_{t-p}$ are past observations (lags), δ, θ_1 -------- θp are parameters (constant and coefficient) to be estimated similar to regression coefficients of the Auto Regressive process (AR) of order "p" denoted by AR (p) and is written as

$Y = \delta + \theta_1 y_{t-1} + \theta_2 y_{t-2} + \text{----------} + \theta p y_{t-p} + e_t$ ---------- (2)

Where, e_t is forecast error, assumed to be independently distributed across time with mean θ and variance $\theta_2 e$, e_{t-1}, e_{t-2} ------ e_{t-q} are past forecast errors, α_1, ------ α_q are moving average (MA) coefficient that needs to be estimated. While MA model of order q (i.e.) MA (q) can be written as

$Yt = e_t - \alpha_1 \alpha_{t-1} - \alpha_2 e_{t-2}$ ---------- $\alpha_q e_{t-q}$ ---------- (3)

The major problem in ARIMA modeling technique is to choose the most appropriate values for the p, d, and q. This problem can be partially resolved by looking at the Auto Correlation Function (ACF) and Partial Auto Correlation Functions (PACF) for the series. Auto correlation function indicates the order of the autoregressive components 'q' of the model, while the partial auto correlation function gives an indication for the parameter p. The degree of the homogeneity, (d) i.e. the number of time series to be differenced to yield a stationary series, is determined on the basis where the ACF approached zero.

After determining "d" a stationary series $\Delta d\ y_t$ its auto correlation function and partial auto correlation function were examined to determined values of p and q, next step was to "estimate" the model. The model was estimated using Box Jenkins approach. The following diagnostic checks are applied to the obtained results to get the good fitted model.

1. The first diagnostic check is to draw a time series plot of residuals. When the plot makes a rectangular scatter around a zero horizontal level with no trend, the applied model is declared as proper.
2. The second diagnostic check is the identification of normality. For this purpose, normal scores are plotted against residuals and it is declared in case of a straight line. A histogram of the residuals is also used as the second diagnostic check to test whether the data are skewed or outliers exist in the data.
3. The third diagnostic check is finding out the fitness of good fit. For this purpose, residuals were plotted against corresponding fitted values and the residuals should be scattered randomly about zero.
4. The fourth diagnostic check is finding out whether the fitted model shows any pattern i.e ascending or descending trend in the residuals; it must contain no pattern in the residuals. This check is to be done with the help of residuals versus order plots.

(II) ASSUMPTIONS

The monthly forecasts of cumulative FIIs in BSE and NSE equity market from 01-04-2008 to 31-03-2010 are prepared by using ARIMA (p, d, q). For this purpose, the following assumptions are made.

1. Absence of financial shocks in the economy, internal or external
2. SEBI's (Securities and Exchange Board of India) regulations will remain unchanged
3. Foreign Institutional Investor's preferences in BSE and NSE equity investment will remain the same.

ANALYSIS AND RESULT

FORECASTING MONTHLY FOREIGN INSTITUTIONAL INVESTMENTS IN BSE AND NSE EQUITY MARKET

1. Identifying the parameter'd'

Table 1 shows the auto correlation function (ACF) for the cumulative FIIs in BSE and NSE equity market. From this, it is inferred that the T-statistic shows that auto correlation for the first 8 lags is greater than 2 and LBQ statistic for all 24 lags are also greater than the critical value of 37.65 at 95 percent confidence level. It shows that autocorrelations for all the lags is significantly different from zero which indicates that the cumulative FIIs are not stationary.

Table 2 shows the autocorrelation function (ACF) for the differenced cumulative FIIs in BSE and NSE equity market. It is inferred that the T-statistic shows that autocorrelation for the all the lags is less than 2. The LBQ statistic for all the lags are also lower than the critical value of 37.65 at 95 percent confidence level. It shows that autocorrelations for all the lags is significantly equal to zero which indicates that the differenced cumulative FIIs are stationary. From this the parameter 'd' is decided to be equal to '1'.

[4] Box-Jenkins modeling involves identifying an appropriate ARIMA process, fitting it to the data, and then using the fitted model for forecasting. One of the attractive features of the Box-Jenkins approach to forecasting is that ARIMA processes are a very rich class of possible models and it is usually possible to find a process, which provides an adequate description to the data.

[5] Najeeb Iqbal, Khuda Bakhsh, Asif maqbool and Abid Shohab Ahmad, "Use of the ARIMA model for forecasting Wheat Area and Production in Pakistan", *Journal of Agricultural and Social Sciences*, Vol. 1, No. 2, 2005.

TABLE 1: AUTOCORRELATION FUNCTION OF CUMULATIVE FIIS

Lag	ACF	T	LBQ
1	0.971187	9.52	93.41
2	0.941028	5.43	182.04
3	0.909604	4.13	265.73
4	0.872523	3.40	343.59
5	0.836993	2.93	416.01
6	0.798034	2.57	482.59
7	0.764237	2.31	544.32
8	0.733805	2.10	601.89
9	0.699416	1.92	654.79
10	0.671446	1.78	704.11
11	0.643107	1.65	749.89
12	0.614717	1.53	792.21
13	0.587212	1.43	831.29
14	0.558339	1.33	867.06
15	0.530854	1.24	899.79
16	0.502635	1.16	929.50
17	0.472604	1.07	956.10
18	0.444455	1.00	979.93
19	0.417876	0.93	1001.26
20	0.391433	0.86	1020.23
21	0.364821	0.80	1036.93
22	0.337693	0.73	1051.42
23	0.309693	0.67	1063.79
24	0.278856	0.60	1073.95

TABLE 2: AUTOCORRELATION FUNCTION OF CUMULATIVE FIIS (DIFFERENCE 1)

Lag	ACF	T	LBQ
1	-0.035794	-0.35	0.13
2	0.131397	1.28	1.84
3	0.179238	1.72	5.05
4	-0.214162	-1.99	9.70
5	0.168428	1.50	12.60
6	-0.142495	-1.24	14.71
7	0.049109	0.42	14.96
8	0.166777	1.43	17.90
9	-0.049175	-0.41	18.16
10	0.041065	0.34	18.35
11	0.124484	1.04	20.05
12	0.079238	0.66	20.74
13	0.080781	0.66	21.48
14	-0.036377	-0.30	21.63
15	0.026994	0.22	21.71
16	-0.003530	-0.03	21.71
17	-0.054057	-0.44	22.06
18	-0.022872	-0.19	22.12
19	0.126843	1.04	24.07
20	0.157860	1.27	27.13
21	0.019512	0.15	27.18
22	0.114308	0.91	28.83
23	0.007230	0.06	28.84
24	0.022129	0.17	28.90

2. Identifying the parameters 'p' and 'q'

After identifying the order of 'd' the next step is to find out the parameters 'p' and 'q'. These two parameters are determined based on the following criteria:

1. T statistic must be greater than 2 in its absolute value
2. P value must be less than the α level (5 percent)
3. MSE (mean square error) must be smaller which indicates a better fitting model
4. P value of Ljung Box (chi-square statistics) must be greater than the α level which explains that the residuals are uncorrelated

The above criteria were applied and the different models' results are given below:

TABLE 3: ARIMA RESULTS OF DIFFERENT MODELS

S.No	MODEL (with differencing 1)	P-value	MS	P-value in Ljung Box stat
1.	ARIMA (1,1,1)	AR 1 = 0.000 MA 1 = 0.000	24491505	0.018 at lag 12
2.	ARIMA (2,1,1)	AR 1 = 0.000 AR 2 = 0.407 MA 1 = 0.000	24507687	0.037 at lag 12
3.	ARIMA (1,1,2)	AR 1 = 0.000 MA 1 = 0.000 MA 2 = 0.786	28507263	0.004 at lag 12
4.	ARIMA (2,1,2)	AR 1 = 0.001 AR 2 = 0.300 MA 1 = 0.000 MA 2 = 0.571	24746107	0.025 at lag 12
5.	ARIMA (3,1,1)	AR 1 = 0.000 AR 2 = 0.004 AR 3 = 0.000 MA 1 = 0.000	22244572	All the lags are greater than 0.05

The models 1 to 5 above are not suitable for the cumulative FIIs in BSE and NSE equity market. Finally, ARIMA (3, 1, 3) model (given below) has been selected. It gives the significant p-values and lowest mean square error and the Ljung Box statistics gives the non-significant p-values, which indicate that the residuals are uncorrelated. Hence, the orders of 'p' and 'q' are decided to be equal to 3 for the respective parameters.

3. Diagnostic checking or Residual analysis

CHART 1 and CHART 2 show the ACF and PACF residual plots for the cumulative FIIs. The ACF and PACF of residuals for the cumulative FIIs show non-significant spikes (the spikes are within the confidence limits) indicating that the residuals seem to be uncorrelated. It is inferred that the ARIMA model with differencing '1' appears to fit for the cumulative FIIs time series.

CHART 3 exhibits the residual plots for cumulative FIIs. For first normality test, plot of normal scores and residuals for the cumulative FIIs data indicate an approximate straight line showing normality, which is a necessary condition for normality. The second normality test is to plot the histogram of residuals. The residual plots against frequency show the bell shaped histogram of the residuals for the cumulative FIIs, which also reveals the normality of the residuals and goodness of fit of the model. The residuals versus fitted value graph shows that the residuals appear to be randomly scattered about zero, except for the outlier in the bottom half of the plot. The residual versus order graph also shows that the residuals randomly scattered around zero. It indicates that the errors are independent of each other and it indicates the normality and goodness of fit of the model. Therefore, it is observed that ARIMA (3, 1, 3) model is fitted properly by residual analysis.

CHART 1: ACF OF RESIDUALS FOR CUMULATIVE FIIs

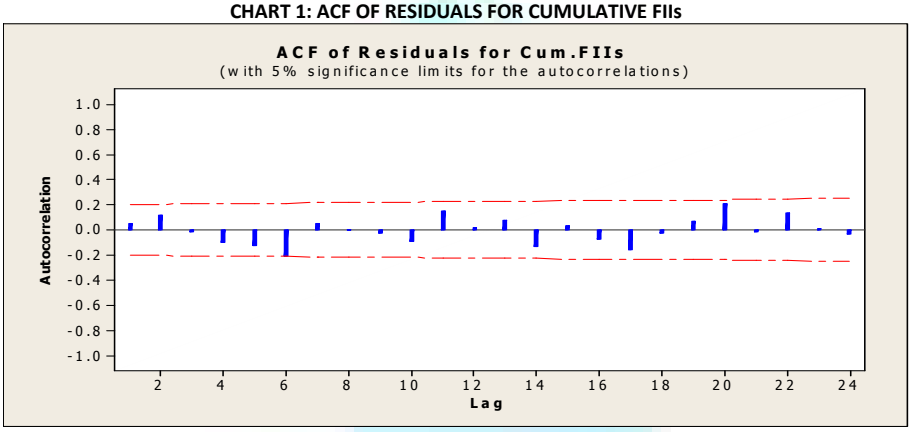


CHART 2: PACF OF RESIDUALS FOR CUMULATIVE FIIs

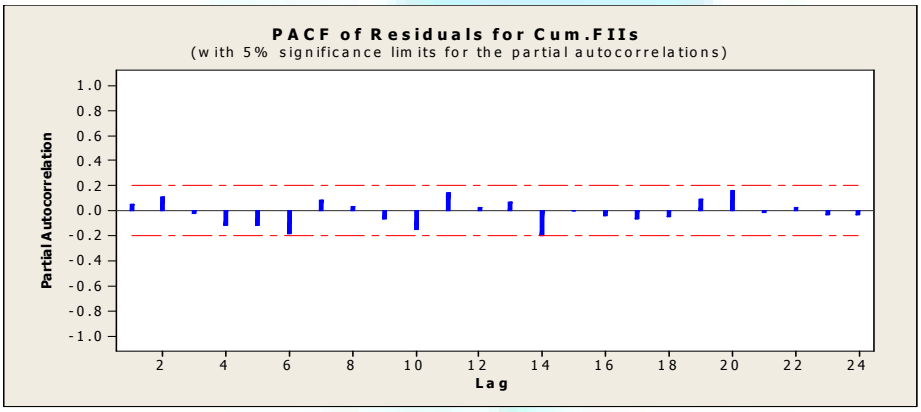
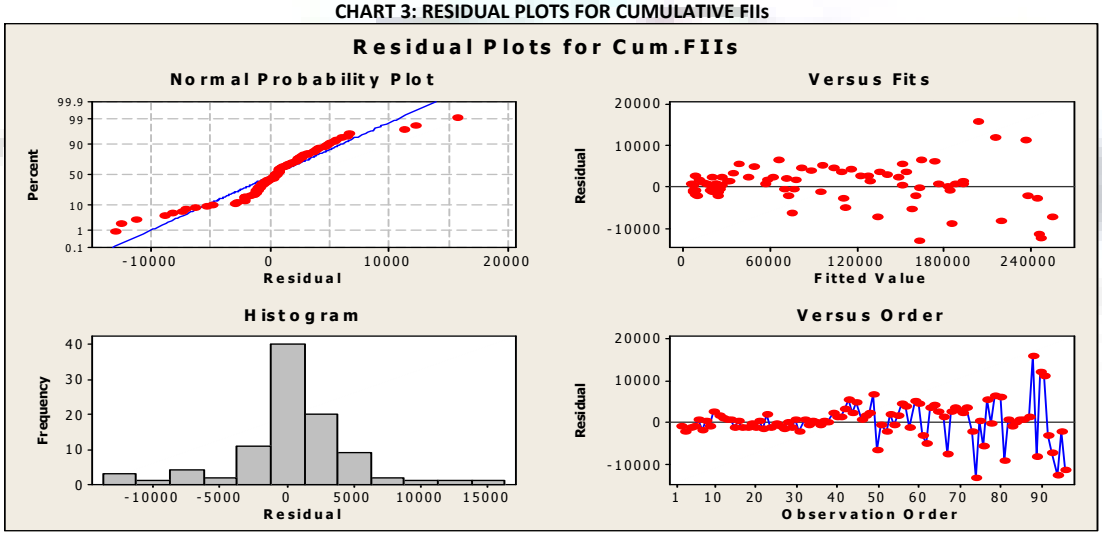


CHART 3: RESIDUAL PLOTS FOR CUMULATIVE FIIs



FORECASTING RESULTS

Final Estimates of Parameters					
Type		Coef	SE Coef	T	P
AR	1	-0.6614	0.0598	-11.05	0.000
AR	2	0.6526	0.0575	11.34	0.000
AR	3	1.0145	0.0547	18.55	0.000
MA	1	-0.7927	0.0974	-8.14	0.000
MA	2	0.6837	0.1300	5.26	0.000
MA	3	0.9074	0.0981	9.25	0.000

Differencing: 1 regular difference
Number of observations: Original series 96, after differencing 95
Residuals: SS = 1811120569 (back forecasts excluded)
MS = 20349669 DF = 89

Modified Box-Pierce (Ljung-Box) Chi-Square statistic

Lag	12	24	36	48
Chi-square	12.4	27.2	31.9	39.6
DF	6	18	30	42
P-Value	0.054	0.076	0.373	0.578

From the above results, it is indicated that the T- statistic is greater than 2 in absolute value and the associated p-values are also significant at 5 percent α level for the ARIMA (3, 1, 3). The p-value of 0.000 indicates that there is a 0 percent chance in the obtained estimates of the parameters, if the true parameters were zero. Since the p-value is small (less than the -level of 0.05) the test is significant; hence, the null hypothesis that the parameters are zero can be rejected at 5 percent level of significance. The Ljung-Box statistics shows the insignificant p values of 0.054, 0.076, 0.373 and 0.578, which indicate that the residuals appear to be uncorrelated. Therefore, ARIMA (3,1,3) model gives a best model when compared to other model.

TABLE 4: FORECASTS FROM THE MONTH APRIL 2008 TO MARCH 2010

Month	Forecast	95% Limits		Actual
		Lower	Upper	
Apr-2008	227521	218677	236364	**235474**
May-2008	242250	228897	255603	**230462**
Jun-2008	236284	220202	252366	**220366**
Jul-2008	242865	223177	262553	218529
Aug-2008	249561	227355	271767	217317
Sep-2008	243375	218370	268379	209039
Oct-2008	258514	230601	286427	193692
Nov-2008	251257	221068	281446	191094
Dec-2008	259661	226410	292911	192844
Jan-2009	264725	229147	300303	188599
Feb-2009	259498	221201	297795	186162
Mar-2009	274787	233726	315847	196692
Apr-2009	266401	222994	309809	193200
May-2009	276622	230179	323065	213317
Jun-2009	279900	231073	328728	217147
Jul-2009	275895	224233	327557	**228211**
Aug-2009	291053	236599	345507	233114
Sep-2009	281740	224781	338699	**235342**
Oct-2009	293729	233657	353802	**242238**
Nov-2009	295100	232523	357676	**247735**
Dec-2009	292569	226995	358144	**257968**
Jan-2010	307301	238853	375748	**257468**
Feb-2010	297296	226160	368433	258685
Mar-2010	310961	236599	385322	**278613**

The above table shows the forecasts of cumulative FIIs in BSE and NSE equity market from the period 01-04-2008 to 31-03-2010. The forecasts of the cumulative FIIs in BSE and NSE equity market shows positive and fluctuating trend. The forecasts of cumulative FIIs for the months of April 2008, May'08, June'08 and July'09 are about Rs.2,35,474 crores, Rs.2,30,462 crores, Rs.2,20,366 crores and Rs.2,28,211 crores respectively. The forecasts of cumulative FIIs for the months of Sep'09, Oct'09, Nov'09, Dec'09, Jan 2010 and Mar 2010 are about Rs.2,35,342 crores, Rs.2,42,238 crores, Rs.2,47,735 crores, Rs.2,57,968 crores, Rs.2,57,468 crores and Rs.2,78,613 respectively.

The forecasts for the above months are within the lower and the upper limits at 95% confidence intervals. It means that the forecast results are nearer to the actual results. The reason is that there is no change in the existing market conditions in the above period so that the actual and forecast results have no huge differences. The above table also shows that there are huge differences in the forecast results and the actual results for the remaining period. Because the following reasons have changed the market conditions and affected the FIIs inflows in BSE and NSE equity market.

1. The global financial crisis has reduced the FIIs capital inflows into the equity and debt market of the BSE and NSE.
2. The continued depreciation of Indian rupee against the US dollar has also acted as deterrent (restriction) for the FIIs because it lowers their returns in dollar terms.
3. The direct impact of Lehman Brothers going bankrupt and Bank of America taking over Merrill Lynch has affected the FIIs inflows in BSE and NSE equity market.
4. The curbs on the P-notes issue have also affected the FIIs capital inflows in BSE and NSE equity market.

CONCLUSION

From the above study, it is observed that the actual results of cumulative FIIs in BSE and NSE equity market showed the positive and fluctuating trend. The Auto Regressive Integrated Moving Average (ARIMA) Model showed no huge differences in the forecast results and the actual results for the months of April 2008, May'08, June'08 and July'09. The reason is that there is no change in the existing market conditions for the above mentioned period. The ARIMA model also showed huge differences in the forecast results and the actual results for the remaining period. The global financial crisis, depreciation of Indian rupee against US dollar, direct impact of Lehman Brothers going bankrupt and curbs on Participatory notes issue are the main reasons for restricting the FII inflows into the BSE and NSE equity market for the remaining period. From this, it can be concluded that the ARIMA model helps to identify that the positive and fluctuating trend in cumulative FIIs of Bombay Stock Exchange and National Stock Exchange will occur if the same market conditions exist.

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