Investigating causal relationship between stock return with respect to exchange rate and FII: evidence from India

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1 May 2009

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Abstract

The purpose of this paper is to investigate the relationship between macroeconomic parameters like Exchange rate and foreign institutional investment with stock returns in India, in particular at National Stock Exchange. I find that both stock returns and exchange rate are integrated of order one. The Engle–Granger Cointegration test is then performed, suggesting that there is not a long-run equilibrium relationship between stock returns and exchange rates at 5% significance level. Moreover, there is no evidence suggesting that there is any causality relationship from the nominal exchange rate to the stock returns.

Furthermore, FII data is found to be I(0) i.e. It doesn't have a unit root at conventional level. It also gives positive unidirectional Granger causality results i.e. stock returns Granger cause FII. No reverse causality is seen even after inserting a structural break in 2003, as some of the researchers suggest.

Keywords: Unit root test; Cointegration; Granger causality; Exchange rate; Stock return; FII

1. Introduction

National Stock Exchange is one of the fastest emerging stock markets with high volatility. The increase in the number of listed companies and market capitalization value confirms this fact. That is why in the paper, Composite index CNX Nifty evaluated daily by CRISIL is taken as a proxy for the performance of equity market and thereafter, the relationship between stock returns with exchange rates and FII is investigated. This paper employs monthly average of daily data and considers a more recent sample period after new economic policy being implemented in India felicitating greater volume of trade and high volatility in equity as well as Forex market. Floating exchange rate has been implemented in India since 1991 increasing its exposure to economic and financial risks. India, being a capital scarce country has also taken up measures to attract foreign investment since the beginning of reforms in 1991. This coincidence motivates and justifies the current research work.

The relationship between stock returns and foreign exchange rates has drawn much attention of economists, for theoretical and empirical reasons, because they both play crucial roles in influencing the development of a country's economy. In addition, the relationship between stock returns and foreign exchange rates has frequently been utilized in predicting the future trends for each other by investors. The case with FII is no different.

According to Dornbusch and Fischer (1980) research, currency movements directly affect international competitiveness of a firm. Basically, Foreign exchange rate volatility influences the value of the firm since the future cash flows of the firm change with the fluctuations in the foreign exchange rates. Depreciation of a currency of a country affects the competitiveness of the firms engaged in international competition by leading an increase in the demand for its export goods. Adler and Dumas (1984) reported that although firms whose operations are widely domestic may be influenced by the fluctuations in the foreign exchange rates as their input and output prices may be affected by the currency movements. At the same time, if the country is import denominated, the weak currency may have a negative impact on the country due to the increase in the cost of imported goods.

In India, Major portion of FII has gone into equities over the years since its inception in 1990's and given the huge volume of these flows especially after 2003, its impact on domestic financial market is worthy of a rigorous empirical analysis. The short-term nature of FII also suggests a possibility of bidirectional causality running between it and stock returns.

2. Literature Review

Considerable amount of research have been conducted about the impact of financial and macroeconomic variables on stock prices in different economies with widespread econometric methods.

Fama (1981) said that stock prices reflect these variables such as inflation, exchange rate, interest rate and industrial production. Later, Maysami and Koh (2000) and Choi et al. (1992) examined the impacts of the interest rate and exchange rate on the stock returns and showed that the exchange rate and interest rate are the determinants in the stock prices.

Frank and Young (1972) investigated the relationship between stock prices and exchange rates by employing six different exchange rates and concluded no statistically significant underlying relationship. Solnik (1987) gave positive as well as negative relationship between real stock returns and real exchange rate movements for different time frames. Ma and Kao (1990) found a negative relationship whereas Oskooe and Sohrabian (1992) claimed a bi-directional Granger causality with no long-term relationship.

Most of the existing studies performed in Indian context found that the equity return has a significant and positive impact on the FII (Agarwal, 1997; Chakrabarti, 2001; and Trivedi & Nair, 2003) but some also agree on bidirectional causality stating that foreign investors have the ability of playing like market makers given their volume of investments. (Gordon & Gupta in 2003 and Babu and Prabheesh in 2007). Griffin (2004) found that foreign flows are significant predictors of returns for Korea, Taiwan, Thailand and India.

Some researchers also point out a structural break in 1998-99 Asian crises when FII went down, before and after which drastically different results are expected. That's one reason why current study analyzes recent data since 1998.

Rajput and Thaker state that no long run positive correlation exists between exchange rate and Stock Index in Indian context except for year 2002 and 2005. FII and Stock Index show positive correlation, but fail to predict the future value. Takeshi (2008) reports unidirectional causality from stock returns to FII flows irrelevant of the sample period in India where as the reverse causality works only post 2003. The structural break of 2003 as suggested by him and some other researchers was introduced in the current model and hence analyzed.

To summarize, even though the theoretical explanation may seem obvious at times, empirical results have always been mixed and existing literature is inconclusive on issue of causality. However, Cointegration and Granger causality test form integral part of methodology adopted by researchers across the globe.

3. Data and variables

I have collected the daily nominal exchange rate data INR against the USD for 1994-2008 period. The exchange rate series were the daily middle exchange rate obtained from OANDA, a trusted source for currency data. For same period, daily closing values of NSE's stock market composite index S & P CNX Nifty is obtained from NSE website archives. Stock index data doesn't have the observations on Saturday and Sunday. Finally monthly averages are taken for analysis.

FII monthly data from Jan 1998 to Dec 2008 has been obtained from RBI bulletin archive.

The following variables are used in the model. X_t represents Exchange rate (it is defined as domestic currency units per unit of U.S. dollar) in month t. N_t represents Nifty's index value in month t. F_t represent's FII's value in month t.

4. Methodology and Analysis

This section comprises of the methodologies this paper incorporates to explore the relationship between stock returns and exchange rates in India and the relevant data analysis.

4.1 Unit Root Test (Stationarity Test):

To determine the stationarity of each economic time-series sample, augmented Dickey-Fuller (ADF) and Phillips Perron tests are employed. The ADF model used is given as follows:

$$\Delta Y_t = b_0 + \delta Y_{t-1} + \alpha_1 \Delta Y_{t-1} + \alpha_2 \Delta Y_{t-2} + \ldots + \alpha_p \Delta Y_{t-p} + e_t \quad (1)$$

(Minimum AIC & SIC is used to decide no. of lags)

where AIC-Akaike Information criteria, SIC-Schwartz Bayesian information criterion, Y_t represents time series to be tested, b_0 is the intercept term, δ is the coefficient of interest in the unit root test, α_i is the parameter of the augmented lagged first difference of Y_t to represent the pth-order autoregressive process, and e_t is the white noise error term.

H_0: Unit Root, $\delta=0$ (Data needs to be differenced to make it stationary)

Ha: Stationary, $\delta<0$ (No need of differencing)

When the time series is potentially slow-turning around a zero value, an intercept term is not employed in ADF. Without intercept, ADF model becomes:

$$\Delta Y_t = \delta Y_{t-1} + \alpha_1 \Delta Y_{t-1} + \alpha_2 \Delta Y_{t-2} + \ldots + \alpha_p \Delta Y_{t-p} + e_t \quad (2)$$

It is also suggested that when time-series is flat, trend need not be included in the model. With trend, the ADF model becomes:

$$\Delta Y_t = b_0 + \delta Y_{t-1} + \beta t + \alpha_1 \Delta Y_{t-1} + \alpha_2 \Delta Y_{t-2} + \ldots + \alpha_p \Delta Y_{t-p} + e_t \quad (3)$$

Where t=time and β is the corresponding coefficient.

We have run ADF test with trend also since certain trend is spotted through the graphs.

T-statistic associated with the ordinary least squares estimate of δ is called the Dickey-Fuller t- statistic. It does not follow a standard t-distribution as the sampling distribution of this test statistic is skewed to the left with a long, left-hand-tail. Hence, appropriate critical values are taken for rejection of the hypothesis.

Phillips Perron test is similar in spirit to ADF with corrections made for serial correlations in DF test statistic.

A stochastic process is said to be integrated of order p, abbreviated as I(p), if it need to be differenced p times in order to achieve stationarity. If series is found non-stationary at level, ADF is also employed on first difference of series as follows:

$$\Delta^2 Y_t = b_0 + \delta \Delta Y_{t-1} + \alpha_1 \Delta^2 Y_{t-1} + \alpha_2 \Delta^2 Y_{t-2} + \ldots + \alpha_p \Delta^2 Y_{t-p} + e_t \quad (4)$$

We reject the null hypothesis of the unit root if the t-statistic of δ is smaller than the 95% Dickey–Fuller critical value, given by MacKinnon (1991).

The ADF test results in Table 1 clearly show that both the variables Exchange rate and stock return are not stationary at the 5% level of significance; however, ADF statistics reject the null hypothesis of non-stationarity at the 5% level of significance after the variable have been first differenced (Table2). Thus, the variables are integrated of order 1.

4.2 Cointegration Test

X_t and Y_t are said to be cointegrated of order CI (d, p) if X_t and Y_t are both integrated of order d but there exists an α such that $Y_{t-\alpha}$ X_t is integrated of order d-p. Since most applications in financial economics treat the case of CI (1,1), I will also be testing for the same.

The Engle-Granger test (EG)

After having verified that Y_t and X_t both are I(1), a static regression is run:

$$Y_t=\theta' X_t + e_t \quad (5)$$

X_t can be higher dimensional but in present case it is one-dimensional. After estimating $\theta^\wedge$ by OLS , test for unit root in residual series is done:

$$e_t = Y_t - \theta^\wedge X_t \quad (6)$$

H_0: No Cointegration

Ha: Cointegration

This Cointegration ADF test is called CRADF (Cointegrating Regression ADF) test. The critical values are taken from MacKinnon (1991) table which is more complete and accurate than that of Engle and Granger (1987).

$$\Delta e_t = b_0 + \delta e_{t-1} + \alpha_1 \Delta e_{t-1} + \alpha_2 \Delta e_{t-2} + \ldots + \alpha_p \Delta e_{t-p} + \varepsilon_t \quad (7)$$

Alternatively, Phillips Perron test is also employed to test for unit root.

The last test known as CRDW (Cointegrating regression Durbin Watson) is also used where a Durbin Watson statistic ζ close to zero represents no cointegration.

$$\zeta = 2(1-r) \quad (8)$$

Where r is coefficient of correlation between e_t and e_{t-1}

Keeping exchange rate as regressor and stock return as explained variable, test is done and the results are tabulated in table3. Making stock return a regressor and exchange rate as explained variable, the results are tabulated in table4.

4.3 Granger Causality Test

It is based on lag-augmented Vector autoregression (LA-VAR) approach.

H_0: No causal relationship from X to Y

Ha: X Granger-causes Y

As proposed by Granger in 1969, a time series X is said to Granger-cause Y i.e. X can be used to forecast Y; if it can be shown, usually through a series of F-tests and considering AIC on lagged values of X (and with lagged values of Y also known), that those X values provide statistically significant information about future values of Y.

Since the time series of FII series is stationary or I(0) from the ADF test, the Granger Causality test is performed as follows:

$$N_t=\alpha_1+\beta_{11}N_{t-1}+\beta_{12}N_{t-2}+\ldots+\beta_{1n}N_{t-n}+\gamma_{11}F_{t-1}+\gamma_{12}F_{t-2}+\ldots+\gamma_{1n}F_{t-n}+\varepsilon_{1,t} \quad (9)$$

$$F_t=\alpha_1+\beta_{21}F_{t-1}+\beta_{22}F_{t-2}+\ldots+\beta_{2n}F_{t-n}+\gamma_{21}N_{t-1}+\gamma_{22}N_{t-2}+\ldots+\gamma_{2n}N_{t-n}+\varepsilon_{2,t} \quad (10)$$

Since time series of stock returns and exchange rate are I(1) and not cointegrated, Granger causality model to be tested becomes

$$\Delta N_t=\alpha_1+\beta_{11}\Delta N_{t-1}+\beta_{12}\Delta N_{t-2}+\ldots+\beta_{1n}\Delta N_{t-n}+\gamma_{11}\Delta X_{t-1}+\gamma_{12}\Delta X_{t-2}+\ldots+\gamma_{1nv}X_{t-n}+\varepsilon_{1,t} \quad (11)$$

$$\Delta X_t=\alpha_1+\beta_{21}\Delta X_{t-1}+\beta_{22}\Delta X_{t-2}+\ldots+\beta_{2n}\Delta X_{t-n}+\gamma_{21}\Delta N_{t-1}+\gamma_{22}\Delta N_{t-2}+\ldots+\gamma_{2n}\Delta N_{t-n}+\varepsilon_{2,t} \quad (12)$$

Where ΔX_t is the first difference at time t of nominal exchange rate where the series is nonstationary and ΔN_t is the first difference at time t of stock returns where the series is nonstationary.

The empirical results listed in Table5 reveal that at 5% significance level there is no causality from the first difference of nominal exchange rate to the first difference of stock returns in our sample. Hence, there are no short-run uni-directional causality relationships from the nominal exchange rate to the stock returns at 5% significance level.

However, Stock return tends to Granger-cause FII at 5% level of significance according to results listed in Table6. However, the reverse causality doesn't work.

After inserting a structural break in year 2003 and splitting the sample period in two pats, results don't differ qualitatively and thus their exact values have not been tabulated in the paper.

5. Conclusion and Limitations

This paper I examined the causal relationship of stock market returns with two set of variables i.e. exchange rate and FII in Indian economy. FII data was found to be stationary at level but I had to differentiate stock return and exchange rate series once to make them stationary.

Further, It was checked whether stock return and exchange rate are cointegrated i.e. they follow a long-term relationship but I could not reject the null hypothesis of no cointegration at 5% level of significance.

Different versions of Granger causality models are employed for investigating direction of causation in I(1) and I(0) series. Exchange rate and stock returns were found to have no causality from either of the sides where as stock return was found to Granger cause FII series.

Since the previous studies have yielded mixed results and given the fact that they were employed on older data when there was less quantum of trade and foreign investment along with a less volatile domestic financial market, the current paper gains more relevance.

I understand the following limitations to the proposed model which can be addressed for the purpose of empirical robustness.

The present study doesn't account for ARCH effect present in most of monthly financial time series data. Also, since Granger test can be applied only to a pair of variables, simultaneous effect of multiple variables can't be tested.

Granger cause doesn't imply true causality either. If both economic variables X and Y are driven by a common third process, but with a different lag, there would be positive results in granger causality test even in absence of a true relationship. To address to the problem of spurious inferences, unit root and cointegration tests are performed before conducting Granger causality test to measure changes in existence and direction of causality.

Causality may run from Y to X instead of X to Y and in some cases, it can even run both ways. However, this limitation has been overcome in the prescribed model by considering all such possibilities.

It is agreed that a vector autoregressive model including more variables may be little more robust since stock returns are determined by a number of factors and more macroeconomic variables like inflation, interest rate etc. can also be employed in the model. But one must also address issues of multicollinearity of regressors before running a multivariate Cointegration. For example, in our model, we have tried to see the impact of exchange rate and FII on stock returns where as FII flows themselves tend to affect exchange rates and vice-versa.

Acknowledgement:

I would like to express my gratitude to Mr. Ch. V.V.S.N.V. Prasad for valuable guidance. I am also thankful to Dr. Debasis Patnaik and Dr. G.V. Kumari for comments and suggestions.

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Results

Table 1: Unit Root tests at level

Variable	With trend		Without trend		PP test statistic
	Lags	ADF test statistics	Lags	ADF test statistics	
Exchange Rate	1	-1.6361***	1	-1.5427	-1.6009
CNX Nifty	2	-1.57***	3	-1.3248	-1.9004
FII	1	-1.7799**	1	-1.1562	-1.9004

Critical values: 1%(*)- :5%(**)- :10%(***)-

Table 2: Unit Root tests at first difference

Variable	With trend		Without trend		PP test statistic
	Lags	ADF test statistics	Lags	ADF test statistics	
Exchange Rate	3	2.6656**	3	-1.73**	-9.6911
CNX Nifty	3	5.6655*	3	5.8964*	-9.2329

Level of significance: 1 %(*), 5 %(**), 10 %(***)

Table 3: Engle-Granger Cointegration Test

Variables	CRDW	CRDF	lags
Exchange Rate and CNX Nifty	d=0.0233	ADF test statistic for residual series =-1.5418*** PP test statistic for residual series=-1.834	3

Level of significance: 1 %(*), 5 %(**), 10 %(***)

Table 4: Engle-Granger Cointegration Test

Variables	CRDW	CRDF	lags
CNX Nifty and Exchange Rate	d=0.00889	ADF test statistic for residual series=-1.6114*** PP test statistic for residual series=-1.6068	1

Significance Levels: 1% (*); 5% (**)

Table5: Granger Causality Test

Dependent Variable	Stock returns	Exchange rate
Intercept	16.0015 [1.2594]	0.0762[1.4399]
Stock Returns		
Lag1	0.3493 [4.0817]	0.3033[3.5394]*
Lag2	-0.3327 [-3.6912]	-0.0634[-0.7054]
Lag3	0.2520 [2.6319]	0.034[0.3571]
Lag4	-0.0828 [-0.8630]	0.0469[0.4904]
Lag5	-0.0179 [-0.1969]	0.0971[1.0294]
Exchange Rate		
Lag1	-54.9836 [-2.6728]	0[-0.0624]
Lag2	-19.9435 [-0.9246]	0.0002[0.5946]
Lag3	10.9070 [0.4778]	-0.0011[-2.7857]*
Lag4	7.6875 [0.3346]	0[-0.0481]
Lag5	-30.4228 [-1.3428]	0.0005[1.2526]
FII flows does not Granger cause Stock Returns	F statistic=5.6873	P value=0
Stock Returns does not Granger cause FII flows	F statistic=3.5562	P value=0.0003

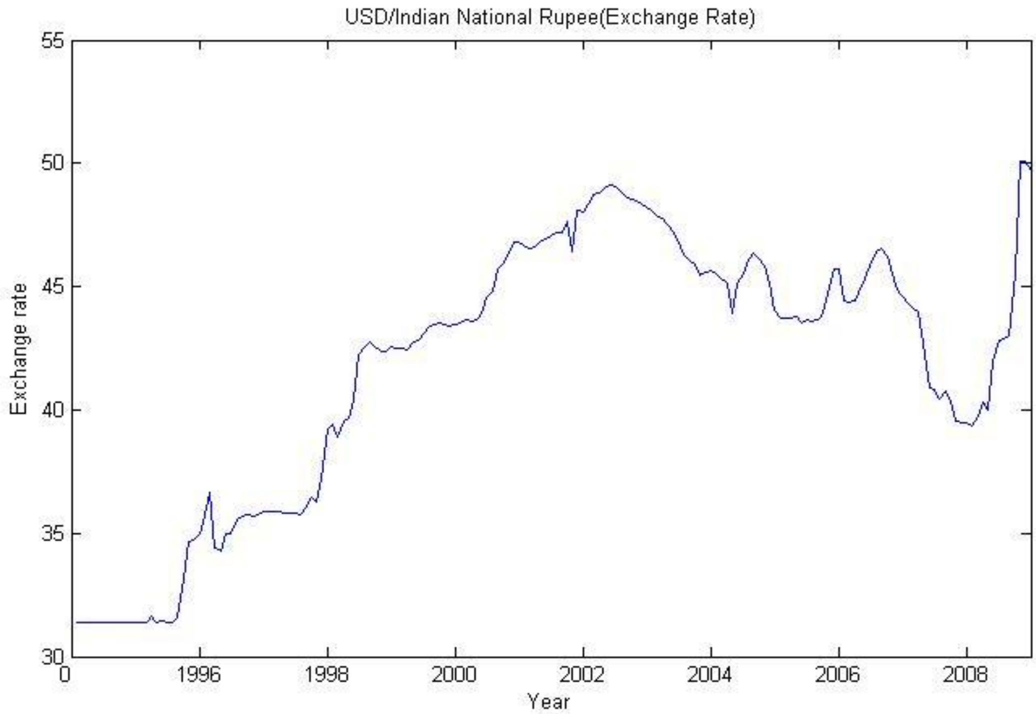
*, ** and *** denotes statistically significance at 1, 5 and 10% level respectively and t statistic is in square brackets.

Table6: Granger Causality Test

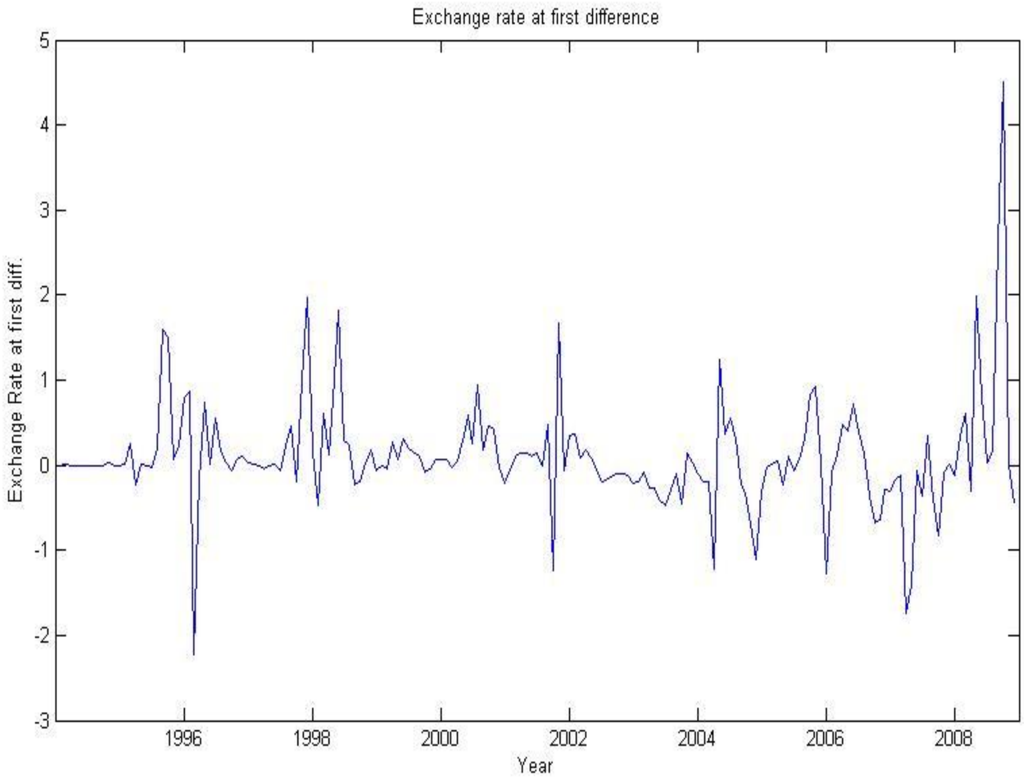
Dependent Variable	Stock returns	FII inflows
Intercept	26.98[0.7542]	-396.18[-1.243]
Stock Returns		
Lag1	1.5857[12.718]*	-0.3815[-2.9524]*
Lag2	-0.7782[-3.8372]*	-0.2093[-1.5423]
Lag3	0.4664[2.1834]*	0.3483[2.7779]*
Lag4	-0.2776[-1.2753]	0.1196[0.9393]
Lag5	0.0036[0.02753]	0.0369[0.3421]
FII flows		
Lag1	-0.0146[-1.0059]	[5.6643]*
Lag2	-0.0268[-1.7569]***	[-3.6979]*
Lag3	0.0092[0.6554]	[1.8278]***
Lag4	0.0058[0.4068]	[-2.2606]*
Lag5	0.0055[0.4561]	[1.4923]
FII flows does not Granger cause Stock Returns	F statistic=752	P value=0
Stock Returns does not Granger cause FII flows	F statistic=9.9	P value=0

*, ** and *** denotes statistically significance at 1, 5 and 10% level respectively and t statistic is in square brackets.

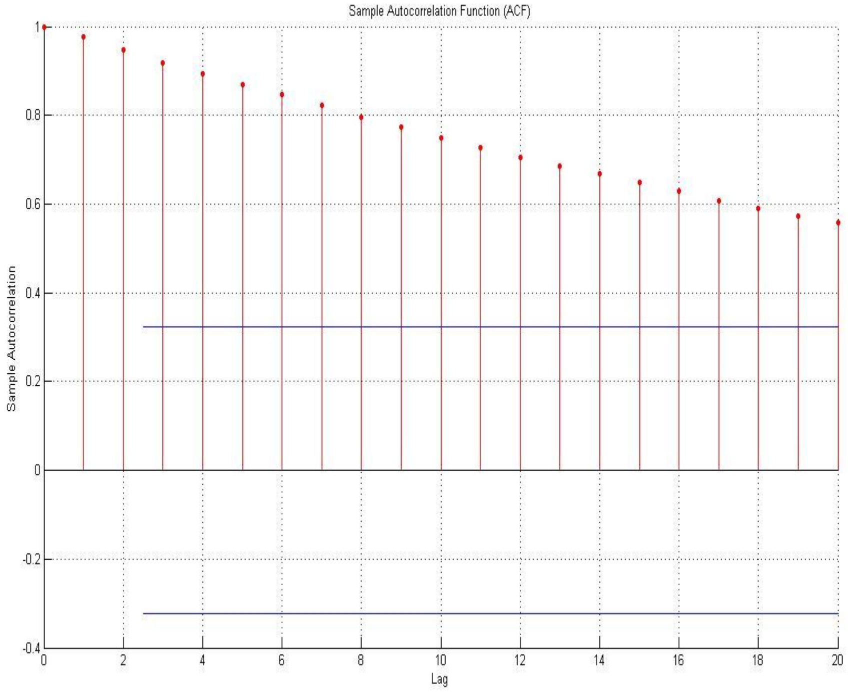
Graphs:



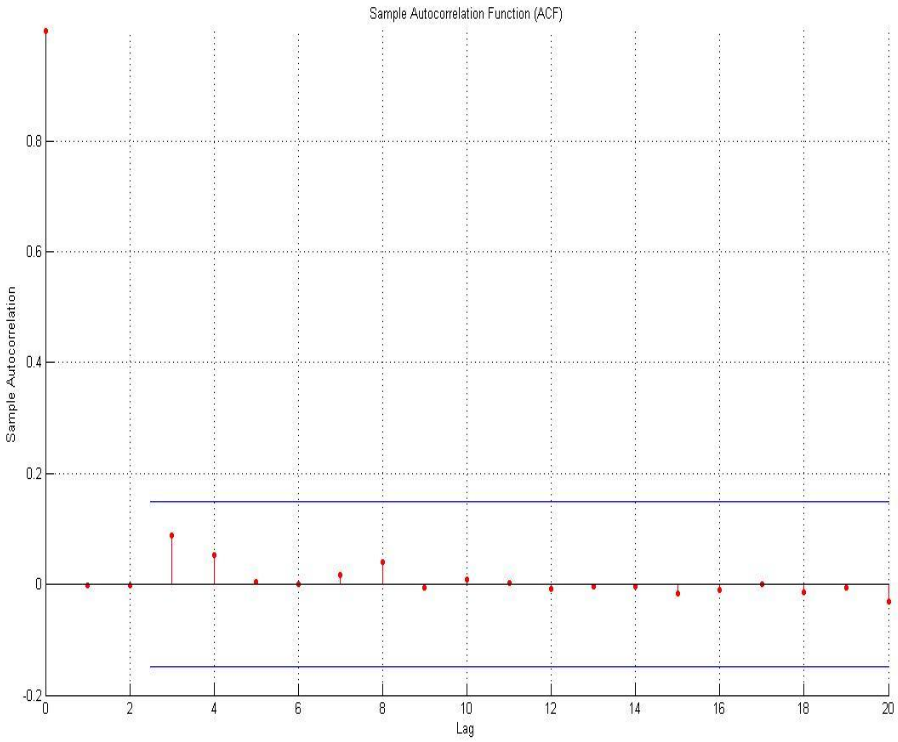
Graph1: USD/Indian National Rupee(1994-2008)



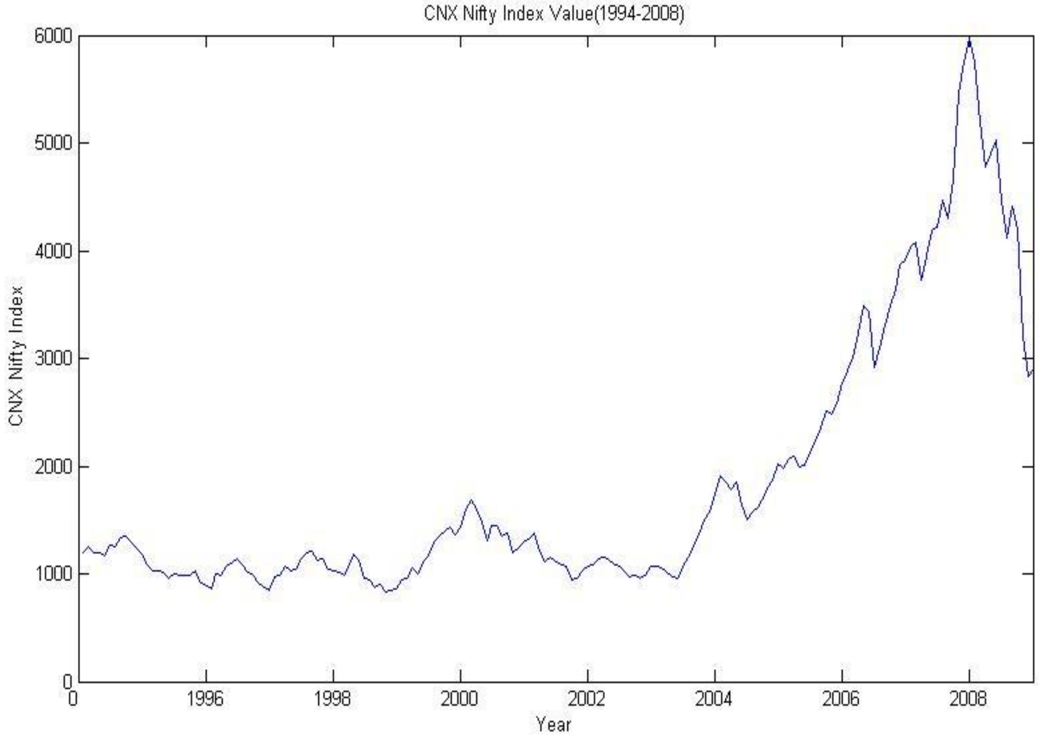
Graph2: Exchange Rate after first difference



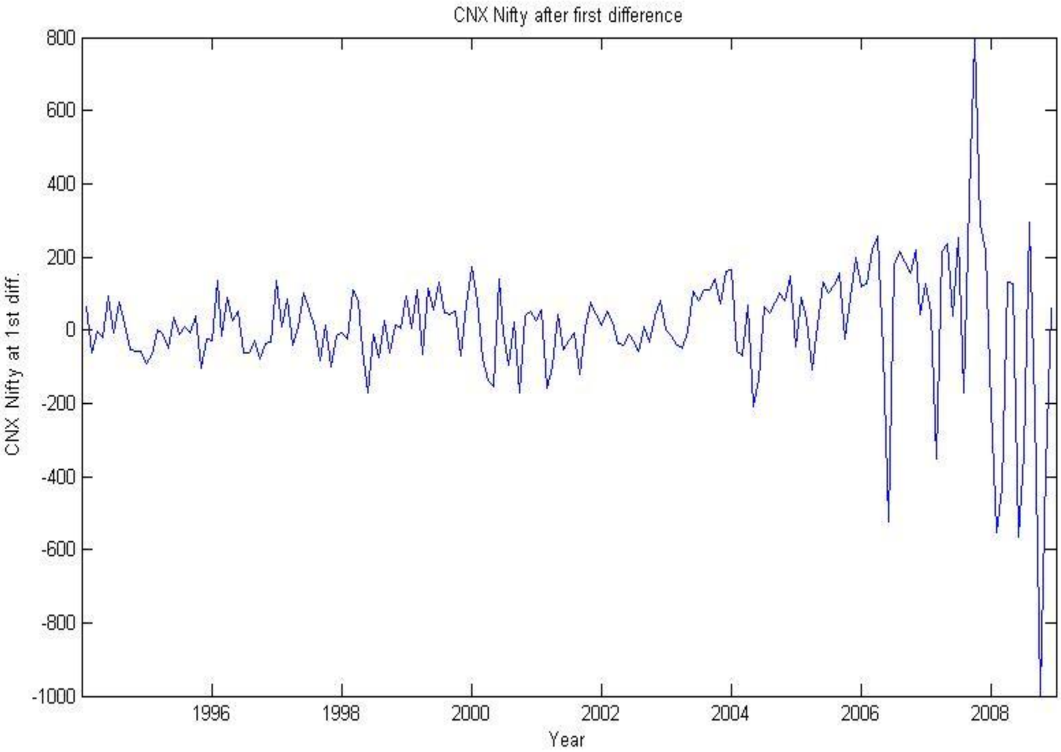
Graph3: acf plot for exchange rate at level



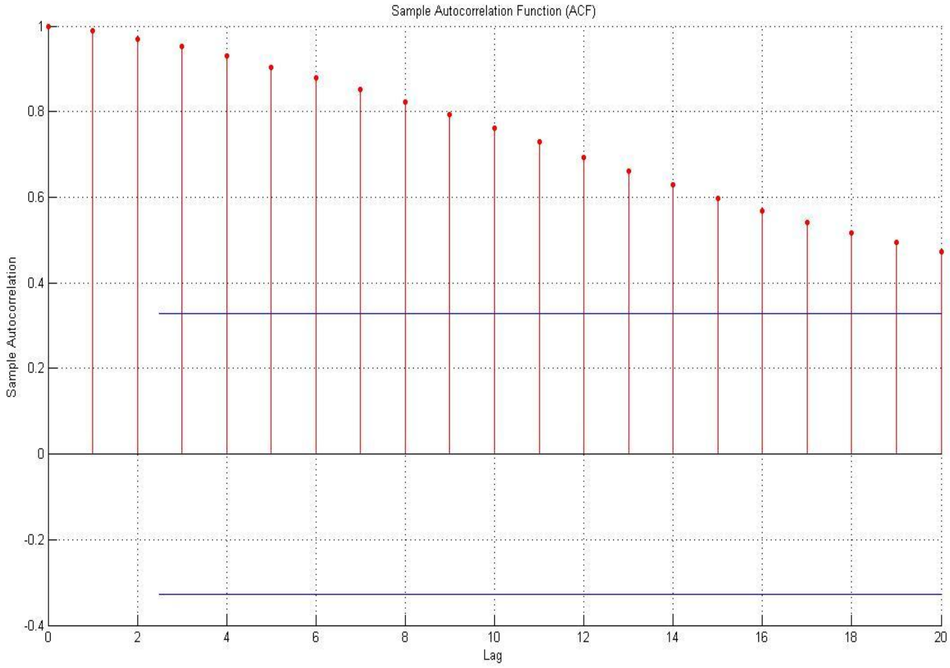
Graph4: acf plot for exchange rate at first difference



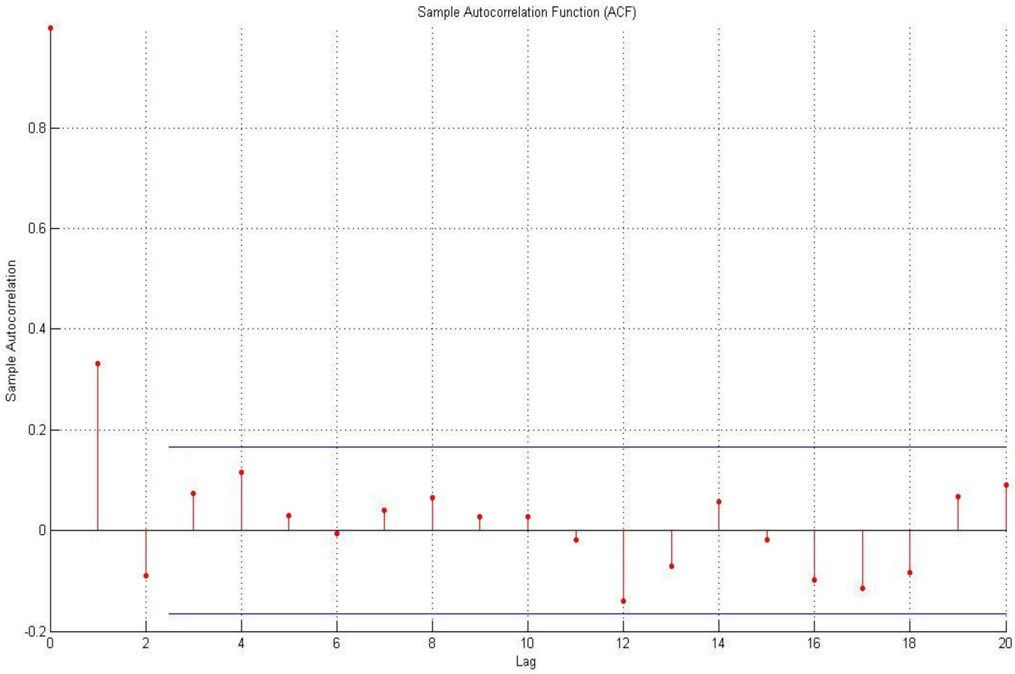
Graph5: CNX Nifty Index Value (1994-2008)



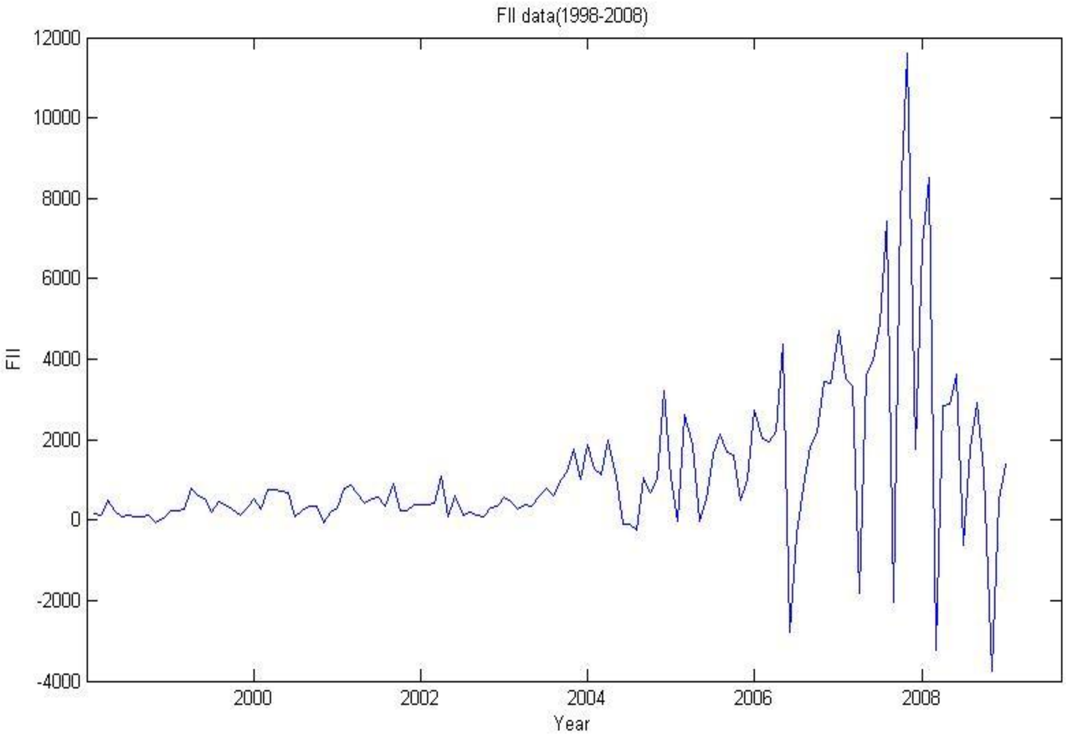
Graph6: CNX Nifty after first difference



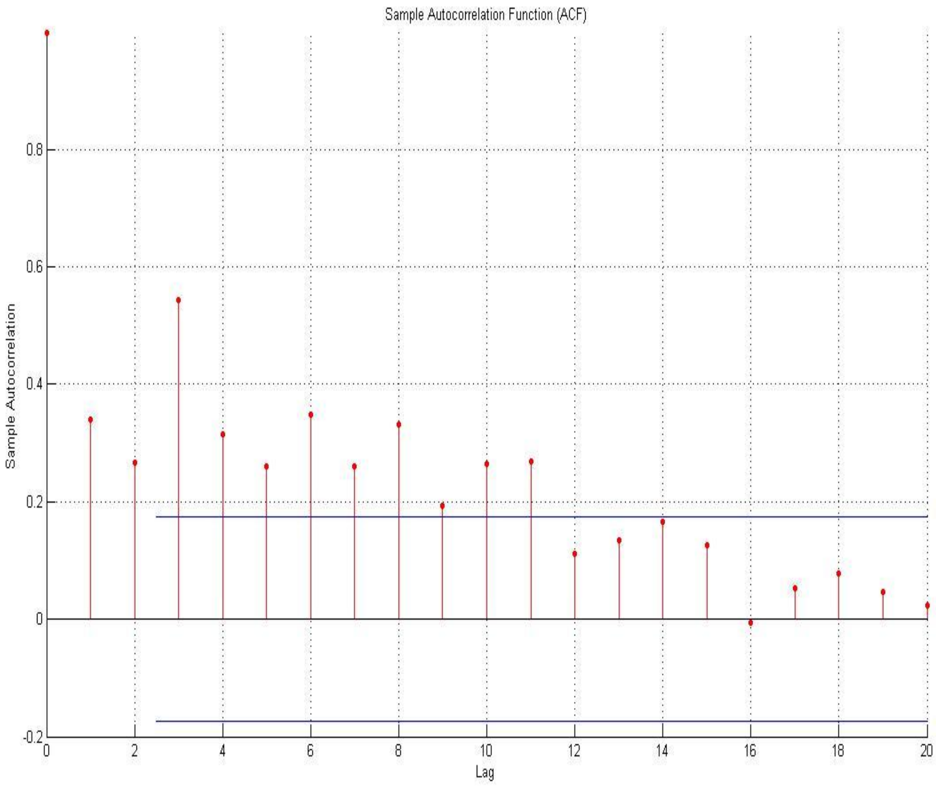
Graph7: acf plot for Nifty at level



Graph8: acf plot for Nifty at first difference



<u>Graph9: FII data in US $ million (1998-2008)</u>



<u>Graph10: acf plots for FII at level</u>