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# IMPACT OF EXCHANGE RATE VOLATILITY ON REVENUES: A CASE STUDY OF SELECTED IT COMPANIES FROM 2005 - 2009

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## ABSTRACT

*Foreign exchange rate is a key factor in foreign trade. Recent developments in the global economy: recession and looming threat of deflation in the US and Europe has contributed to the weakening of the US dollar against most other currencies including the rupee. This has affected India's export sector, especially IT sector (about 67% of their revenues is from North America and about 90% of their exports are invoiced in US dollars). Consequently operating margins of IT Companies have been hit hard with adverse impact on stock prices. The competitive environment is such that the foreign exchange rate volatility needs to be monitored and managed. Volatility can have profound effects on earnings and stock/share prices. However, the extent and nature of this volatility crucially depends upon firm's exposure. The inter-connections between exchange rate, valuation, profitability, stock prices has to be measured and quantified as precisely as possible.This paper attempts to measure the impact of exchange rate volatility on key parameters of five IT majors in India.*

## KEYWORDS

GARCH, Omega, Vega, Delta, Beta, Persistence, Volatility, Exchange rate, Revenue, Operating profits, INR, USD.

## INTRODUCTION

Performance of the Indian Information Technology (IT) industry has been a success story all over the world. The revenue growth of the Industry has been impressive. According to as estimate of National Association of Software and Services Companies' (NASSCOM), growth rate of the industry is at 33% and total revenue (domestic and exports combined) is at USD 64 billion for year ended March 31, 2008 (*The Hindu Business line, Tuesday February 12, 2008*). However, it is projected to decline to USD 60 billion by 2010. (*The Hindu Business line, Saturday April 12, 2008)*

The last five years have witnessed a shift in the power of the various foreign currencies that Indian Rupee trades against. In particular, the US dollar has moved from being the most powerful and important currency to a position of relative non- importance following the crisis of 2008. Yet USD continues to be key element in India's exports. Indian rupee's roaring appreciation against the US dollar, although for a short period has sent a note of warning to the exporters; Software, textile, Leather, Sugar and Pharmaceutical Industries. This is especially because of the major portion of their earnings (Revenue) is from the overseas market. Nearly 67% of the Revenue is from North America and over 90% of their exports are invoiced in dollars.

Firms that have exposure to exchange risk craft well defined strategies for managing foreign exchange volatility risk. The volatility in foreign exchange is a result of multiplicity of factors, and to fully comprehend volatility a thorough review of the foreign exchange market is necessary.

The Foreign Exchange Market Today

The major currencies today move independently from other currencies. The currencies are traded on well developed market just like the commodities and securities. This has caused a recent influx of speculation by banks, hedge funds, brokerage houses and individuals. Central banks intervene on occasion to move or attempt to move currencies to their desired levels. The underlying factor that drives today's Forex markets, however, is supply and demand. The free-floating system is ideal for today's Forex markets. Thus, the volatility of the Indian rupee against the dollar is of great concern for especially the IT sector companies.

This is a case study of selected major IT firms in India from 2005 to 2009. Secondary data available from company reports, journals and websites has been used.

## OBJECTIVES

- To estimate daily exchange rate volatility.
- To evaluate the impact of exchange rate volatility on the revenues of the IT sector companies.
- To evaluate the impact of exchange rate volatility on the share price of IT sector companies.

## RESEARCH METHODOLOGY

### RESEARCH DESIGN

The study is both qualitative and quantitative. The quantitative data will be used to support the qualitative facts obtained. The study concentrate on the major 5 IT sector companies only namely;

- Tata Consultancy Services Ltd
- Infosys Technologies Ltd
- Wipro Technologies Ltd
- HCL Technologies Ltd

### DATA SOURCES AND COLLECTION

Secondary data has been used. The sources used include mainly company reports, newspaper articles, journals and magazines, research bulletins, and other accessible publications.

*Data Analysis Techniques*

First, to estimate daily exchange rate volatility a *Generalized Auto Regressive Conditional Heteroscedastic (GARCH) Model* is used. The model specification is:

$\sigma_n^2 = \gamma V_L + \alpha u^2_{n-1} + \beta \sigma^2_{n-1}$

modified as

$\sigma_n^2 = \omega + \alpha u^2_{n-1} + \beta \sigma^2_{n-1}$

Where $\gamma$, $\alpha$, $\omega$ and $\beta$ are constants and

$\omega = \gamma V_L$

Secondly, to measure the impact of exchange rate volatility on the profitability of the IT sector companies, *revenue and operating profits* of five companies is correlated with exchange rate.

The following regression equations are used:

*Rev_Company* = $\alpha + \beta$ *(Exch_Rate)*

*EBIT_Company* = $\alpha + \beta$ *(Exch_Rate)*

Where $\alpha$ *and* $\beta$ are constants, *Rev_Company and EBIT_Company,* are Revenue and Operating profit of the company respectively, *Exch_Rate* means exchange rate between Rs and USD.

Finally to evaluate the impact of exchange rate volatility on the share price of IT sector companies, daily share prices of the companies is correlated with exchange rate:

The regression equation applied is;

*Share P_Company* = $\alpha + \beta$ *(Exch_Rate)*

Where *Share P_Company* is the share price of the company and $\alpha$ and $\beta$ are constants.

## ESTIMATING EXCHANGE RATE VOLATILITY – THE MODEL

It is well-established that the volatility of asset prices displays considerable persistence. That is, large movements in prices tend to be followed by larger moves, producing positive serial correlation in squared returns. Thus current and past volatility can be used to predict future volatility[1]

The methods of measuring volatility have evolved over time to reflect new advances in econometric techniques. There has not yet emerged a clearly dominant approximation for uncertainty. The volatility variable may be constructed as the standard deviation of a rate of change, or the level, of a variable; a moving standard deviation, or a within-period one (*Mohsen & Hegerty, 2007*)

The most popular model for estimating volatility however is the GARCH (1, 1) Model proposed by *Bollerslev* in 1986. The GARCH model has been used to characterize patterns of volatility in U.S. dollar foreign exchange markets (*Baillie and Bollerslev 1989 and 1991*) and in the European Monetary System (*Neely,1999)*

The variance rate ($\sigma_n^2$) is calculated from a long-run average rate, $V_L$ as defined in the equation;

$\sigma_n^2 = \gamma V_L + \alpha u^2_{n-1} + \beta \sigma^2_{n-1}$

This equation can also be written as;

$\sigma_n^2 = \omega + \alpha u^2_{n-1} + \beta \sigma^2_{n-1}$

Where $\omega$ is set equal to $\gamma V_L$

When $\alpha + \beta < 1$, the variance process displays mean reversion to the unconditional expectation of $\sigma_n^2$, $\omega / (1-\alpha-\beta)$. That is, forecasts of volatility in the distant future will be equal to the unconditional expectation of $\sigma_n^2$, $\omega/ (1-\alpha-\beta)$. *Table 1* explains the parameters used in the GARCH (1, 1) Model

**TABLE – 1: PARAMETERS USED IN ESTIMATING VOLATILITY**

| Symbol | Description0 |
|---|---|
| $\sigma_n$ | Defined as the Volatility of exchange rate at day "n" estimated at the end of day "n-1" |
| $\sigma_n^2$ | Defined as the variance rate |
| $U_n$ | Defined as the percentage change in the exchange rate between the end of day "n-1"and the end of day "n" between Rs and USD |
| $V_L$ | Long - run average variance rate |
| $\omega$, $\gamma$, $\alpha$ and $\beta$ | Constants |

*Estimating Volatility*

$\sigma_n^2 = 0.0000029366 + 0.008306\, u^2_{n-1} + 0.722034\, \sigma^2_{n-1}$

from $\gamma + \alpha + \beta = 1$

Then, $\gamma = 0.26966$

Further, $\omega = \gamma V_L$, Therefore, $V_L = 0.0000029366 / 0.26966$

$= 0.0000108$

Thus, the ***long run average variance*** implied by the model is *000001089.* This corresponds to volatility of *√0.00001089 = 0.0033 = 0.33%* per day. Therefore, the ***Long-term volatility*** equals 0.33% per day.

The ***Long-term volatility of the year*** equals 0.33* *√252=5.23%*

**TABLE – 2: PARAMETER VALUES FOR ESTIMATING VOLATILITY BETWEEN 2005 TO 2009**

| Parameter | 2005 | 2006 | 2007 | 2008 | 2009 |
|---|---|---|---|---|---|
| $\Omega$ | 2.94E-06 = 0.0000029366 | 1.19E-06 = .0000011930 | 2.4E-06 = .0000024166 | 1.4E-06 = 0.000001407 | 1.24E-06 = 0.000001247 |
| A | 0.008306 | 0.835337381 | 0.058298587 | 0.09254248 | 0.016693584 |
| B | 0.722034 | 0.914870715 | 0.831786413 | 0.89153412 | 0.947678416 |
| $V_L$ | 5.23% | 6.032% | 7.3022% | 14.92% | 9.36% |

**DISCUSSION**

- In 2005, the daily exchange rate volatility ranges between 0.187% and 0.477% for most of the periods with long term volatility averaging 0.33% .Long run yearly variance is 5.23%
- In 2006, daily volatility ranges between 0.234% and 0.5067% with long-term average volatility of 0.38%. Long run yearly variance is 6.023%
- In 2007, daily volatility ranges between 0.289% and 0.626% with long-term average volatility of 0.46%. Long run yearly variance is 7.30%
- In 2008, daily volatility ranges between 0.648% and 1.49% with long-term average volatility of 0.94%. Long run yearly variance is 14.92%. During this period INR had appreciated against USD, so volatility is high in this period.
- In 2009, daily long-term average volatility was 0.59%. Long run yearly variance is 9.36%.

**EXCHANGE RATE VOLATILITY AND PROFITABILITY**

The relationship between exchange rate volatility and the performance of IT firms as measured by proftability/(earnings) i.e., how the firms earnings/ profits respond to changes in exchange rates between Indian Rupee (INR) and US Dollar (USD) is analysed. The general trend in exchange rate will first be analysed and the impact on firm performance will then be presented.

The analysis will be done on three basic premises:

- Revenue
- Operating profits (Earnings Before Interest and Tax- EBIT)

[2]http://research.stlouisfed.ord/wp/2001/2001-2009.pdf

**REVENUE ANALYSIS**

**TABLE – 3: RELATIONSHIP BETWEEN EXCHANGE RATE AND REVENUE**

| | corr | $R^2$ | Adjusted $R^2$ | Regression Constant (a) | Coefficient (b) | t test | Sig |
|---|---|---|---|---|---|---|---|
| **Infosys** | -.475 | .225 | .148 | 1033610.101 | -16923.52 | -1.705 | .119 |
| **TCS** | -0.536 | 0.287 | 0.216 | 1348314.622 | -23031.85 | -2.008 | 0.072 |
| **Wipro** | -0.495 | 0.245 | 0.169 | 1146422.936 | -18998.787 | -1.801 | 0.102 |
| **Satyam** | -0.601 | 0.361 | 0.297 | 604900.797 | -10503.451 | -2.377 | 0.039 |
| **HCL** | -0.261 | 0.068 | -0.025 | 231730.625 | -3443.352 | -0.853 | 0.413 |

The regression equations can be constructed for all the five companies in the form as explained in the methodolgy. These equations work out to be
Infosys:
*Rev_Infy = 1033610.101- 16923.52(Exch_Rate)*
TCS:
*Rev_TCS = 1348314.622 - 23031.85 (Exch_Rate)*
Wipro:
*Rev_Wip = 1146422.936 -18998.787 (Exch_Rate)*
Satyam:
*Rev_SAT = 604900.797 - 10503.451 (Exch_Rate)*
HCL:
*Rev_HCL = 231730.625 - 3443.352 (Exch_Rate)*

**DISCUSSION***:*

- All the five companies have a weak negative correlation with revenue. Satyam having the highest negative correlation of -0.601 and HCL having the lowest of -0.261.
- The coefficient of determination is also very low for all the companies, showing that the Revenue growth/decline is explained little by exchange rate changes.
- This means that an increase in exchange rate decreases revenue. This also holds for all the firms under study. Therefore, an appreciating currency leads to a fall in foreign-currency-denominated revenue and similarly, a depreciating currency leads to increased revenue (denominated in foreign currency). In this case, dollar denominated revenue decreases with an appreciating rupee year on year basis.

**Other Factors Responsible For Revenue Growth**

- *Currency Denomination***:** The export revenue denominated in US dollars of all the companies has been decreasing. This implies that the companies are shifting slowly from using dollars to the more stable Euro for denominating their bils. Example HCL's revenue from the USD denominated billing has been declining from 57.11% to 55.00% . in the same period, revenue from Euro denominated billing has increased from 26.01% to 29.70%[2]
- *Hedging***:** The hedge positions of all the companies has been increasing showing their response towards currency risk by hedging. For example, the hedging position of TCS as at March 31, 2007 was $1434 million compared to $566 millions as at March 31, 2006[3] indicating an aggressive hedging strategy.
- *Outsourcing***:** India is a powerhouse catering to almost all the leading global companies of the world. IBM, Cisco, Yahoo! Amazon and Oracle all outsource from India. India gives complete solutions supported by its technological ability, quality, flexibility, and cost effectiveness; time to market and in turn the competitive edge[4]. This helps indian companies in absorbing the shocks of currency fluctuations.

**Operating Profits (EBIT) Analysis**

**TABLE – 4: RELATIONSHIP BETWEEN EXCHANGE RATE AND OPERATING PROFITS**

| | Corr | $R^2$ | Adjusted $R^2$ | Regression Constant (a) | Coefficient (b) | t test | sig |
|---|---|---|---|---|---|---|---|
| **Infosys** | -0.313 | 0.098 | 0.008 | 223602.593 | -2990.549 | -1.042 | 0.322 |
| **TCS** | -0.431 | 0.186 | 0.104 | 340267.028 | -5492.455 | -1.511 | 0.162 |
| **Wipro** | -0.165 | 0.027 | -0.070 | 119160.425 | -1068.377 | -0.529 | 0.608 |
| **Satyam** | -0.170 | 0.029 | -0.068 | 77817.176 | -828.387 | -0.545 | 0.598 |
| **HCL** | -0.273 | 0.074 | -0.018 | 91177.153 | -1528.664 | -0.897 | 0.391 |

The regression equations can thus be constructed as;
Infosys
*EBIT_Infy = 223602.593 - 2990.549 (Exch_Rate)*
TCS
*EBIT_TCS = 340267.028 - 5492.455 (Exch_Rate)*
Wipro
*EBIT_Wip= 119160.425 - 1068.377 (Exch_Rate)*
Satyam
*EBIT_SAT = 77817.176 - 828.387 (Exch_Rate)*
HCL
*EBIT_HCL = 91177.153 - 1528.664 (Exch_Rate)*

**DISCUSSION**:

- There is generally weak correlation between exchange rate and Operating profits. For all the companies, the correlation is negative and less than 0.500, the highest being TCS' -0.431 and the lowest being Wipro's -0.165.The coefficient of determination is also very weak averaging between 2.7% for Wipro and 18.6% for TCS. Implying that there is less association between ecahange rate and operating profits.

**EXCHANGE RATE VOLATILITY AND SHARE PRICES**

The relationship between share price and exchange rate can be analysed from the data in *table* below

[2] HCL Technologies Ltd., Quarterly reports 2005-2007
[3] Jyotsna & Veerendra, Indian IT Industry, will it be a victim of "Dutch Disease"? Treasury Management, February 2008.
[4] http://sify.com/finance/fullstory.phd?id=14579322

**TABLE – 4: RELATIONSHIP BETWEEN EXCHANGE RATE AND SHARE PRICE**

| | Correlation | Coefficient of Determination $R^2$ | Constant , α | Beta value, β |
|---|---|---|---|---|
| **Exchange rate** | | | | |
| **Infosys** | 0.820 | 0.672 | -1593.887 | 85.967 |
| **TCS** | 0.779 | 0.606 | -741.203 | 45.779 |
| **Wipro** | 0.829 | 0.688 | -602.404 | 27.388 |
| **Satyam** | 0.300 | 0.090 | 292.284 | 4.008 |
| **HCL** | 0.799 | 0.639 | -2106.520 | 60.143 |

**DISCUSSION**:

Infosys

There is a positive correlation between exchange rate and the share price of Infosys stock The relationship is very strong and highly positive. The coefficient of determination $R^2$ of 67.2% is high and thus indicates that the movement in the infosys share price can be explained by the exchange rate movements. There degree of relationship can be explained by the regression equation below;

*Share P_Infy = -1593.887 + 85.967(Exch_rate)*

TCS

There is a strong positive correlation between exchange rate and the share price of TCS The coefficient of determination, $R^2$ of 60.6% is also high enough to justify using the model. Thus, the movement in the TCS share price can be explained by the exchange rate movements. The degree of relationship is thus explained by the regression equation below;

*Share P_TCS = -741.203+ 45.779 (Exch_rate)*

WIPRO

There is a strong positive correlation between exchange rate and the share price of Wipro. The coefficient of determination, $R^2$ of 68.8% is also high. This implies the model will correctly bringout the relationship. Thus, the movement in the TCS share price can be explained by the exchange rate movements. The degree of relationship is thus explained by the regression equation below;

*Share P_Wipro = -602.404 + 27.388 (Exch_rate)*

SATYAM

There is a very weak positive correlation between exchange rate and the share price of Satyam. The coefficient of determination, $R^2$ of 9.0% is too low. This implies the model will not correctly bringout the relationship. Thus, the movement in the Satyam share price can't be explained fully by the exchange rate movements. The degree of relationship can be explained by the regression equation below;

*Share P_Satyam = 292.284 + 4.008 (Exch_rate)*

HCL

There is a strong positive correlation between exchange rate and the share price of HCL. The coefficient of determination, $R^2$ of 63.9% is also high. This implies the model can correctly bringout the relationship. Thus, the movement in the HCL share price can be explained by the exchange rate movements. The degree of relationship is thus explained by the regression equation below;

*Share P_HCL = -2106.520 + 60.143 (Exch_rate)*

## CONCLUSIONS

**REVENUE AND EXCHANGE RATE**

- Revenues of all the five IT companies is increasing but at a decreasing rate
- On the relationship with revenue, the study found out that there is a weak and negative correlation coefficient. Further, the coefficient of determination is low, implying that exchange rate is a weak factor in explaining the revenue movements. Therefore other factors that explain this trend in revenue:
  - Decline in dollar denominated exports, in favor of the Euro
  - Hedging currency exposures to minimize volatility impact
  - Pursuing other value based strategies that have helped improve the quality of services and thereby help maintain growth
- The regression equations obtained help clarify the nature of relationship that exist between INR and USD. It has been found that an appreciation of USD against INR reduces revenue, and similarly depreciation in exchange rate between USD and INR increases revenue, other factors being constant, because all the revenues are billed in dollar and there is negative correlation between exchange rate and revenues.

**OPERATING PROFIT AND EXCHANGE RATE**

- Operating profit has also followed the same trend as revenue, increasing at a decreasing rate
- The operating margins have however been coming down
- The study also found out that there is a weak and negative relationship as indicated by correlation coefficients of the different companies in the sample. The coefficient of determination is also very weak averaging between 2.7% and 19%. Thus, exchange rate movements have no significant impact on operating profits
- The same observations can be made from the results of the regression. The two variables are negatively related thus implying that an increase in exchange rate reduces operating profit and vice versa.

**SHARE PRICES AND EXCHANGE RATE**

Observations from the study on the relationship between exchange rate and share prices include;

- The share prices of four of the five companies (excepting Satyam) are highly positively correlated. The share price of ***Satyam*** has a low positive correlation of 0.300 and a low coefficient of determination of 9.0%. Implying that Satyam share price is less affected by exchange rate movements. But, Satyam stock price is the most volatile of the five stocks.
- The share price of ***Infosys*** is highly positively correlated at 0.820 with a coefficient of determination of 67.2%, implying is highly affected by exchange rate movements
- The share price of ***TCS*** is highly positively correlated at 0.779 with a coefficient of determination of 60.6%. However, it's share price is relatively less volatile with decreasing volatility.
- ***Wipro*** and ***HCL*** are no exceptions. They too posted strong positive correlations of 0.829 and 0.799 respectively with coefficients of determination of 68.8% and 63.9%.

In general, the companies exhibiting weak correlation between earnings and volatility have used currency derivaties effectively to minimize the risk of exchange rate volatility. Companies with moderate to strong correlation between earning and volatility have not used currency derivaties effectively and were exposed to volatility in their profitability.

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20) http://www.tcs.com/
21) http://www.satyam.com/
22) http://www.hcltech.com/
23) http://www.exchange-rates.org
24) http://www.rbi.org.in/
25) http://www.thehindubusinessline.com/
26) http:/www.ratesfx.com

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