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An Experimental Study on Currency Market Efficiency USDCHF Currency Pair

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Abstract: **The purpose of this study is to analyze the efficiency of foreign exchange market using Random Walk Models. For the efficient market hypothesis, daily rates of USDCHF currency pairs for 5 years period from 01/01/2009 to 31/12/2013 are taken. It is found that the foreign exchange market is not weak form efficient in respect of this currency pair, and traders of foreign exchange in respect of these current pair is able to predict their future values based on their values in the recent past.**

Keywords: **Currency market efficiency, USDCHF Currency Pair.**

I. INTRODUCTION

The purpose of this study is to analyze the efficiency of foreign exchange market using Random Walk Models, viz., Serial Correlation test (Autocorrelation test) and Augmented Dickey Fuller (ADF) test (also called as Unit root test). This is because of the fact that Efficient Market Theory and the Random Walk Model have been at the centre of debate in financial literature for several decades. In developing economies like India, analyzing the efficiency of the functioning of the foreign exchange market may help to solve the concerns of the investors and also can simulate their interest in foreign exchange market activities.

II. METHODOLOGY

For the efficient market hypothesis, daily rates of selected currency pairs for 5 years period from 01/01/2009 to 31/12/2013 are taken. To test the randomness in the return sequence of selected currency pairs as well as the efficiency of the foreign exchange market in terms of these currency pairs, the statistical tools such as Autocorrelation (Serial correlation) and Augmented Dickey Fuller (ADF) test are used in the present study. The details of these tests are given hereunder:

Autocorrelation / Serial Correlation Test

Autocorrelation test is the most commonly used tool to test weak form efficiency. This test measures the correlation between series of returns and lagged series and tested whether the correlation coefficients are significantly different from zero. That is, autocorrelation measures the relationship between the foreign exchange market return at current period and its value in the previous period. It is calculated as per the formula given hereunder:

$$\rho_k = \left[\frac{\sum_{t=n-k}^{n} (r_i - \bar{r})(r_{t-k} - \bar{r})}{\sum_{t=1}^{n} (r_i - \bar{r})^2} \right]$$

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where ρ_k is the serial correlation coefficient of stock returns of lag k, k is the lag of the period, n is the number of observations, r_i is the stock return over period t, r_{t-k} is the stock return over period t-k, and $\bar{r}$ is the mean of stock returns.

Unit Root Test

Unit root tests are used to see that whether the financial time series is non-stationary which is necessary condition for a random walk. Here Augmented Dickey-Fuller (ADF) test is used to test whether a unit root is present in the foreign exchange market return series. The more negative it is the stronger is the rejection of the hypothesis that there is a unit root at a given level of confidence.

Objectives of the Study

The present study is undertaken with the following objectives:

1. To analyze the efficiency of the Foreign Exchange Markets relating to USDCHF currency pairs.
2. To test whether the return from Foreign Exchange Market has a unit root or not in relation to USDCHF Currency pair.

III. EFFICIENCY MARKET HYPOTHESIS

Fama (1965) evolved Efficient Market Hypothesis in his doctoral research work and he persuasively made the argument that in an active market, which includes many well-informed and intelligent investors, securities will be appropriately priced, and reflect all available information. Thus, if a market is efficient, no information or analysis can be expected to result in the out-performance of an appropriate benchmark. The "efficient market hypothesis" posits that investors adjust securities prices rapidly to reflect the effect of new information. Proponents of the efficient market hypothesis argue that stock prices are essentially random and therefore, there is no chance for profitable speculation in the stock market. The efficient market hypothesis is based on the assumption that share prices follow a random walk and successive price changes are independent of each other (Rapuluchukwu, 2010). Samuels and Wilkes (1981) defined an efficient market as one in which prices of traded instruments (equity shares or foreign currencies) always fully reflect all publicly available information concerning those instruments. Further, they identified necessary conditions for an efficient market to include accurate signals for investors' choices. The identified necessary condition is that today's price which reflects all publicly available information is the best estimate of tomorrow's price. Thus, a capital market (stock market or foreign exchange market) is said to be efficient if information is widely and cheaply available to investors such that share prices are fair.

IV. RANDOM WALK THEORY

Small and medium investors can be motivated to save and invest in the capital market only if their securities in the market are appropriately priced. The information content of events and its dissemination determine the efficiency of the capital market. In the developed countries, many research studies have been conducted to test the efficiency of the capital market with respect to information content of events (Raja and Sudhahar, 2010). Since the real markets are not perfectly efficient, three levels of efficiency have been defined, based on the information that is reflected in prices. Fama (1970) classified the market efficiency into the three categories as: Weak form efficiency, Semi strong form efficiency and Strong form efficiency. The market is considered to be weak form efficient if the prices (share prices / currency prices) reflect all the information that is contained in the historical sequence of prices. At the same time, a financial market is considered to be the semi strong form efficient if the current market prices not only reflect all information content of historical prices but also reflect all publicly available information. On the other hand, strong form of efficiency of the market is the one in which current market prices reflect all information whether it is publicly or privately (insiders information) available or private information. So, the share price or currency price movements are said to be at random if future price movements cannot be predicted based on any patterns or trends in the past. Hence, the random walk theory asserts and emphasizes that the price movements in share market or currency market will not follow any patterns or trends and past movements

cannot be used to predict future movements. Therefore, in the random walk, successive changes in each direction are independent without the affection of each other results. The next time's result cannot be predicted before it happens at all.

V. REVIEW OF LITERATURE

Christos Kollias et al. (2012), discussed that both the goods market hypothesis and the portfolio balance theory, suggested a nexus between exchange rates and stock prices, albeit with a different direction of causality. They used daily data, takes up the issue of the linkages between stock prices and exchange rates in the case of the euro-dollar rate and two composite European stock market indices: the FTSE Eurotop 300 and FTSE eTX All-Share index. The empirical results provided evidence of time-varying causality between the two markets. Mayowa Gabriel Ajao and Richard Osayuwu (2012) tested weak form efficient market hypothesis in the Nigerian capital market. The serial correlation technique of data analysis was used to test for independence of successive price movement and the distributive pattern while runs test was used to test for randomness of share price movement. They concluded that the past and future prices of stocks traded in the Nigerian Stock market are independent. Kuntara and Lee (2008) in their article on "Weak-Form Efficiency in Currency Markets" found the currencies trend and technical trading rules produced statistically and economically significant profits. In other words, foreign exchange markets were weak-form inefficient. The study examined this phenomenon with use of a new database of currency futures for 1975-2006 that included old and newly liquid currencies. The findings from the recent data are contradictory. The profitability of trend following eroded for major currencies and their associated cross exchange rates around the mid-1990s. Newly liquid currencies after 2000 do trend, however, just as major currencies did in earlier years. The evidence is consistent with early weak-form inefficiency followed by vanishing trends as traders learn and adapt their strategies. Reddy and Sebastin (2008) found that entropic analysis is a novel area in the Indian financial market and there is a lot of scope for the application of entropic analysis in the Indian markets. They applied entropic analysis to study interaction between forex and stock market and transfer entropy is found to be suited and it was found that only low level interactions existed between the two markets in India although theory suggests interactive relationship between the two markets. Samuel Dupernex (2007) defined and discussed Random Walk Model and outlined its relationship to the efficiency of markets. Empirical evidence is used to investigate the arguments for and against the model. He concluded that the EMH can be used as a benchmark for measuring the efficiency of markets, and from this the traders will have at least a rough idea as to whether the stocks are likely to follow a random walk.

Autocorrelation (Serial Correlation)

To ascertain the reliability or validity of the results of the Runs test, the autocorrelation (also called as serial correlation) test is employed in the present research work. The autocorrelation on foreign exchange market returns series of selected currency pairs is run for 20 lags. The results of the autocorrelation for selected currency pairs are tabulated and discussed hereunder.

5.1 Autocorrelation of USDCHF Currency Pair

Table 1.1 reports the autocorrelation coefficient along with significant test-statistics for price movements in USDCHF currency pair for lag one to lag twenty.

It can be seen from the table that the autocorrelation of daily returns on USDCHF currency pair is significant at lag 14, 17, 18 and 19 and also autocorrelations of all 20 lags are significant (Q statistic 47.88, $p < 0.01$).

The above figures indicate that the daily price returns at levels does not follow a random walk and historical information in earlier period tend to predict the daily price returns at current period. The significant autocorrelation for all lags clearly envisages that foreign exchange market in terms of USDCHF currency pair is weak form inefficient. For the first differences of return series, the autocorrelation coefficient is significant and negative at lag 1 and at lag 14.

The significant negative correlations at these two lags had revealed the price reversals at current period based on information inherent in the return series in the past. The Q statistics for autocorrelation of all 20 lags is also significant at 1 per cent level (Q stat = 361.16, $p < 0.01$), in turn indicating that USDCHF currency pair is inefficient in foreign exchange market.

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Table 5.1 Autocorrelation Coefficients and Q Statistics for Price Movements in USDCHF Currency Pair for Lags 1 through 20

Lag	Levels			First Difference		
	AC	Q Stat	p Value	AC	Q Stat	p Value
1	-0.0040	0.02	0.8945	-0.5090**	338.97	0.0000
2	0.0160	0.32	0.5696	0.0390	1.97	0.1604
3	-0.0430	2.41	0.1204	-0.0280	1.04	0.3078
4	-0.0420	2.36	0.1245	-0.0290	1.09	0.2965
5	0.0140	0.26	0.6083	0.0240	0.74	0.3897
6	0.0240	0.73	0.3942	-0.0030	0.02	0.8875
7	0.0380	1.87	0.1710	0.0110	0.16	0.6892
8	0.0310	1.25	0.2632	0.0090	0.12	0.7290
9	0.0040	0.03	0.8717	-0.0250	0.79	0.3741
10	0.0280	1.07	0.3016	0.0070	0.06	0.8065
11	0.0390	1.97	0.1604	0.0170	0.36	0.5485
12	0.0170	0.40	0.5297	-0.0070	0.08	0.7773
13	0.0090	0.12	0.7312	0.0470	2.95	0.0859
14	-0.0920**	11.08	0.0009	-0.0740**	7.16	0.0075
15	-0.0490	3.12	0.0772	0.0020	0.00	1.0000
16	-0.0090	0.12	0.7345	-0.0130	0.23	0.6315
17	0.0560*	4.20	0.0404	0.0180	0.43	0.5120
18	0.0880**	10.24	0.0014	0.0270	0.97	0.3247
19	0.0630*	5.19	0.0227	0.0340	1.52	0.2176
20	-0.0290	1.12	0.2891	-0.0430	2.50	0.1138
All Lags		47.88	0.0004		361.16	0.0000

**Significant at 5% level; **Significant at 1% level.*

5.2 Augmented Dickey-Fuller Test of USDCHF Currency Pair

Table 5.2 shows the ADF test results of return series USDCHF currency pair in foreign exchange market.

Table 5.2 ADF Test Results for Return Series of USDCHF Currency Pair

Particulars		Without Drift & Trend (None)	With Drift (Constant)	With Drift & Trend (Constant & Trend)
ADF test statistics		-36.25**	-36.25**	-36.23**
#Test Critical values	1% level	-2.57	-3.44	-3.97
	5% level	-1.94	-2.86	-3.41
	10% level	-1.62	-2.57	-3.13
Augmented Dickey-Fuller Test Equation **Dependent Variable: D(RETURN)**				
RETURN(-1)	Coefficient	-1.0034	-1.0037	-1.0037
	SE	0.0277	0.0277	0.0277
	t-Statistic	-36.25**	-36.25**	-36.23**
	p Value	0.0000	0.0000	0.0000
C	Coefficient		-0.0001	-0.0002
	SE		0.0002	0.0005
	t-Statistic		-0.53	-0.35
	p Value		0.5944	0.7285

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Trend	Coefficient			0.0000
	SE			0.0000
	t-Statistic			0.09
	p Value			0.9254
R^2		0.5023	0.5025	0.5025
Adjusted R^2		0.5023	0.5021	0.5017
SE of Regression		0.0082	0.0082	0.0082
Sum of Squared Residuals		0.0866	0.0866	0.0866
F Value of Regression			1313.85**	656.43**
p Value			0.0000	0.0000

*#MacKinnon one-sided p-values; **Significant at 1% level*

As shown in the table, the ADF test statistic value of -36.25 for model without drift and trend is less than one tailed critical value of -2.57 for 1 per cent level, -1.94 for 5 per cent level and -1.62 for 10 per cent level. The ADF test statistic for model with drift but without trend, -36.25 is also significantly less than critical value of -3.44, -2.86 and -2.57 for 1 per cent, 5 per cent and 10 per cent levels respectively.

In the model for return series of USDCHF currency pair with both drift and trend also, the ADF test statistic, -36.23 is significantly less than the MacKinnon critical value of -3.97,

-3.41 and -3.13 for 1 per cent, 5 per cent and 10 per cent levels respectively. From the above table, it is evident that sequence of returns from USDCHF currency pair in the foreign exchange market is stationary and does not follow random walk and not have unit root.

Hence, it is deduced that the foreign exchange market is not efficient in terms of USDCHF currency pair. That is, historical prices can be used to predict the future price for this currency pair as it does not satisfy weak form of market efficiency.

VI. CONCLUSION

It is concluded that there is non-randomness in the daily exchange rate return series of USDCHF currency pair. This is also supported by the presence of serial correlation in the daily exchange rate return series as obtained from Autocorrelation analysis and absence of unit root as revealed by ADF test. From Autocorrelation test and ADF test, it is concluded that the current or future exchange rate is predictable from the exchanges in the recent past for USDCHF currency pairs.

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