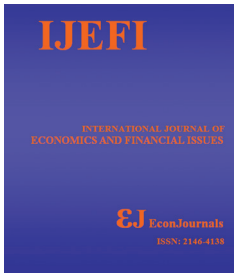

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Efficient Market Hypothesis: Foreign Exchange Market of Bangladesh

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ABSTRACT

Efficiency in a foreign exchange market (FEM) is very essential for a developing economy like Bangladesh as the foreign exchange rates play a critical role to determine the various macroeconomic policies and issues of an economy. Thus the main objective of this paper is to investigate the efficiency of the FEM of Bangladesh. Statistics that have worn in this paper comprises of nominal daily exchange rates (spot) of seven bilateral currency rates in opposition to the Bangladeshi currency Taka over the period 1st January 2010 to 30th November 2017 obtained from the website of Bangladesh Bank. The unit root test and the cointegration test are run by econometric software to look into the efficiency of the FEM of Bangladesh. The concluding findings indicate that all the seven exchange rates succeed the random walk hypothesis and this is the verification of the weak form of efficiency. Moreover, the cointegration scrutiny depicts there is no indication of the semi-strong form of efficiency in the FEM of Bangladesh.

Keywords: Foreign Exchange Market, Exchange Rate, Efficiency
JEL Classifications: F31, E44

1. INTRODUCTION

The development of the foreign exchange market (FEM) of Bangladesh is strongly related to the different exchange rate regime of the country. Bangladesh had been maintaining various pegged exchange rate regimes till 1999. It had followed 3 years crawling band exchange rate during 2000-2003. By abandoning the adjustable pegged system, Bangladesh adopted a freely floating regime on May 30, 2003. The first 10 months (June 2003–March 2004) of the floating exchange rate regime was viewed as the "honeymoon period" for Bangladesh because of the stability of the exchange rate (Hossain & Ahmed, 2009). At present Bangladesh is following real effective exchange rates (REER). Therefore, this paper aims to examine the efficiency of the FEM of Bangladesh whether it is efficient in the weak form *(W-form)*, semi-strong form *(SS-form)* or not. To check the efficiency of any financial market efficient market hypothesis (EMH) is widely used. The EMH was an academic concept, autonomously introduced and advanced by Paul A. Samuelson and Eugene F. Fama in 1960s (Malkiel & Fama, 1970). The EMH states that the financial or monetary markets are efficient, that refers that the financiers in these market are not able to predict the future stock price by using previous data. Fama (1991) diversified market efficiency into three grades: *Weak Form of Efficiency (W-form):* prices in this market contains all available information of the previous prices, and beating is impossible by using historical data, and thus participants cannot earn any abnormal profit from the market, *Semi-Strong Form of Efficiency (SS-form):* Prices of monetary belongings efficiently adjust all openly accessible information and *Strong Form of Efficiency (S-form):* Present prices of monetary assets display all public and inside information denoting that no one can able to beat the market, even given investors or groups have no monopolistic power. With the above notions in mind, the foremost purpose of this paper to investigate the *W-form* and the *SS-form* of the EMH concerning FEM of Bangladesh.

The rest of the article is structured as supervenes. Section 2 develops the historical idea of the FEM of Bangladesh from the independence to the present time. Section 3 implies the literature review. Section 4 discusses the methodology that has been followed in this paper, Section 5 for data and result and Section 6 concludes the paper with some policy guidance.

2. FEM OF BANGLADESH

FEM is a universal market structure for trading currencies. This market determines the exchange rate of different currencies. Every country choice a particular exchange rate regime between these two: Fixed exchange rate regime and the floating rate regime. But it's an issue of little surprise that there was no established FEM in Bangladesh up to the year 1993. Till 1979 Bangladesh followed the managed floating exchange rate regime based on currency weighted basket. This system was replaced by the trade-weighted basket in 1983. To facilitate the service of the FEM a secondary exchange rate market (SEM) was established parallel to the official exchange rate. These two rates were unified in 1992. In the year 2000 to 2003, Bangladesh pursued a pegged exchange rate regime which is adjustable. But in 1st May 2003, Bangladesh started a floating exchange rate system in replace of the pegged exchange rate (Chaudhry and Javid, 2012). At present Bangladesh is following REER. However, to avoid any unusual volatility in the exchange rate regime Bangladesh bank regulates the FEM under the Foreign Exchange Regulation Act-1947.

3. LITERATURE REVIEW

Fama's EMH repeatedly adapted to check the efficiency of the stock market. But after the seminal work of Fama in 1970 many developed countries started to use this EMH for the efficiency FEM. There is a few research works in this field in our country, but the evidence is strong in the case of world FEM. A number of researches have emphatically done to test the efficiency of the FEM; some of them are highlighted here.

Ibrahim et al. (2011) examined competence in the FEM of OECD countries in thirty organizations. They collected bilateral weekly exchange rate data for 7 years and ran the ADF & PP tests of unit root tests. Their result suggested that the FEM of OECD countries followed a *W-form* of efficiency.

Chaudhry and Javid (2012) studied to check the *W-form* as well as the *SS-form* of the EMH in four economies of South Asia, namely Bangladesh, India, Pakistan and Sri Lanka. They had used monthly spot exchange rates of the British pound, US dollar and the Japanese yen for the year 1995:01 to 2010:12. To examine the *W-form* of efficiency they had used two tests: ADF and PP test and they had also used co-integration and Granger causality tests to inspect *SS-form* of efficiency. Their results suggested that markets are reliable with the *W-form* of the efficiency but inconsistent with the *SS-form* of EMH.

Noman and Ahmed (2008) investigated the *W-form* of efficiency in the FEM of SAARC countries by using monthly data from the year 1985to 2005, and they had used at least 250 data for each country. They highlighted on Lo-Mackinlay variance ratio test and Chow-Denning joint variance ratio test instead of usual unit root tests. Their findings suggested that the FEM of SAARC countries are efficient in the *w-form*.

Mabakeng and Shefeni Johannes (2014) analyzed the *W-form* of efficiency in Namibia by using traditional technique of unit root. It was the first studies on the investigation of the efficiency of the FEM of Namibia. By using monthly data of UK pound, the US dollar and the European currency unit for the period 1993:01 to 2011:12 they had found that the market efficiency in the *W-form* exists in the FEM of Namibia.

Makovský (2014) verified the efficiency of the FEM by using Pedroni's panel cointegration test on the panel data of the Australian dollar (AUD), the Canadian dollar (CAD), the Swiss franc (CHF), the British pound sterling (GBP), the Japanese yen, and the Swedish krona (SEK) against the central European currency unit euro of central European countries covering the period 4 January 1999 to 29 December 2006. The outcome was broadly reliable with the EMH and the author suggested for no regulation in the financial sectors of the FEM of those countries.

Wickremasinghe (2005) used unit root tests, Eagle Granger causality test and variance decomposition test on monthly average of six currencies (Japanese yen, the UK pound, the US dollar, French franc, Indian rupee and German mark) from 1986:1 to 2000:11to verify the *W-form* and the *SS-form* of EMH in the FEM of Sri Lanka. The author found that the market was consistent with the *W-form* of EMH but not with the *SS-form* of EMH and the investors in this market could earn a supernormal profit in short-run as well as in long-run.

Matebejana et al. (2017) first time investigated the efficiency of FEM in Botswana taking monthly exchange rate data of the South African rand, the American dollar, British pound and the Japanese yen against Botswana's currency pula covering the period 2000:01 to 2015:12. By using unit root tests (ADF, PP, KPSS) they have instituted that the FEM of Botswana was showed the evidence of the EMH in *W-form* except for the British pound, and by using Johansen cointegration test, they had not concluded about the existence of the *SS-form* of the EMH in the FEM of Botswana.

4. ECONOMETRIC METHODOLOGY

Empirical literature shows that there are several tests or techniques whose have been used to find out the efficiency in the FEM. These techniques have prominently evaluated either the spot exchange rates follow the random walk (Bleaney, 1998), the future spot rate can estimate (which is unbiased) by using forward exchange rate (Zacharatos & Sutcliffe, 2002) or there exist any cointegration among a group of spot rates (Speight & McMillan, 2001). For the *W- form* of efficiency, it is required to follow the random walks and a time series follow this when it has a unit root and non-stationary. Thus in this study usual unit root test is adapted to check the *W-form* of efficiency in the FEM of Bangladesh. After ensuring the *W-form* of efficiency, the *SS-form* of efficiency is checked through the cointegration test. Econometric software e-views 8 is used to conduct those tests.

4.1 Unit Root Test

A test which performed to detect either a time series is steady over its level (trend-stationary) or steady over the differences in its level (difference stationary) is known as unit root test. We use ADF, PP and KPSS tests of unit roots.

4.2 Augmented Dickey-Fuller (ADF) Test

ADF is a parametric test designed to determine the presence of unit root in a time variable of previous returns which was first proposed by Said and Dickey (1984). ADF formula for a time series Z can be expressed by the following formula:

$$\Delta Z_t = \alpha_0 + \beta 0 Z_{t-1} + \gamma_0 \Delta Z_{t-i} + u_t$$

Here Δ is the first difference symbol; α_0, β_0, γ_0 are the coefficient which is projected, and u is the white-noise stochastic process. The null and alternative hypothesis for this test:

H_0: Prevail a unit root for Z

H_a: No prevalence of unit root for Z

Most of the economics time variable or series show the trend around time and then usually said these series contain a unit root or not stationary. In the contest of this study when a series of exchange rate includes a unit root then it pursues a random walk which is harmonious with the *W-form* of efficiency in the FEM.

4.3 The Phillips-Perron (PP) Test

The PP test is a non-parametric test which controls the higher order autocorrelation of a time variable first recommended by Phillips and Perron (1988). This test established on a 1st order autoregressive AR(1) process like $\Delta Z_t = m + nZ_{t-1} + e_t$, where Δ is a symbol of the first difference, m is a constant, n is a slope, Z_{t-1} is the first time interval of series Z and e_t is the disturbance term which obtained form a white-noise route and hypothesized to be identically and independently scattered having zero expected value, unvarying variance and not correlated over time. The null and alternative hypothesis of PP test is equivalent to the ADF test.

4.4. The Kwiatkowski–Phillips–Schmidt–Shin (KPSS) Test

The KPSS is a complimentary test of unit root like the ADF. This test performs to detect the null hypothesis to a recognizable time series is stationary over a deterministic trend (trend stationary). This test considered a time series can be formulated as the summation of a deterministic time trend, a random walk process and a stationary stochastic term and the test based upon the Lagrange multiplier test for the assumption that the random walk process has zero variance. It can be expressed by the following:

$Z_t = f_t + (w_t + g) + v_t$ where $wt = w_{t-1} + u_t$ is a random walk, initial value of w_t is $w_0 = g$ work as an interval, u_t is identical and independently distributed error term, and v_t is a stationary stochastic term. The model without time trend also uses as a simplified version to test the level stationary. The null and alternative hypothesis for this test:

H_0: The series is stationary

H_a: The series is not stationary

4.5 Cointegration Test

This test detects the extensive affiliation among the variables whose are integrated as the same order. Johansen cointegration test is used in this study to detect the *SS-form* of EMH. This test stands on the subsequent vector autoregression equation:

$Z_t = B_0 Z_{t-1} + ... + BpZ_{t-P} + Y_t + \mu_t$; here Z_t is a vector which is integrated into order one, Y_t is a vector of deterministic time series, and μ_t is a vector of innovation.

For this test two test statistics, maximum eigen value and trace statistics are worn to make inference about the number of cointegration equations. The null hypothesis for the trace test is that there are at most n numbers of cointegration vectors against the alternative of n or more cointegration vectors. The null hypothesis for the maximum eigen value test is as like the trace test, but the alternative is n+1 cointegration vectors.

5. DATA AND EMPIRICAL RESULTS

Forward contract market does not exist in Bangladesh as yet, so the extent of this paper is only occupied to the efficiency of spot FEM of Bangladesh. Secondary data are worn in this study which consists the daily average (mid value of buying and selling rate of transaction in the interbank market) of seven bilateral exchange rates Australian dollar (AUD), Canadian dollar (CAD), European currency unit (EUR), UK pound (GBP), Japanese yen (JPY), Swedish krona (SEK), and US dollar (USD) against the Taka covering the period of 2010:01:01 to 2017:11:30. Those data are obtained from the official website of Bangladesh Bank.

Table 1 displays the result of the ADF test of unit roots at the level and the 1st difference for the seven bilateral exchange rates. The results specify that rejection of the null hypothesis of the unit root is not possible at level except for JPY and SEK. That's mean those five exchange rates do not show the characteristics of stationary time series at the level and pursue the random walk hypothesis which is consistent with the *W-form* of the EMH. All the

Table 1: Results of ADF test

Exchange rate	Level		1st Difference		Integration order
	With intercept	Intercept and trend	With intercept	Intercept and trend	
AUD	−1.1331 (0.7047)	−2.0269 (0.5856)	−43.2538[s] (0.0000)	−43.2670 (0.0000)	I (1)
CAD	−0.9897 (0.7589)	−1.9839 (0.6092)	−44.0475[s] (0.0001)	−44.0524[s] (0.0000)	I (1)
EUR	−1.5422 (0.5120)	−1.6138 (0.7876)	−43.0429[s] (0.0000)	−43.0332[s] (0.000)	I (1)
GBP	−1.4263 (0.5708)	−1.6896 (0.7558)	−44.9482[s] (0.0001)	−44.9481[s] (0.0000)	I (1)
JPY	−5.7611[s] (0.0000)	−9.0054[s] (0.0000)	−20.1523[s] (0.0000)	−20.1476[s] (0.0000)	I (0)
SEK	−2.9081[t] (0.0446)	−3.5077[t] (0.0388)	−19.5568[s] (0.0000)	−19.5579[s] (0.0000)	I (0)
USD	−1.6511 (0.4561)	−1.5019 (0.8290)	−16.9575[s] (0.0000)	−16.9727[s] (0.0000)	I (1)

s and t specify the refusal of null hypothesis at 1% and 5% point of significance correspondingly

exchange rates show the characteristics of stationary time series at the 1st difference for jointly intercept and trend and intercept alone at 1% significance point. Except for JPY and SEK, all exchange rates are integrated into order one.

Table 2 depicts the results of the PP unit roots test at both level and the 1st difference for all seven exchange rates. PP test confirms the earlier result of the ADF test. It's ensuring the presence of unit root at 1% significance level for five exchange rates except for JPY and SEK. Similar to the finding of the ADF test all five are integrated into order 1 and JPY and SEK integrated into order zero.

Many economists disagree to make the decision through standard unit root test and suggest to use others powerful test like KPSS the test which hypothesized stationary as null against the non−stationary as an alternative (Ibrahim et al., 2011). Table 3 shows the outcome of the KPSS test of unit roots at the level and 1st difference. The result of the KPSS test is quite identical to those form ADF and PP test except for the JPY and SEK. Now according to KPSS test, all bilateral rates do not contain the properties of stationary series at level (as the null hypothesis of stationary series is rebuffed at 1% level) but contain the stationary properties at the 1st difference with intercept and all are integrated into order 1. So the series of all exchange rates have a unit root and they follow the random walks.

According to EMH, a market will be efficient in *W-form* when the exchange rates follow the random walk. Previous analysis with three different unit roots tests depicts that almost all exchange rates behave as random walk and previous rates can't use to forecast the former rates. Which indicate participate in this market can't able to use any statistical procedure to earn extra profit from the persistent transaction of foreign currencies. So, it is evident that the FEM of Bangladesh is efficient in the *W-form*.

For the test, the *SS-form* form of efficiency, the Johansen cointegration test is used which finds the long-run affiliation among the currencies. All non-stationary exchange rates series are considered for this test. To scrutinize the number of cointegration equations trace statistics and maximum eigen value both are performed. According to the EMH for the *SS-form* of efficiency, it is necessary to ensure no relationship among the exchange rates. If it depicts any cointegration equation then there exist long-run affiliation among the exchange rates and the market is inefficient in the *SS-form*. This implies any participant in the market can able to estimate the future value of an exchange rate for calculating the movement of others exchange rate and make extra profit. From the results of Johansen cointegration Test in Table 4, it is found that there prevails a

Table 2: Results of PP test

Exchange rate	Level		1st difference		Integration order
	With intercept	Intercept and trend	With intercept	Intercept and trend	
AUD	−1.1876 (0.6820)	−2.0579 (0.5684)	−43.2974[s] (0.0000)	−43.3007[s] (0.0000)	I (1)
CAD	−1.0141 (0.7503)	−1.9989 (0.6010)	−44.0586[s] (0.0001)	−44.0621[s] (0.0000)	I (1)
EUR	−1.5660 (0.4998)	−1.6458 (0.7745)	−43.0413[s] (0.0000)	−43.0315[s] (0.000)	I (1)
GBP	−1.4555 (0.5562)	−1.7133 (0.7453)	−44.9339[s] (0.0001)	−44.9348[s] (0.0000)	I (1)
JPY	−51.9678[s](0.0001)	−49.1065[s] (0.0000)	−1498.918 (1.0000)	−1563.952 (1.0000)	I (0)
SEK	−40.1277[s] (0.0000)	−44.3161[s] (0.0000)	−508.6236[s] (0.0001)	−564.5994[s] (0.0001)	I (0)
USD	−1.6721 (0.4454)	−1.5973 (0.7941)	−17.5581[s] (0.0000)	−17.5701[s] (0.0000)	I (1)

s specifies the refusal of null hypothesis at 1% point of significance

Table 3: Results of the KPSS test

Exchange rate	Level		1st difference		Integration order
	With intercept	Intercept and trend	With intercept	Intercept and trend	
AUD	2.6241[s]	0.8172[s]	0.2693	0.1549[t]	I (1)
CAD	3.2005[s]	0.8864[s]	0.2779	0.1889[t]	I (1)
EUR	2.1881[s]	0.7573[s]	0.1058	0.1112	I (1)
GBP	1.4963[s]	1.0813[s]	0.1538	0.0728	I (1)
JPY	3.3061[s]	0.6068[s]	0.4498	0.4506[s]	I (1)
SEK	2.3505[s]	0.9675[s]	0.1782	0.1470[t]	I (1)
USD	2.2767[s]	0.7491[s]	0.2336	0.1680[t]	I (1)

s and t depict the refusal of null hypothesis at 1% and 5% point of significance correspondingly

Table 4: Results of Johansen Cointegration test (Trace and maximum eigen value) among seven exchange rates

Hypothesized No. of Cointegrations	Trace statistics	5% critical value	P-value	Maximum eigen value statistics	5% critical value	P-value
None[s]	390.9299	125.6154	0.0000	320.0371	46.2314	0.0000
At most 1	70.8929	95.7537	0.6924	29.8556	40.0778	0.4333
At most 2	41.0373	69.8189	0.9304	19.1144	33.8769	0.8149
At most 3	21.9229	47.8561	0.9756	11.2484	27.5843	0.9587
At most 4	10.6746	28.7971	0.9685	7.0663	21.1316	0.9513
At most 5	3.6083	15.4947	0.9326	2.9012	14.2646	0.9531
At most 6	0.7071	3.8415	0.4004	0.7071	3.8415	0.4004

s indicates the refusal of hypothesis at the 1% significance level

cointegration equation both in the maximum eigen value and trace test at 1% significance level. For this, in opposition to the alternative hypothesis of cointegration, the null hypothesis is no cointegration. From the result, it is depicted that the null is rejected and there prevails a cointegration equation among all the currencies which violate the condition of the EMH in the *SS-form*. Therefore, it finds the facts in opposition to the *SS-form* of the EMH.

6. CONCLUSION

This paper investigates the *W-form* and *SS-form* of EMH in the FEM of Bangladesh by adopting the daily average rate of seven bilateral exchange rates over the period 2010:01:01 to 2017:11:30. For this purpose ADF, PP, KPSS tests of stationary are operated to examine the *W-form* of the EMH and cointegration test of Johansen is operated for the *SS-form* of the EMH. The outcome of stationary tests reveals that almost all of the seven exchange rates follow the random walks which approve the *W-form* of the EMH. This refers that the participators or investors of the FEM in Bangladesh not able to apply any method or rule to anticipate the potential value of an exchange rate from the prior values of its. Cointegration test finds the verification opposite the *SS-form* of the EMH, which means the trend of an exchange rate can be forecasted to notice the movement of others exchange rates. Thus the participators or investors in the FEM of Bangladesh can able to involve in extra lucrative transaction persistently.

Efficiency in the FEM is incredibly noteworthy for policymakers of an economy as the exchange rate is a dominant policy variable in economics. However, the FEM of Bangladesh is showing the characteristics of the efficient market in *W-form* at least. So the government can ensure the present status of efficient FEM and achieve *SS-form* as well as the *S-form* of efficiency in the near future. Further research can be done by using high-frequency data and other econometric tools like nonlinear trend models.

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