An Analysis of Stock Returns and Exchange Rates: Evidence from IT Industry in India

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Abstract

This paper attempts to examine the relationship between exchange rates and IT stock prices. The data for the study was taken from the information of daily closing observations of the NSE CNX IT Index and the nominal Indian Rupee per US dollar exchange rates. The study was based on exchange rate of Indian rupee and US Dollar. Statistical tests were applied to study the behavior and dynamics of exchange rates. The results of the study indicate that, both CNX IT Nifty returns and Exchange Rates are not normally distributed. Also it was found that, time series; Exchange rate and CNX IT returns are stationary at the level form itself. A negative correlation is observed between CNX IT returns and Exchange Rates. The direction of influence between two series is verified by the Granger causality test and the results of the test states that Exchange rates, clearly, Granger cause the IT stocks whereas IT stocks prices cannot be said to direct the Exchange rates.

Keywords: CNX IT; Exchange rate; J-B test; Unit root test; Granger causality

1. Introduction

Stock market related to information technology (IT) is distinguished as an extremely momentous factor of the financial sector of Indian economy. It plays an imperative role in the mobilization of capital in India. IT Stocks and exchange rates are very sensitive and get affected whenever changes exist in Government policies, politics, finance, Rupee depreciation etc. The exchange rate between the U.S. dollar and the Indian rupee is the ratio at which the U.S. unit of currency may be traded for the rupee. The fluctuation of exchange rate between currencies may be attributed to the economic principle of supply and demand. Speculations of foreign exchange traders about the futures of particular currencies will decide the demand for a particular currency. The rupee weakness is
broadly a negative indication for stock market in general and in particular, IT firms likely to benefit from rupee depreciation. The rupee depreciation happens because of domestic and global factors.

1.1 Importance of Nifty and CNX IT Nifty

NSE provides trading facility across the nation for all securities of different sectors. It deals with different market segments like equity market and capital market, futures and options or derivatives market, wholesale debt market, mutual funds, initial public offerings and so on. CNX IT is an index comprised of the most liquid and large capitalization IT stocks traded on the NSE engaged in the business of software or hardware. CNX IT index provides investors and market intermediaries with an appropriate benchmark that captures the performance of the IT segment of the market. IT companies have bigger role in Indian economy and it is very important to know the changes in investment pattern of investors in IT stocks.

1.2 Background of the study

Information technology is playing an important role in India today and has transformed India's image from a slow moving bureaucratic economy to a land of innovative entrepreneurs. **Information technology in India** is an industry consisting of two major components: IT services and business process outsourcing (BPO). In the last two decades, the Indian IT industry has contributed significantly to Indian economic growth in terms of GDP, foreign exchange earnings and employment generation.

2. Review of Literature

There has been considerable attention on the existence of a relationship between stock prices and exchange rate. In the many early studies, only the correlation between the two variables, exchange rates and stock returns are considered. Theory explained that a change in the exchange rates would affect a firm’s foreign operation and overall profits which would, in turn, affect its stock prices, depending on the multinational characteristics of the firm. Conversely, a general downward movement of the stock market will motivate investors to seek for better returns elsewhere. This decreases the demand for money, pushing interest rates down, causing further outflow of funds and hence depreciating the currency.

Courage Mlambo *et al*(2013), studied the effects of Exchange Rate Volatility on the Stock Market of South Africa by considering monthly data from 2000 -2010 and inferred a very weak relationship between currency volatility and the stock market. Deepti Gulati and Monika Kakhani (nov 2012), in their study, entitled “Relationship between Stock market and foreign exchange market in India” studied the existence of a causal relationship between foreign exchange rates and stock market by applying Granger causality test and correlation test. Study concluded that there is no or little impact of exchange rate on Indian stock market (NIFTY AND SENSEX). Divyang Patel and Nikita Kagalwala (2013) analysed the relationship between exchange rate ($/Rs.) and Indian stock exchange like BSE,NSE etc., using monthly data and found that there is no or little impact of exchange rate (USD/INR) on Indian stock market ( Nifty and Sensex).
Olugbenga (2012) examined the long-run and short-run effects of exchange rate on stock market development in Nigeria over 1985:1–2009:4 using the Johansen cointegration tests. Results showed a significant positive stock market performance to exchange rate in the short-run and a significant negative stock market performance to exchange rate in the long-run. Pilinkus and Boguslaskas (2009) used the impulse response function to test the existence of the short-run relationship between stock market prices and macroeconomic variables. Their study concluded that unemployment rate, exchange rate, and short-term interest rates negatively influence stock market prices.

Most of the studies showed that there are mixed views on the link between the two variables. Interesting to note is that some studies (Alam and Tafiques (2007); Morales (2008)) admit that there is need for continuous research in the area of exchange rates and stock markets in order to establish more comprehensively the true nature of spillovers from exchange rates to equity markets.

3. Data and Methodology

The current study is to investigate the interactions between stock prices of IT companies and exchange rates in India. The data series use in the present study is time series data. The data used in this include daily closing nominal exchange rates of US dollar in terms of Indian rupee and daily closing value of IT Nifty returns. The study is conducted for the period from 3rd January 2011 to 31st March 2015. The daily returns and exchange rates have been matched by Calendar date. Further, the daily Nifty returns and daily exchange rates are converted into the natural logarithm of their respective closing price relatives. i.e. in case of Nifty returns, the variable is \( x = \ln(P(t)/P(t-1)) \), where \( P(t) \) is the closing price on the day \( t \) and in case of exchange rate, \( y = \ln(E(t)/E(t-1)) \), where \( E(t) \) is the closing exchange rate for the \( t \)th day. The values so obtained have been employed for studying the relationship between IT Nifty returns and exchange rates.

4. Objectives of the Study

1) To study the association between Exchange rate and CNX IT Nifty Index movement of NSE.
2) To understand the causal relationship between Exchange rate and CNX ITNifty Index movement of NSE.

5. Empirical Framework

The following hypotheses are considered in the study.

**Hypothesis 1**: IT Nifty Stock returns and exchange rates are not normally distributed.

**Hypothesis 2**: Unit Root exists (i.e. non stationarity) in both the series.

Further, the hypothesis to address the objectives of our study are taken as

**Hypothesis 3**: Correlation exists between the two variables- IT Stock returns and Exchange rates.
Hypothesis 4: No Causality exists between IT stock returns and exchange rates.

Following methods/tools are used to test the above hypotheses and subsequently draw inferences about the behavior and dynamics of the two variables. The tests - namely, the JB Test, Unit root test and Granger Causality test - were conducted with the aid of Eviews software (version 7.0).

Normality Test

Jarque-Bera is a test statistic for testing whether the series is normally distributed. The test statistic measures the difference of the skewness and kurtosis of the series with those from the normal distribution. Samples from a normal distribution will have an expected skewness of 0 and an expected kurtosis of 3. To test the hypothesis for normality of data, the null hypothesis to be tested are the skewness being zero (i.e. $S = 0$) and the kurtosis being three (i.e. $k = 3$).

The test statistic is

$$JB = n \left[ \frac{S^2}{6} + \frac{(K-3)^2}{24} \right]$$

Where $n$ is the number of observations (or degrees of freedom in general); $S$ is the sample skewness, and $K$ is the sample kurtosis:

The $JB$ statistic asymptotically features a chi-squared distribution ($\chi^2$) with 2 degrees of freedom. The reported Probability is the probability that a Jarque-Bera statistic exceeds (in absolute value) the observed value under the null hypothesis—a small probability value leads to the rejection of the null hypothesis of a normal distribution.

Table 1

<table>
<thead>
<tr>
<th></th>
<th>CNX_IT_NIFTY</th>
<th>EXCHANGE RATE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>0.000457</td>
<td>0.000319</td>
</tr>
<tr>
<td>Median</td>
<td>0.000487</td>
<td>0.000000</td>
</tr>
<tr>
<td>Maximum</td>
<td>0.089220</td>
<td>0.039116</td>
</tr>
<tr>
<td>Minimum</td>
<td>-0.124903</td>
<td>-0.034698</td>
</tr>
<tr>
<td>Std. Dev.</td>
<td>0.014095</td>
<td>0.005804</td>
</tr>
<tr>
<td>Skewness</td>
<td>-0.941747</td>
<td>0.279989</td>
</tr>
<tr>
<td>Kurtosis</td>
<td>13.49154</td>
<td>8.253496</td>
</tr>
<tr>
<td>Jarque-Bera</td>
<td>4951.940</td>
<td>1216.532</td>
</tr>
<tr>
<td>Probability</td>
<td>0.000000</td>
<td>0.000000</td>
</tr>
<tr>
<td>Sum</td>
<td>0.477904</td>
<td>0.333411</td>
</tr>
<tr>
<td>Sum Sq. Dev.</td>
<td>0.207613</td>
<td>0.035203</td>
</tr>
<tr>
<td><strong>Observations</strong></td>
<td><strong>1046</strong></td>
<td><strong>1046</strong></td>
</tr>
</tbody>
</table>

Table 1 shows the descriptive statistics and the results of the test for the two time series. For series to be normal, Skewness value to be 0 and kurtosis value to be 3. Present study shows the skewness values for CNX IT Nifty returns and exchange rates are -0.941747 and 0.279989 respectively and the kurtosis values are 13.49154 and 8.253496 respectively indicates that both the series are non-normally distributed.
Further, the Jarque-Bera statistic is distributed as $\chi^2$ with 2 degrees of freedom. The probability that a Jarque-Bera statistic exceeds (in absolute value) the observed value under the null hypothesis is 0.0000 (i.e., significant value) which leads to the rejection of the null hypothesis of a normal distribution of both series.

Secondly, having affirmed the non-normal distribution of the two series, the stationarity of the two time series are checked by plotting time series graphs and observing the trends in mean, variance and autocorrelation. The line plots of the two series (natural log values of relatives) are shown in Fig 1 and Fig 2 respectively. From the graphs it is evident that, for the series, the mean and variance appear to be constant because the trends show neither upward nor downward. Also, the vertical fluctuations indicate that the variance, too, is not changing. This is the clear indication of stationarity in both the series in their level forms.

Fig. 1. Stationarity graph of IT Nifty

Fig. 2. Stationarity graph of exchange rate.
Unit Root Test (Stationarity Test)

A data series is said to be stationary, if it vary around a constant mean level, neither decreasing nor increasing systematically over time, with constant variance. Any series that is not stationary is said to be nonstationary. Stationarity of series can be checked by a unit root test. Unit root tests for whether the series (or it’s first or second difference) is stationary. Stationarity condition has been tested using Augmented Dickey Fuller (ADF) (Dickey and Fuller (1979, 1981)).

Augmented Dickey–Fuller (ADF) Test

Table 2: Unit root test 1

| Null Hypothesis: X_IT_NIFTY has a unit root |
| Exogenous: Constant, Linear Trend |
| Lag Length: 0 (Automatic - based on SIC, maxlag=21) |

<table>
<thead>
<tr>
<th>Augmented Dickey-Fuller test statistic</th>
<th>t-Statistic</th>
<th>Prob.*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Augmented Dickey-Fuller test statistic</td>
<td>-30.530200</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

Test critical values:
- 1% level: -3.966854
- 5% level: -3.414119
- 10% level: -3.129163


Augmented Dickey-Fuller Test Equation

Dependent Variable: D(X_IT_NIFTY)
Method: Least Squares

Sample (adjusted): 2 1046
Included observations: 1045 after adjustments

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>X_IT_NIFTY(-1)</td>
<td>-0.944321</td>
<td>0.030931</td>
<td>-30.53020</td>
<td>0.0000</td>
</tr>
<tr>
<td>C</td>
<td>-0.000824</td>
<td>0.000872</td>
<td>-0.945049</td>
<td>0.3449</td>
</tr>
<tr>
<td>@TREND(1)</td>
<td>2.40E-06</td>
<td>1.45E-06</td>
<td>1.657806</td>
<td>0.0977</td>
</tr>
</tbody>
</table>

R-squared         | 0.472163   | 0.471150   | -3.94E-06   | 0.019351|
Adjusted R-squared| 0.471150   | 0.472163   | 0.014073    | 0.140733|
S.E. of regression| 0.206354   | 0.206354   | -5.686314   | -5.686314|
Sum squared resid  | 2974.099   | 2974.099   | -5.680922   | -5.680922|
Log likelihood     | 466.0466   | 466.0466   | 1.992216    | 1.992216|
F-statistic        | 0.000000   | 0.000000   | 0.000000    | 0.000000|
Prob(F-statistic)  | 0.000000   | 0.000000   | 0.000000    | 0.000000|
An augmented Dickey–Fuller test (ADF) is a test for a unit root in a time series sample. It is an augmented version on the Dickey–Fuller test for a larger and more complicated set of time series models (i.e. for higher-order correlation). The ADF approach controls for higher-order correlation by adding lagged difference terms of the dependent variable to the right-hand side of the regression. The augmented Dickey–Fuller (ADF) statistic, used in the test, is a negative number. The more negative value contributes to the more powerful rejection of the null hypothesis that there is a unit root at some confidence level. The Augmented Dickey-Fuller test model taken in this study is as follows.

\[ \Delta Y_t = \alpha + \beta t + Y_{t-1} + \delta_1 \Delta Y_{t-1} + \delta_2 \Delta Y_{t-2} + \ldots + \delta_{p-1} \Delta Y_{t-p+1} + \delta_p \Delta Y_{t-p} + \varepsilon_t \]

Where \( \Delta \) is the difference operator, \( \alpha \) is the constant, \( \beta \) is the slope and \( Y_{t-1} \) is the first lag of the variable \( Y \). \( Y \) is the variable whose time series properties are examined and \( \varepsilon \) is the white-noise error term. \( P \) is the number of augmenting lags determined by minimizing the Schwartz Bayesian information criterion or minimizing Akaike information criterion.

Stationarity of the series can also be substantiated by conducting formal econometric test called unit root test due to Dickey-fuller, known as Augmented Dickey fuller test (ADF). We used the ADF test with constant and linear trend as suggested by Engle and Granger (1987). the lag length and bandwidth in the unit root test were allowed to vary across the IT Nifty stock index and exchange rates to correct any serial correlation in the residuals. The results of the test are given in the table 2 and table 3.

**Table 3** Unit root test 2

<table>
<thead>
<tr>
<th>Null Hypothesis: Y_ERATE has a unit root</th>
<th>Exogenous: Constant, Linear Trend</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lag Length: 0 (Automatic - based on SIC, max lag=21)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>t-Statistic</th>
<th>Prob.*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Augmented Dickey-Fuller test statistic</td>
<td>-33.11980</td>
<td>0.0000</td>
</tr>
<tr>
<td>Test critical values: 1% level</td>
<td>-3.966854</td>
<td></td>
</tr>
<tr>
<td>5% level</td>
<td>-3.414119</td>
<td></td>
</tr>
<tr>
<td>10% level</td>
<td>-3.129163</td>
<td></td>
</tr>
</tbody>
</table>


Augmented Dickey-Fuller Test Equation
Dependent Variable: D(Y_ERATE)
Method: Least Squares

Sample (adjusted): 2 1046
Included observations: 1045 after adjustments
Results of ADF test shown in tables 2 and 3 clearly indicate that null hypothesis of a unit root is rejected for both series IT Nifty returns and Exchange rates, since, the obtained statistics of these series are -30.5302 and -33.11980 respectively, fall behind the critical value at all levels of significance. Thus, the two time series IT Nifty returns and Exchange rates are clearly stationary at level form itself.

**Granger Causality Test**

Correlation does not necessarily imply causation in two data series always. In the absence of any cointegrating relationship between the variables, Granger causality test based on Granger (1969, 1988) will be applied to determine the influence of one time series in forecasting another series. The method seeks to determine how much of a variable, Y, can be explained by past values of Y and whether adding lagged values of another variable, X, can improve the explanation. Y is said to be Granger-caused by X if X helps in the prediction of Y, or equivalently if the coefficients on the lagged X's are statistically significant. In two time series data, two-way causation is frequently the case; X Granger causes Y and Y Granger causes X. In the absence of cointegration, the study uses bivariate Granger causality test at the first difference of the variables. The first requirement for applying Granger Causality test is to ascertain the stationarity of the variables in the pair and for this unit root test is applied. The second requirement for the Granger Causality test is to find out the appropriate lag length for each pair of variables. For this purpose, we used the vector auto regression (VAR) lag order selection method available in Eviews 7. There are many functions (or criteria) to decide the optimal lag length and the choice of optimum lag length is at the minimum of the respective function value and is denoted as a * associated with it. Our study used Schwarz information criterion (SC). The Granger method involves the estimation of the following equations.

\[
\Delta X_t = \alpha_0 + \alpha_{11} \Delta X_{t-1} + \alpha_{12} \Delta X_{t-2} + \alpha_{13} \Delta X_{t-3} + \ldots + \alpha_{1p} \Delta X_{t-p} + \beta_{21} \Delta Y_{t-1} + \beta_{22} \Delta Y_{t-2} + \beta_{23} \Delta Y_{t-3} + \ldots + \beta_{2p} \Delta Y_{t-p} + \epsilon_{1t}
\]

\[
\Delta Y_t = \beta_0 + \beta_{11} \Delta Y_{t-1} + \beta_{12} \Delta Y_{t-2} + \beta_{13} \Delta Y_{t-3} + \ldots + \beta_{1p} \Delta Y_{t-p} + \alpha_{21} \Delta X_{t-1} + \alpha_{22} \Delta X_{t-2} + \ldots + \alpha_{2p} \Delta X_{t-p} + \epsilon_{2t}
\]
In which \( X_t \) and \( Y_t \) represent IT stock prices and exchange rates, \( \epsilon_{1t} \) and \( \epsilon_{2t} \) are uncorrelated stationary random processes, and \( t \) denotes the time period. Failing to reject \( H_0: \beta_{21} = \beta_{22} = \ldots = \beta_{2p} = 0 \) implies that exchange rates do not Granger cause stock prices. On the other hand, failing to reject \( H_0: \alpha_{21} = \alpha_{22} = \ldots = \alpha_{2p} = 0 \) implies that stock prices do not Granger cause exchange rates.

**Correlation Test:**

Further, we conducted a correlation test to study the relationship between CNX IT Nifty returns and exchange rates. The results are shown in the table 4. The coefficient of correlation between the two series found to be -0.164194, a negative correlation which indicates the existence of interdependency among time series. However, this correlation may be spurious. Therefore, the directions of influence between two series are verified by the Granger causality test.

**Table 4** Correlation coefficients matrix

<table>
<thead>
<tr>
<th></th>
<th>X_IT_NIFTY</th>
<th>Y_ERATE</th>
</tr>
</thead>
<tbody>
<tr>
<td>X_IT_NIFTY</td>
<td>1.000000</td>
<td>-0.164194</td>
</tr>
<tr>
<td>Y_ERATE</td>
<td>-0.164194</td>
<td>1.000000</td>
</tr>
</tbody>
</table>

**Granger causality test analysis**

Lastly, we used Granger-causality test to test the 4th hypothesis mentioned above. (i.e to know the direction of influence of two series IT Nifty returns and exchange rates). The results of the test are given in the Table 5. Among the two Null hypothesis “IT Nifty Stock returns do not Granger cause Exchange series” and “Exchange Rates do not Granger cause Stock returns”, the latter one is rejected at 5% level of significance which clearly tells us that, fluctuations in exchange rates have influence on IT stocks and not vice-versa. Hence, this is the clear indication of unidirectional causality and causality running from exchange rates to IT stock returns.

**Table 5** Pairwise Granger Causality Tests

<table>
<thead>
<tr>
<th></th>
<th>Obs</th>
<th>F-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y_ERATE does not Granger Cause X_IT_NIFTY</td>
<td>1044</td>
<td>8.05898</td>
<td>0.0003</td>
</tr>
<tr>
<td>X_IT_NIFTY does not Granger Cause Y_ERATE</td>
<td>0.14265</td>
<td>0.8671</td>
<td></td>
</tr>
</tbody>
</table>

It is evident that the outcome of causality between the particular indicators does not mean that movement in one indicator essentially causes movements in another indicator.
6. Conclusion and Recommendations

This research empirically examines the dynamics between the volatility of IT stock returns and movement of Rupee-Dollar exchange rates, in terms of the extent of interdependency and causality. The analysis of this study reported a relationship between exchange rate volatility and the IT stock market. This result is supportive of the presumption that the uncertainty surrounding exchange rate market distorts efficient investment allocation in IT companies. However, the IT stocks may also be affected by other macroeconomic variables namely: interest rates, money supply and the United States interest rates. The coefficient of correlation computed between the two variables indicated low negative correlation between them. This made way for determining the direction of influence between the two variables. Hence, Granger Causality test was applied to the two variables, which proved unidirectional causality running from exchange rates to IT stock returns, that is, an increase in the exchange rates caused a decline in the stock returns but the converse was not found to be true.

The findings from this study have a number of policy implications. Firstly, the weak volatility transmission from the Rupee to stock market may be indicative of increased use of hedging instruments by firms on the CNX IT Nifty. More hedging instruments needs to be put in place to ensure the elimination of negative effects of rupee volatility. These hedging instruments should be efficient and they should not distort the normal functioning of the CNX IT Nifty. Secondly, since the Indian stock market is not really exposed to the negative effects of currency volatility, relevant policy-makers can use exchange rate as a policy tool to attract foreign portfolio investment in IT related stocks.

References


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http://dx.doi.org/10.5901/mjss.2013.v4n14p561