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IS INDIAN FOREX MARKET PERSISTENT?

Muskan Karamchandani[1] and Savera Jain[2]

[1]Assistant Professor, International Institute of Professional Studies, Devi Ahilya Vishwavidyalaya, Indore, India
Email: karamchandanimuskan@gmail.com
[2]Student (Final Year MBA), International Institute of Professional Studies, Devi Ahilya Vishwavidyalaya, Indore, India
Email: savera.jain@gmail.com

ABSTRACT

The world has become financially integrated which provides nations ample opportunity to directly invest in international markets, borrow funds at profitable rates, avail arbitrage opportunity and earn increased profits. These opportunities have increased the importance of foreign exchange market for every country. So, greater understanding of functioning of foreign exchange market is required in the emerging dynamics of global economy. This study attempts to study Indian foreign exchange market with the much celebrated econophysics tool of Hurst analysis for a period of five years spanning from January 2008 to January 2013. The values of Hurst exponent represent persistent/anti-persistent behaviour of the data series. The persistence / anti persistence of behaviour helps in throwing light on randomness of the market.

The findings reveal the random nature of Indian Foreign Exchange Market, which render the applicability of any profit making strategy useless.

Keywords: Hurst exponent, Indian Foreign Exchange Market, Financial Integration

INTRODUCTION

The emerging dynamics of global economy demand greater understanding of functioning of foreign exchange market. It is imperative then to attempt gaining insights on the persistency of the Indian foreign exchange market. Nations can unswervingly invest in international markets to avail arbitrage opportunity and earn increased profits similarly, funds can be borrowed from international markets at profitable interest rates. Foreign exchange rate (USD/INR) has shown tremendous volatility in the last 5 years. It has increased from 39.42 rupees per Dollar in January 2008 to 53.29 rupees per Dollar in January 2013 and is still volatile.

This study is an exploration of the persistence/ antipersistence behaviour of Indian Foreign Exchange Market. The econophysics concept of Hurst Analysis estimates the persistency of time series by the historical price data. It is the relative tendency of a time series to either 'cluster' in a direction or regress to a longer term mean value. Hurst classifies a time series on the basis of its long term dependencies which helps to identify the markets which have higher predictability.

Technical analysis is widely used by academicians to predict future price movements but the informational content of technical analysis is even opposed by some studies (Allen and Karjalainen (1999), Lo, Mamaysky and Wang (2000), and Bokhari, J., Cai, C., Hudson, R., and Keasey, K. (2005).

OBJECTIVES

The study intends to hit upon Hurst exponent analysis in the Indian Foreign Exchange market. The market under study would be explored for a period of 5 years from January 2008 to January 2013. The objective is to investigate persistency of the Indian Foreign Exchange Market by Hurst Analysis.

LITERATURE REVIEW

Hurst analysis is an extensively used tool in modern finance. The *H* was investigated in foreign exchange market for various currencies like the British Pound, the Canadian Dollar, the German Mark, the Swiss Franc, and the Japanese Yen by Corazza and Malliaris (2002). It was found that in the majority of the studied sample, the foreign currency markets exhibit an *H* that is statistically different from 0.5 and this value changes dynamically over time. Glenn (2007) investigated the Hurst exponent of time series on the NASDAQ using the rescaled range analysis and calculated *H* of 0.59 for 1-day returns on the NASDAQ. Similarly, other significant studies have been done on the use of Hurst exponent to measure the market predictability (Peters (1991), etc).

Moreover, Hodges (2006) and Bender et al. (2006) investigated the possibility of developing portfolios on the basis of long term dependencies of time series. Investor's ability to form arbitrage portfolios under realistic transactions costs for different values of H was studied by Hodges (2006). While a general theory of arbitrage portfolio building was developed by Bender et al. (2006) based on long term dependencies of time series using synthesis of different tools and Hurst analysis.

METHODOLOGY

The Indian Foreign Exchange Market finds adequate representation through USD/INR. Daily returns from the time series of USD/INR for the period of January 2008 to January 2013 are used to calculate the Hurst exponent.

1*)* Return Calculation : The raw series of daily USD/INR is converted into return series so as to avoid the problem of highly non stationary and highly volatile exchange rate which interferes in calculation of technical trading rules as well as that of Hurst. Returns are calculated by following:

$r_t = \log(p_t) - \log(p_{t-1})$ (1)

Here, p_t=spot price of USD/INR, r_t =log returns

The descriptive statistics for the daily return series of USD/INR for last five years was studied.

2) The Hurst Exponent (H)

The basis of the rescaled range analysis was laid by Hurst et al. (1965) and was further examined and elaborated by Mandelbrot and Wallis (1968, 1969a, 1969b, and 1971). The *H* measures dependencies in time series and is calculated through rescaled range analysis (R/S

analysis) in the study. For a time series where X = X_1, X_2 , …,X_n, R/S analysis can be calculated by firstly determining the mean value m:

$$m = \frac{1}{n}.\sum_{i=1}^{n} X_i \quad (2)$$

Here, X_i is the daily return series of USD/INR

Secondly, Mean adjusted return series Yt is generated:

$Yt = Xt - m, \quad t= 1, 2, \ldots, n$ (3)

Thirdly, the cumulative deviation series Z is calculated:

$$Z_t = \sum_{i=1}^{t} Y_i, \; t=1,2,\ldots,n \quad (4)$$

Fourthly, the range series R is calculated:

$$Rt = max(Z1, Z2, \ldots, Zt) - min(Z1, Z2, \ldots, Zt), \qquad t= 1, 2, \ldots, n \quad (5)$$

Fifthly, the standard deviation series S is calculated:

$$S_t = \sqrt{\frac{1}{t}\sum_{i=1}^{t}(X_i - u)^2} \quad (6)$$

Here, u is the mean from X1 to Xt

Finally, the rescaled range series (R/S) can be estimated:

$(R/S)t = Rt / St, \; t= 1, 2, \ldots, n$ (7)

Hurst exponent is calculated as the slope of the line generated by taking log (sample size) on x axis and log(R/S) on y axis. Sample size varies as n, n/2, n/4 and so on, series of rescaled range is calculated separately for different sample sizes.

FINDINGS AND DISCUSSIONS

Descriptive Statistics

Table 1. Descriptive Statistics

	Minimum	Maximum	Mean	Standard Deviation	Skewnwss	Kurtosis	Valid N (list wise)
USD/INR	-3.0065	2.4903	.024589	.5897270	-.089	2.068	1226

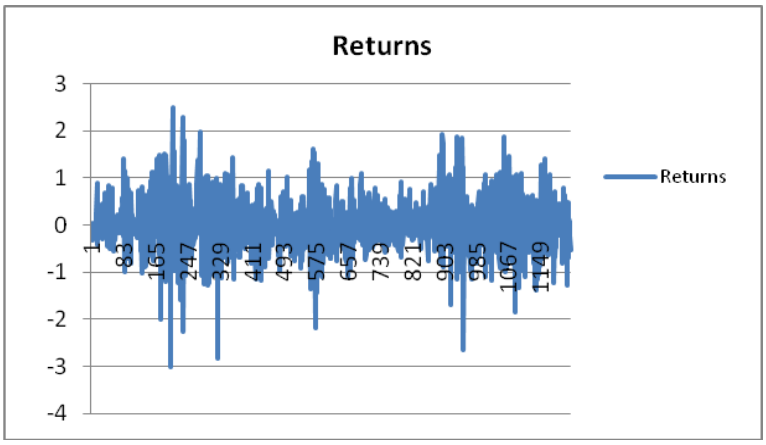

Figure 1. Daily Returns of USD/INR for January2008-January 2013

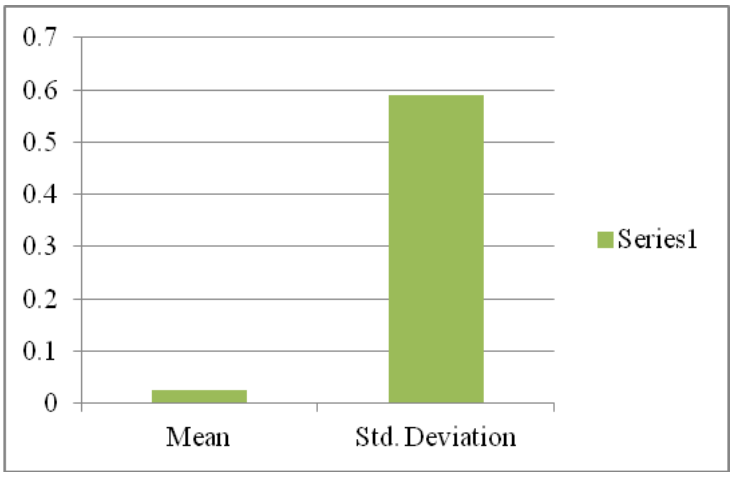

Figure 2. Mean and Standard Deviation

Hurst Exponent

Hurst calculates the persistency of market. The value of Hurst shows different behaviours of the data series on the basis of the following results:

- If the value so calculated lies between 0 and .5 it indicates anti-persistent behaviour of the series,
- If the value so calculated is equal to .5 it indicates fractal Brownian motion or Random Walk, and
- If the value so calculated lies between .5 and 1it indicates persistent behaviour of the time series.

The calculation of Hurst is done for last 5 years i.e., from 1st January 2008 to 31st January 2013.

Table 2. Hurst Exponent Calculation

Number of observations(N)	Average Rescaled Range (R/S)	$Log_2(N)$	Log_2(Average R/S)
1226	52.92619	10.25974	5.725909936
613	39.37281	9.259743	5.299127939
306.5	21.31414	8.259743	4.413739007
153.25	15.16934	7.259743	3.923086199
76.63	13.12803	6.259837	3.714578018
38.31	9.725552	5.259649	3.281780185

The Hurst is found to be .499 which is very close to .5, as shown in Fig. 3 below. Hence, the foreign exchange market exhibits random walk. (Random walk and efficiency) In a series indicating random walk behaviour, there is no correlation between the present and future elements. Also, there is a 50% probability about future returns values going either up or down. These series are difficult to predict.

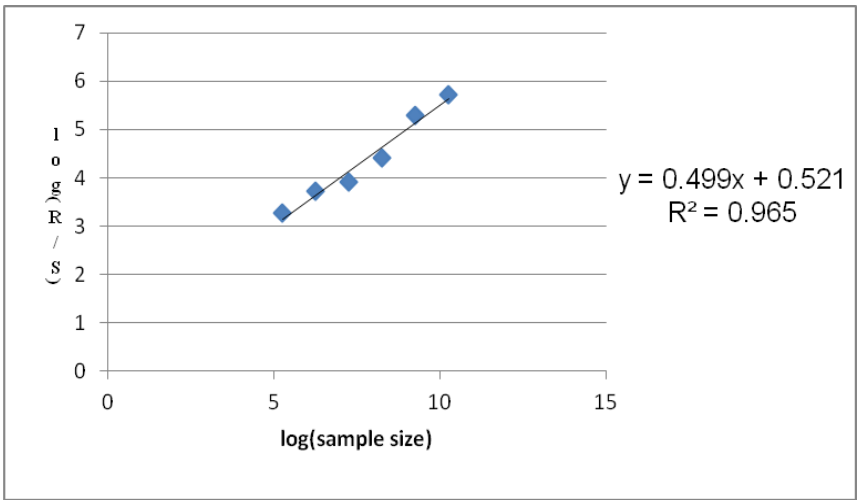

Figure 3. Hurst Exponent

Hence, the data series of past five years of Indian Foreign Exchange market is difficult to predict as it exhibits random walk. The result shows that in Indian Foreign Exchange market future prices could not be predicted by past prices, volume and other market statistics.

CONCLUSION

Hurst analysis is a concept of physics. But nowadays it is widely used in several areas of applied mathematics, including fractals and chaos theory, long memory processes and spectral analysis. In the study, Hurst is used to estimate the persistency of data series of Indian foreign exchange market.

Hurst exponent which is now a frequently used tool for analysis of stock market finds an innovative application in Indian Foreign Exchange Market.

The value of Hurst is calculated as .499~.5. This depicts that Indian foreign exchange market exhibits Random Walk behaviour. Investors could not predict the future price movements or

the future profit margins from foreign exchange market data because of the randomness of the series.

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