Identifying Interdependence between Returns on Currency Rate (INR/$) and NIFTY50 for Predicting Currency Rate (INR/$) Returns

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Abstract

In present study, researcher tries to identify whether there is simultaneous impact of FII on currency rate and equity market do exist or not. Analysis was performed by using 1125 observation of daily returns for NIFTY50, FII and Currency rate taken from Capital Line and confirmed through NSE for developing model. In present study, proposed model found to be significant predictable for both currency rate and NIFTY50. Result can be used to control currency fluctuation, which is major issue of concern for Indian economy. Result will be helpful in deciding buy/sell strategies to traders of equity market and currency market for earn abnormal returns.

Keywords*: Currency Rate, FII Cash Flow, NIFTY50, Prediction model*

1. Introduction

With recent currency fluctuation in India, Indian stock market has shown much volatility. Government of India and Reserve Bank of India (RBI) usually take corrective steps in terms of budget and policy regarding different financial measure as tool of reducing currency fluctuation. Meanwhile, continuous Foreign Institutional Investment (FII) outflow is an evidence of Indian stock market degradation in recent time. Thus, this whole process created circular effect. Indian rupee depreciated as money goes out and due to depreciation of money economy worsens which result in decline in stock market. Due to decline in market results, attractiveness of capital market to foreign investor has been reducing. Hence, it resulted in more outflow of money due to bad performance of stock market. To stop this vicious circle, and to make market as well as currency rate stabilize, there must be some corrective steps used in budget or policy regarding deciding key rates.

However, when stock market return is concerned, currency fluctuation or FII cash flow need to be discussed and for prediction different time series models are very effective. For predicting such time series data, many researchers have used different econometrics model like AR (autoregressive) model, MA (moving average) model and (ARIMA) (autoregressive integrated moving average) model (Gupta, 2003; Mishra, 2005; Hadi, 2006; Iqbal and Mallikarjunappa, 2007). These all models assumed to be homoscedacity n

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time series data. But in reality such data do not show homoscedacity and hence lead to development of ARCH (autoregressive conditional hetroscedacity) group of model for prediction of such time series data. Most recently, Junare et al. (2013) used combination of ARIMA-GARCH for better prediction of NIFTY50 returns and found that combination works better for prediction of NIFTY50 returns. In same study one period lag shown major impact on the next day returns and hence in current study one lag period selected to predict the NIFTY50. Similarly, for INR/$ currency rate it may equally applicable and so one period lag taken for use of prediction of currency rate in simultaneous prediction of NIFTY50 and currency rate.

It is also assumed by many investors that return on equity market and currency rates had lagged relationship. In fact, many past studies tried to find out causal relationship for currency rates and equity market performance (Chien and Cheng, 2001; Li and Huang, 2009). But in recent time, direction and relational behavior between Indian rupee and NIFTY50 (Indian stock market performance parameter) has captured the attention of many investor. Past literature has indicated contradictory results and directionality of relationship. There may be three possibilities of relation i.e. I) currency depreciation leads to negative returns on market and vice-versa (Li and Huang, 2009) II) negative returns on market leads to currency depreciation and vice-versa (Horobet et al, 2007) and III) both as well.

In present study, researcher tries to explore third possibility using simultaneous equation model to predict currency rate with consideration of interdependent between NIFTY50 and currency rate. For appropriate prediction of model, daily closing data from 1st January, 2009 to 31st August, 2013 were taken for analysis which will help in formation of buy-sell strategy for NIFTY50 and currency rate for creating abnormal returns.

2. Review of Literature

In past literature, many researchers has worked on prediction of equity market using time series analysis to earn higher and abnormal returns on investment using one lag dependence (Gupta, 2003; Mishra, 2005; Hadi, 2006; Iqbal and Mallikarjunappa, 2007). Similarly, Levich and Rizzo (1998) have showed lag dependence of currency rate. However, there were few studies that talk about prediction of equity market using variable that impacts economy like FII.

Recently, significant impact of FII was found by Raman (2012) on Indian equity market. At the same time, Hyuket al (1998) examined the impact of FII on equity returns in Korea for the period starting from November, 1966 to December, 1997 and found no evidence for stable effects of FII on Korean equity. In fact, Eric et al. (2000) examined the investment behavior of market participants in US, Hong Kong, Japan, South Korea and Taiwan. They found the evidence of no impact of FII on equity market in US and Hong Kong. In same line partial impact was found in Japan and as well significant impact was

found in South Korea and Taiwan. That clearly shows significant impact of FII were present in developing countries.

Similarly if we talk about currency rate predication, very few studies succeeded to identify variables that have impact on currency rate (EPW research foundation, 1997; 2000). Economic and Political Weekly research foundation (2000) clearly indicated impact of FII cash flow on currency rate. Same study is applicable to India, and according to that currency rate has impact on the performance of equity market. So, prediction of currency rate may depend on performance of Indian equity market and vice versa. The result of various studies evidenced impact of currency on equity returns (Bahmani-Oskooee and Sohrabian's, 1992; Chien and Cheng, 2001, 2001; Li and Huang, 2009). On the other hand, possibility of impact of equity returns on currency rates has been evidenced in past studies (Aggrawal, 1981; Roll, 1992; Horobet et al, 2007).

Thus, research on showing dependence of index returns and currency returns on each other was evidence (Bahmani & Sohrabian, 1992; Aggarwal, 1981; Aguirre et al., 2005; Griffin et al., 2004). This interdependence leads to more fluctuation of currency rate during volatile market performance. Hence, in current research using FII and interdependence between market performance & currency change author tried to develop model that may help for prediction of currency rate in Indian context.

In present study, instead of considering directional causality it is assumed that currency rate and stock returns interdependent to each other with single lag relationship. Based on that assumption, model of prediction for both was proposed and developed using two stages least square method in next section.

3. Objectives of the Study

- Developing prediction model for the currency rate (INR/$) on daily basis

Sub Objectives are

- To understand relational behavior between currency exchange rate (INR/$) and NIFTY50
- To develop predicting model for the NIFTY50 on daily basis
- To understand predictability of NIFTY50 and currency exchange rate (INR/$) based on time series data.

4 Research Methodology

4.1 Source of Data

To fulfill the objective of study, NIFTY50, currency exchange rate (INR/$) and FII (Florien Institutional Investor) Cash Flow daily closing data from 1st January, 2009 to 31st August, 2013 were taken for analysis from the capital line and confirm through NSE website. Total 1125 observations were taken out on daily basis for the analysis based on trading days on NSE. Reason for selection of data from 2009 to 2013 is major crash in 2008 may have changed some relation between currency and equity market returns and hence data

from 2009 may give true picture of current scenario. Again, NSE (National Stock Exchange) is considered as number one stock exchange with highest volume in Indian equity market. NIFTY50 index is taken in to consideration as indicator of Indian equity market performance. 50 stock comprised in NIFTY50 index also counted for more than 70 per cent market capitalization and hence may used for generalization of the study (www.nseindia.com, as on 14thOctober, 2013).

4.2 Rational of the Study
Recently, major fluctuation in currency rate become major concern for Indian economy and hence for the government. Predictive model for currency rate help them to design policy that may reduce volatility in currency market and give stable economy to country. This prediction can be useful for mutual fund managers and traders to take advantage of earning abnormal returns through knowledge of daily FII cash flow and NIFTY50 closing in market.

On the other side, mutual fund player have failed to achieve benchmarking returns for their portfolio. Hence the need arise to predict the NIFTY50 returns for next day based on which one can decide trading strategy for buy or sell NIFTY50. This prediction can be useful for mutual fund managers and traders to take advantage of earning abnormal returns through knowledge of daily FII cash flow and currency rate in market.

4.3 Methodology Used
In present study, main attempt was to find out particular model of prediction of currency rates based on equity market returns (NIFTY50 returns) and FII cash flow. Using simultaneous equation model, researcher tries to establish simultaneous equation model of prediction for both currency exchange rate (INR/$) as well as NIFTY50. Figure I indicates proposed model for interdependence between Index and currency rate in India.

Figure 1: Proposed Model
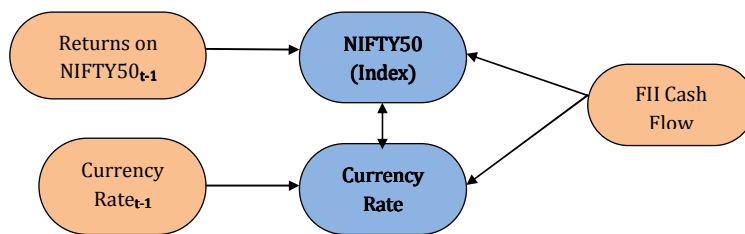
$$CR = \beta_0 + \beta_1 FII + \beta_2 I + \beta_3 CR_{(t-1)} + u_{1t} \dots \dots \dots \dots \dots \dots \dots \dots \dots . \dots (1)$$
$$I = \alpha_0 + \alpha_1 FII + \alpha_2 CR + \alpha_3 IR_{(t-1)} + u_{2t} \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots (2)$$
Where,
CR = Currency Exchange Rate (INR/$)
FII = Foreign Institutional Investment (in Crore Rs.)
I = NIFTY50 (Index Value)

CR_{t-1} = Previous Currency Exchange Rate (INR/$)
IR_{t-1} = Previous NIFTY50 (Index) return (in percent)
u_{1t}, u_{2t} = Residual for Currency Exchange Rate and NIFTY50 (Index Value) respectively

In current study, Currency rate and Index value are endogenous variables, while remaining variables are predetermined variable. FII was considered as exogenous variable, which may function of budget by Government of India and RBI policy that makes economy attractive for investment. First lag of currency rate and Index returns are lag of endogenous variables.

To confirm whether current model exists or not, following step are required to perform:
Step I: To check whether given equation was under identify, just identify or over identify it was required to solve Identification Problem (through Order and Rank condition).
Step II: To check variable as endogenous Hausman Specification Test (Test for erogeneity) was required to perform.
Step III: Using Two Stage Least Square (TSLS) method estimate the NIFTY50 Index value and currency rate for next day.

4.4 Identification Problem
4.4.1 Order Condition of Identifiability (necessary but not sufficient condition)
"In the model of M simultaneous equation, to identify an order for equation, it must exclude at least M-1 variables (endogenous as well as predetermined) appearing in the model. If it excludes exactly M-1 variables, the equation is just identified. If it exclude more than M-1 variables, it is over identified" (Gujarati, Porter and Gunasekar, 2009).

In current model, Currency rate and NIFTY50 are endogenous variables. FII net cash flow, Currency rate (t-1) and Returns on NIFTY50 (t-1) are predetermined variables. Equation 1 excludes exactly one variable NIFTY50 Index value (t-1) and hence just identified. Similarly, equation 2 also excludes exactly one variable Currency rate (t-1) and hence just identified.

4.4.2 Rank Condition of Identifiability (necessary and sufficient condition)

Table 1: Rank condition of Identification

Equation	Coefficients of the Variables					
	Const	I	CR	FII	IR (t-1)	CR (t-1)
CR (2)	$-\beta_0$	$-\beta_2$	1	$-\beta_1$	0	$-\beta_3$
I (1)	$-\alpha_0$	1	$-\alpha_2$	$-\alpha_1$	$-\alpha_3$	0

Note: *bold value is creating matrix of (M-1) * (M-1) = 1*1, where nonzero*

"In a model containing M equation in M endogenous variables, an equation is identified if and only if at least one nonzero determinant of order (M-1)* (M-1) can be constructed from the coefficients of the variables (both endogenous and predetermined) excluded

from that particular equation but included in the other equations of the model" (Gujarati, Porter and Gunasekar, 2009).

Since the determinant as per Table I for the both equation is nonzero, thus equation satisfy rank condition and hence is identified.

4.4.3 Test of Simultaneity (Hausman Specification Test)

To check the simultaneity, following reduced form of equation obtained from equation 1 and 2:

Reduced form of equation;

$$CR = \xi_0 + \xi_1 FII + \xi_2 IR_{(t-1)} + \xi_3 CR_{(t-1)} + v_{1t} \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots (3)$$

$$I = \pi_0 + \pi_1 FII + \pi_2 CR_{(t-1)} + \pi_3 IR_{(t-1)} + v_{2t} \ldots \ldots \ldots \ldots \ldots \ldots \ldots (4)$$

Where,

v_{1t}, v_{2t} = Residual for reduced form equation of Currency rate and NIFTY50 respectively

Estimation was done through Ordinary Least Square (OLS) method for equation 4 and from that we get predicted value for I (PI) and error term (RI) for the same as follow:

$$PI \ 4386.78 + 0.1728FII \ 14.66CR_{(t-1)} \ 42.23IR_{(t-1)} \ldots \ldots \ldots \ldots \ldots \ldots . (5)$$

$$RI \ I - PI \ \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots . (6)$$

These values in equation 5 and equation 6 were required to regress for currency rate prediction based on original equation given at 1 and from that we get result as follow:

$$CR = \beta_0 + \beta_1 FII + \beta_2 PI + \beta_2 RI + \beta_3 CR_{(t-1)} + u_{1t} \ldots \ldots \ldots \ldots \ldots \ldots \ldots . \ldots \ldots \ldots \ldots (7)$$

Estimation was done through Ordinary Least Square (OLS) method for equation 7 and from that we get

$$CR = 0.1309 - 0.00008FII - 0.00005PI + 0.00002RI + 1.0037CR_{(t-1)} + u_{1t} \ldots (8)$$

S.E	0.3882	0.00001	0.00007	0.00001	0.0026
t-value	0.3759	-6.9128	-0.7080	1.6891	384.87
p-value	0.70	0.0000	0.47	0.0936*	0.0000

Solution of equation 7 (shown as equation 8) confirms that coefficient of PI and RI were not same, at the same time coefficient of RI* was statistically significant (p<0.1) and hence there is a problem of simultaneity. In other words, Index (I) is endogenous variable. Same results are required to check for currency rate (CR).

For that equation 3 estimation, values are predicted for CR (PCR) and error term (RCR) through Ordinary Least Square (OLS) method is as follow:

$$PCR = -0.1184 - 0.00006FII - 0.0760IR_{(t-1)} + 1.0032CR_{(t-1)} \ldots \ldots \ldots \ldots (9)$$

$$RCR = CR - PCR \ \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots . (10)$$

These values in equation 9 and equation 10 were required to regress for I prediction based on original equation given at 2 and we get result as follow:

$$I = \alpha_0 + \alpha_1 FII + \alpha_2 PCR + \alpha_2 RCR + \alpha_3 IR_{(t-1)} + u_{2t} \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots . . \ldots (11)$$

Estimation was done through Ordinary Least Square (OLS) method for equation 11 and from that we get

$$I = 4404.55 + 0.1735FII + 15.83PCR + 14.28RCR - 41.08IR_{(t-1)}\ u_{2t} \dots \dots . (12)$$

S.E	250.16	0.0242	65.5757	4.9913	16.3661
t-value	17.61	7.16	0.2414	2.86	-2.51
p-value	0.0000	0.0000	0.8093	0.0043*	0.0000

Solution of equation 11 (shown as equation 12) using OLS confirms that coefficient of PCR and RCR were not come same at the same time coefficient of RCR* was statistically significant (p<0.01) and hence there is problem of simultaneity. In other words, currency rate was also considered to be endogenous variable. Thus, model under consideration showing problem of simultaneity and that's why simultaneity equation model (with the help of TSLS method) is used for estimation of NIFTY50 and currency rate in next section.

5. Data Analysis and Interpretation

Using OLS method following output is obtained for equation 3 and 4:

Reduced form:

$$CR = -0.1184 - 0.00006FII - 0.0760IR_{(t-1)} + 1.0032CR_{(t-1)} + v_{1t} \dots \dots . (13)$$

S.E	0.114	0.00005	0.0074	0.0022
t-value	-1.04	-5.03	-10.18	439.22
p-value	0.3008	0.0000*	0.0000*	0.0000*

(F = 64622; p = 0.0000*; R^2 =99.42 per cent)

$$I = 4386.78 + 0.1727FII + 14.66CR_{(t-1)} - 42.23IR_{(t-1)} + v_{2t} \dots \dots \dots (14)$$

S.E	250.44	0.0241	5.0126	16.33
t-value	17.52	7.16	2.93	-2.59
p-value	0.0000*	0.0000*	0.0035*	0.0098*

(F = 19.34; p = 0.0000*; R^2 =4.93 per cent)

These reduced form equations 13 and 14 gives least squared error for particular equation and hence overall structure under consideration may not with least square error. Secondly, reduced form equation gives significant model (p<0.01) with 99.42 and 4.93 per cent variance explanation for currency rate and Nifty50 respectively. But, use of OLS may create problem of simultaneity and do not give true prediction. Thus, using TSLS method following final structure is identified and then interpreted based on output of E-views, which confirms least square error for the structure under consideration hence for overall equation.

Final form of model under consideration:

$$CR = -8.0072 - 0.0004FII + 0.0018I + 0.9768CR_{(t-1)} + u_{1t} \dots \dots \dots (11)$$

S.E	3.18	0.0001	0.0007	0.0138
t-value	-2.52	-3.07	2.52	70.74
p-value	0.0120*	0.0022*	0.0120*	0.0000*

(F = 3943; p = 0.0000*; R^2 =90.58 per cent)

From the result it is confirmed that model is significant and all the variables under consideration were significant (p<0.05). But FII showed even with negative sign actually showing positive impact on currency rate. Result clearly indicating that net positive FII

cash flow leads to decrease in currency rate and hence appreciation of Indian currency. At the same time, higher the equity market value higher the currency rate and hence depreciation in Indian currency. Result shows that last day closing of currency rate decide next day currency rate and hence higher the last day closing higher the next day value. In short, result indicating positive impact of FII and negative impact of Index value and last day currency rate on next day currency rate.

$$I = \quad 4388.52 + \quad 0.1736 FII + \quad 14.61 CR - \quad 41.13 IR_{(t-1)} + \quad u_{2t} \ldots \ldots \ldots \ldots (12)$$

S.E	249.83	0.0241	4.99	16.32
t-value	17.57	7.19	2.93	-2.51
p-value	0.0000*	0.0000*	0.0035*	0.0119*

$$(F = 19.35; p = 0.0000^*; R^2 = 4.94 \text{ per cent})$$

Result of equation confirms that model is significant and all the variables under consideration found to be significant ($p<0.05$). However, FII cash flow shows positive impact on Index which suggest that if one can prepare a policy in such a way that attracts FII it easily helps in getting better performance of Index. And at the same time currency rate also affects on final outcome of Index. Basically, currency rate directly impacting on Index as depreciation on any currency results in bad performance of economy and vice versa. However, last day returns impact negatively on next day's performance of Index.

Overall model under consideration showing that equation for currency rate and NIFTY50 estimation were statistically significant ($p<0.01$) and explain 90.58 per cent variance and 4.94per cent variance respectively. Again, overall model for currency rate and NIFTY50 as jointly endogenous prediction model provides better understanding about impact of FII on currency and Index performance. Result clearly indicates that when there is huge FII inflow occurs currency is appreciated and NIFTY50 also increase in value. Hence, Net FII cash Inflow if positive suggest buying opportunity (for index as well as local currency i.e. INR) and Net FII cash outflow suggest selling opportunity to traders and investors to creating abnormal returns.

6. Implications and Limitations of the study

In present study, researchers attempted to propose a model that helps to understand the simultaneous movement of Currency rate and NIFTY50. At the same time, researchers humble try to justify effect of FII on both with their respective lag dependence. Overall proposed model was found to be significant and hence it helps for predicting both Currency rate and NIFTY50. Prediction of currency rate helps policy makers to take appropriate steps in advance to prevent major fluctuation in currency rate. And prediction of NIFTY50 helps trader to decide their buy/sell position. Present model provides accurate prediction of Currency rate and NIFTY50. It is also clearly depicted from Figure II and III. Other major findings and implications of the study are as follow:

- By Using simultaneous equation model, it was found that FII cash flow and NIFTY50 returns significantly impacts on currency rates. Hence using market return and FII cash flow one can predict currency rate for the next day.
- By using simultaneous equation model, it was found that FII cash flow and currency rate significantly have impact on NIFTY50. Hence using currency rate in market and FII cash flow one can predict NIFTY50 for the next day.
- Model will help government in deciding policy decision, which may control FII cash flow and hence currency rate and equity market fluctuation.
- Model will also help trader to predict and trade on currency as well as NIFTY50 using FII data for making abnormal profits.

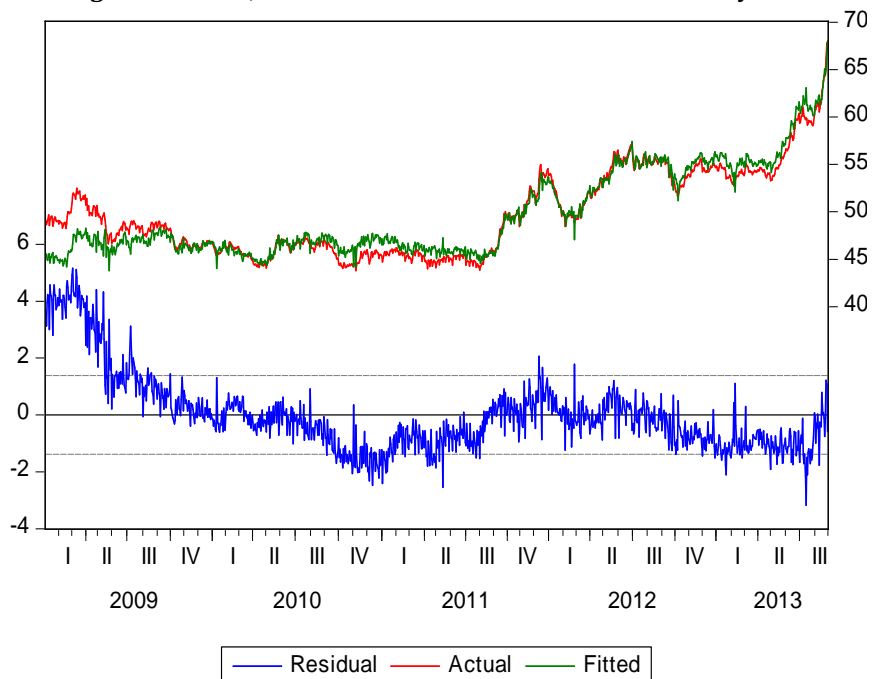**Figure 2: Actual, Predicted and Residual Value for Currency rate**

Figure II shows that predicted and actual values are perfectly match for currency rate. At the same time, residual values for the prediction of currency rate are very near to zero.

Figure III also shows that predicted and actual values are perfectly matched for Nifty50. At the same time, residual values for the prediction of Nifty50 are very small in value.

Figure 3: Actual, Predicted and Residual Value for NIFTY50
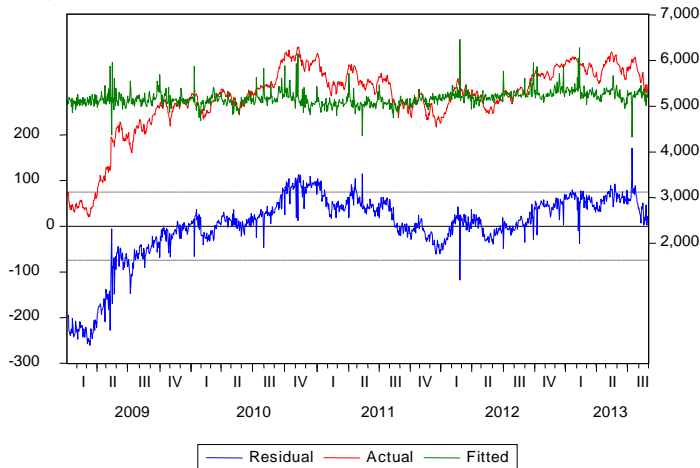
However, no study is possible without any limitations and thus current study also has following limitations:

- Data taken from only 1st January, 2009 to 31st August, 2013 due to consideration of post crisis scenario and hence may have own limitations about time line selection.
- Data available only for week days and no trading occurs on NSE for weed ends. That leads to week end effect on the NIFTY50 that is not possible to cover in the study due to model selection.
- There was only 4.94 variance explained for NIFTY50, Which is too small to get accurate prediction value, hence one can include more exogenous variable that helps in more better prediction of NIFTY50.

7. Conclusion

In present study, we proposed a model for NIFTY50 and currency rate estimation using Net FII cash flow in Indian economy. Study findings show the model fitted information; provide parameter estimation, diagnostic checking procedure, and prediction of currency rate and NIFTY50 data obtained from NSE website, and also regression is done through Net FII cash flows (data obtained from capital line). Using TSLS method of simultaneous equation modeling, model under consideration is solved and found to be significant. Result of current study clearly provides an evidence of impact of FII cash flow on currency rate and NIFTY50. Result also indicates predictability of currency rate and NIFTY50 with knowledge of FII cash flow is possible. Hence using FII data one can decide trading strategy for generating abnormal returns through trading in currency rate or NIFTY50.

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