The International Journal Research Publication's
ISSN:2251 1563
Research Journal of Science & IT Management

Efficiency of the Foreign Exchange Market in Mauritius

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Abstract

This paper uses daily observations for United States Dollar for the period July 2001 to July 2014 to examine the efficiency of the Mauritian Foreign Exchange market. To examine the randomness of the Mauritian Foreign Exchange market, we employed both parametric and nonparametric tests. The parametric tests include the Augmented Dickey-Fuller unit root tests, while the nonparametric tests include Phillips-Peron unit root test and Kwiatkowski-Phillips-Schmidt-Shin. Moreover, we run the different unit root tests on natural and log terms of the spot exchange rates. The unit root tests reveal that the Mauritian foreign exchange market is weakly efficient. This indicates that the values for earlier period cannot be used to forecast the present values of the exchange rate.

Keywords: Efficient Market Hypothesis, Foreign Exchange Market, Parametric and Nonparametric Tests, Mauritius

1. Introduction

Foreign exchange (Forex) market efficiency is an important consideration for all currency market participants. If exchange rate markets are efficient, then the current rate is hypothesized to incorporate all the information in past rates. During the years 1983 to 1993, Mauritius pursued a managed float exchange rate policy under which the Bank of Mauritius (BOM) intervened on the Forex market to smooth out irregular fluctuations of its currency. An undisclosed basket of currencies of major trading partners is used to determine the value of the Mauritius rupee. The managed float was accompanied by floating exchange controls. The Government of Mauritius suspended the Exchange Control Act in 1994 and an interbank Forex market was established. Both the current and capital accounts are fully convertible. The exchange rate of the rupee is determined by the market forces in the interbank Forex market. The rupee is in an independent float regime with its value being largely influenced by the movements of major reserve currencies in international foreign market. BOM intervenes in the interbank Forex market exclusively in United States Dollars (USD) in order to make sure that the value of the rupee vis- a – vis major currencies reflects the macroeconomic fundamentals of the country.

Furthermore, in the IMF‟s Annual Report on Exchange Arrangements and Exchange Restrictions classifications, Mauritius's ER regime has been classified to a free float (Tsangarides 2010). Formerly the Mauritius ER regime was under managed float regime. In principle BOM intervention in the Forex market is limited to smooth operations and this allows the ER regime to group the flexibility of the floating ER with some of the regulation of a smaller amount of the flexible regime. The Forex reserves are the foreign assets held or controlled by the BOM. These reserves are usually made of a specific currency or gold, but in the case of Mauritius, the foreign reserves are denominated in the USD. Thus, USD plays an important role in the Mauritian economy, as it indicates the export-import behaviour in Mauritius. Furthermore, during the last decade the level of interdependence of Mauritius on the rest of the world has increased, which leads to a crucial role of the exchange rate for a small island developing country.

To our best knowledge there is no study conducted on testing the efficiency of Forex in Mauritius, thus the general objective of this paper is to study if the Mauritian Forex market is weakly efficient. Therefore, a chief strand of the study concentrates on the question of whether or not the Mauritian Forex market is weakly efficient. This study uses daily spot Forex rates of USD covering the period

July 2001 to July 2014.The traditional unit root tests namely the Phillips Perron (PP), Kwiatkowski-Phillips- Schmidt-Shin(KPSS)and the Augmented Dickey Fuller (ADF) are used to test the weak form efficiency of the Mauritian Forex market. We also transformed the spot exchange rates into natural logarithms and applied the unit root tests. The paper is structured as follows: Section 2 overviews the literature on Forex market. Section 3 consists of the data analysis and methodology while section 4 reports the findings and finally section 5 concludes the paper.

2. Literature Review

The Efficiency Market Hypothesis (EMH) is one which emphasises on the fact that financial markets are perfectly efficient. Market efficiency evolved from the notion of perfect competition which assumes free and instantly available information, rational investors and no taxes or no transaction costs. It also implies zero serial correlations in exchange rate changes. The EMH plays an important role in financial economics literature. It relies on the efficient exploitation of information by economic actors. According to Fama (1970) when the concept of market efficiency is used with respect to speculative markets it means that market prices should fully and instantaneously reflect all information available to market participants.

Efficient market hypothesis exists at three levels, namely weak form efficiency, semi-strong form efficiency and strong form efficiency. The weak form efficiency states that current share prices should reflect all past publicly available information. As such abnormal return equals actual return minus expected return. Therefore, one cannot study charts or patterns in share prices in order to beat the market. The efficient stock market prices will fluctuate more or less randomly. The semi strong form states that current market prices reflect not only all past prices movement but all publicly available information, which is already incorporated in the current share price. Therefore, abnormal return equals to past history share price plus public information. The strong form efficiency states that current market prices reflect all relevant information namely past history movements, public information and private information. This type of efficiency is the most contestable one.

Moreover, there are a number of studies that have empirically investigated the EMH. Using co-integration methodology, Aron (1997) analyses the weak form efficiency for the growing range of liberalised and liberalizing Forex markets in Sub-Saharan African countries by using three different tests namely the forward market unbiasedness test, the returns predictability test and the weak form efficiency test. The weak form efficiency is tested by using monthly parallel market and exchange rates for South Africa and a variant of the martingale model. The result reveals that the market is inefficient in for the period considered as the exchange rate returns are predictable by previous prices of the exchange rate. Therefore, the null hypothesis of the predictability test is rejected, implying that there is no certainty of excess returns for South Africa

Moreover, Wickremasinghe (2004) explores the semi-strong and weak forms of the EMH by using the unit root test and Engle and Granger methodology to the currency of Sri Lanka for six international currencies. In addition, they also use monthly spot rates for the French Franc, the German Mark, Indian Rupee, the Pound sterling the Japanese Yen and the US dollar, relative to the Sri Lankan Rupee covering the period of January 1986 until November 2000 to carry out the Granger causality, Johansen's tests and Variance Decomposition. The results indicate that the semi-strong version of the EMH is rejected.

Furthermore, Sifunjo et al. (2008) try to test the weak form efficiency for Kenya. They consider daily observations of the Kenyan shillings per US dollar covering the period January 1994 to June 2007. Using the unit root tests, run tests, and the Ljung-Box Q-statistics, they conclude that the Forex rate market of Kenya is not efficient. A significant patterns, stationary trend and autocorrelation in the Forex returns were observed. Moreover, Noman and Ahmed (2008) survey the weak form of efficiency of the Forex markets in seven countries namely Bangladesh, Bhutan, India, Maldives,

Nepal, Pakistan and Sri Lanka. They apply the variance ratio tests and unit root tests to monthly return series for each of the seven markets covering a period of 21 years (1985-2005). The authors conclude that Forex markets in SAARC countries follow the weak-form of EMH, as the growths of return series are not serially correlated. In the same line Kumar (2011) uses Monthly Nominal Effective Exchange Rate data from April 1993 to June 2010 to examine the weak form of the Indian Forex market. Using the both individual and joint variance ratio tests, the author concludes that the Indian Forex market does not follow the weak-form efficiency for the period under consideration.

Applying various time series techniques to monthly nominal and real exchange rate for the period 1963 and 2013, Tweneboah et al (2013) investigate the efficiency of the Forex market in Ghana. Furthermore, parametric and non-parametric variance ratio test are employed to observe the random walk behaviour of the exchange rates. From the results of the non-parametric variance test, the authors conclude that the nominal and real exchange rate violate the random walk process and does not fall under the weak form of EMH. Furthermore, Mabakeng and Sheefeni (2014) use monthly data for the year 1993 to 2011, to examine the weak form of EMH of the Forex market in Namibia. By performing the tradition unit roots namely the ADF, PP and KPPS, they conclude that Namibia's Forex market is efficient, that is the previous values cannot be used to forecast the current value.

Evidently, from the above reviewed literature, there have been several studies with the purpose to study about the Forex market efficiency in many countries around the globe, but there still remains a dearth of investigations in the developing markets. To our best knowledge there is no study conducted on testing the efficiency of Forex in Mauritius, thus this paper attempts to fill in the gap in the empirical literature.

3. Methodology

Empirical literature showed that a variety of econometric techniques have been used to test the Forex market. For the purpose of this study, the traditional unit root tests are applied, namely ADF, PP, and KPSS tests. The ADF and PP tests are based on the null hypothesis of unit root existence in the time-series while the KPSS is based on the reverses null hypothesis of a unit root exists. The efficient market hypothesis can also be applied to the Forex market, to show that it generally follows a random walk model. Daily spot Forex rates of USD/MUR covering the period 2001 to 2014 is graphically described below.

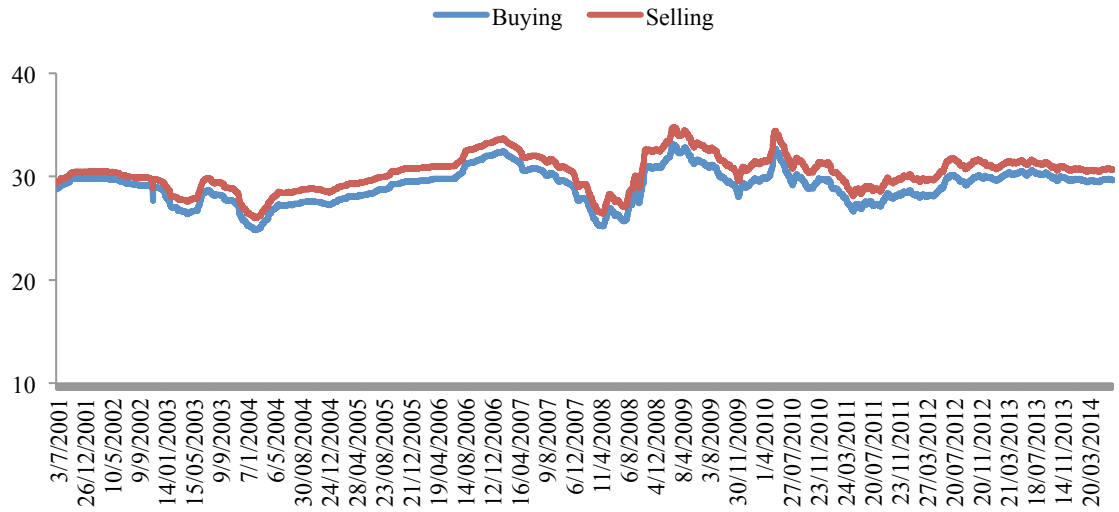

Figure 1: USD/ MUR Exchange Rate
Source: Data Bank of Mauritius, Authors' computation

Figure 1 shows that the Mauritian economy is very sensible to fluctuations in the USD/MUR exchange rate given the fact that we generally import in US dollars. Hence, the following efficient market hypothesis can be applied to the Forex market, to show that it generally follows a random walk model.

Hypothesis:-

H_0: Prices follow random walk (efficient),
H_A: Market is not efficient.

The interpretation from the above hypothesis suggests that the weak form of the EMH must hold, if the random walk hypothesis holds, but not vice versa (Cuthbertson & Nitzsche, 2005). Thus the proof supporting the random walk model is the confirmation of the market efficiency. This test will be implemented to confirm the efficient market view that the exchange rates are not predictable and follow random walk.

I. Unit Root Tests and Orders of Integration

The co-integration test requires that the series must have the same order of integration. Thus, the order of integration of the series is determined by using the unit root test. There are three procedures to detect unit roots namely ADF, PP and KPSS tests. In conducting the DF test, it was assumed that the residual term ε_t was uncorrelated. But Dickey and Fuller have developed a test known as ADF test when ε_t is correlated. For series with a unit root which I (1), results should show that each variable is non-stationary at level and attains stationary after first differencing. Consequently, two tests should be performed, one at level and another at first difference.

II. Augmented Dickey Fuller

In literature, there are a number of unit root tests available to determine the integration order of an individual series. However, in this study used ADF test which was proposed by Said and Dickey (1984). For this purpose, after taking logs, the test of stationary and unit root test will be performed using the ADF tests for all the respective variables. It should be noted that the error term is correlated. Thus technically, ADF test is conducted by 'augmenting" the proceedings equation by adding lagged values of the dependent variable Δgt (Gujarati, 2003).

The hypotheses are tested as follows:

- **H_0: Series are non-stationary (follows a random walk)**
- **H_1: Series are stationary (does not follow a random walk)**

Generally, the significant level for all critical value is 5% and while testing null hypothesis against alternative, the unit root test will be rejected if the t-test statistic is negatively less than the critical value tabulated.

III. Phillips-Perron Unit Root Test

The PP unit root test is a non- parametric method which control for higher order autocorrelation in a series (Phillips and Perron, 1988). The PP test has many advantages over the ADF test, but the asymptotic distribution of the PP t-statistic is the same as the ADF t-statistic critical values.

IV. KPSS Unit Root Test

Consequently, many economists are against the concept of using the standard unit root tests thus, they proposed other powerful tests that can be used (Ibrahim et al, 2011). A number of tests have been developed; the most popular one is the KPSS test developed by Kwiatkowski, For example, if the null of stationarity is accepted (rejected) and the null of non-stationarity is rejected (accepted), it confirmed that the series is stationary (non-stationary).

4. Findings

Table 1 reports the results of the Unit Root tests namely ADF and PP at level and first difference and order of integration, using natural spot exchange rates.

Table 1: Augmented Dickey Fuller Tests and Philip Perron Tests

Variables	Model Specification	Augmented Dickey Fuller Tests		Philip Perron Tests		Integration Order
		Level	1st Difference	Level	1st Difference	
USD	Intercept &trend	-2.707	-14.326***	-2.553	-53.250***	1
	Intercept	0.359	-14.328***	-2.451	-53.254***	1
	None	3.596	-14.329***	0.0021	-53.258***	1

Source: Authors' Compilation
(Note: *significant at 10%, **significant at 5%, ***significant at 1%)

Table 1 reports the results of the Augmented Dickey Fuller Tests and Philip Perron (PP) Tests at level and first difference. The results point out that the null hypothesis of a unit root is accepted given that the variables were not stationary at level form. Thus, USD exchange rates are non-stationary in level with zero mean, correlated residuals over time and the variance is not constant. Since the variables are found to be non-stationary, in order to make these stationary they are differenced once. The results indicate that the series became stationary at first difference with a level of significance of 1%. The fact that the series has a unit root reveals that the exchange rate market takes the weak form of the EMH.As far as the PP tests are concerned, the results confirm the fact that the exchange rate series is non-stationary at levels and when first differenced it becomes stationary with a level of significance of 1%. Again this affirms the weak form of EMH of the Mauritian Forex Market. Moreover, to supplement the tests conducted earlier namely the ADF and PP, the KPSS test will be conducted for confirmatory purposes. Using the natural spot exchange rates, table 2 below reports the KPSS result,

Table 2: KPSS in levels and first difference

Variables	Model Specification	KPSS Tests		Integration Order
		Level	1st Difference	
USD	Intercept and trend	0.266	0.0384***	1
	Intercept	0.970	0.039***	1

Source: Authors' Compilation
(Note: *significant at 10%, **significant at 5%, ***significant at 1%)

From Table 2, at levels the KPSS test reveals that the series have a unit root. Using natural spot exchange rates, the exchange rate series is non-stationary in level form, but at first difference the series become stationary at 1% significance level, thus affirming the weak form efficiency of the Mauritian Forex Market. To further confirm the weak form efficiency of the Mauritian Forex market, we used the log of spot exchange rates. Table 3 shows the result of the ADF and PP tests using log.

Table 3: Augmented Dickey Fuller Tests and Philip Perron Tests Using Log

Variables	Model Specification	Augmented Dickey Fuller Tests		Philip Perron Tests		Integration Order
		Level	1st Difference	Level	1st Difference	
USD	Intercept and trend	-2.817	-14.300***	-2.574	-53.977***	1
	Intercept	0.744	-14.302***	-2.463	-53.980***	1
	None	3.720	-14.304***	0.096	-53.985***	1

Source: Authors' Compilation
(Note: *significant at 10%, **significant at 5%, ***significant at 1%)

The above tests confirm that the exchange rate has a unit root at level. From the ADF and PP results, we can conclude that the series of the exchange rate is non- stationary in levels. But, in both cases, the series become stationary at first differenced with a 1% significance level. This further affirms that the Mauritian's foreign exchange market is weakly efficient. Table 4 below shows the result of the KPSS tests using log.

Table 4: KPSS in levels and first difference Using Log

Variables	Model Specification	KPSS Tests		Integration Order
		Level	1st Difference	
UDS	Intercept and trend	0.255	0.038***	1
	Intercept	0.979	0.038***	1

Source: Authors' Compilation
(Note: *significant at 10%, **significant at 5%, ***significant at 1%)

It is observed that at level the series is non-stationary at level but at first differenced the series become stationary with 1% significance level. Thus, using both the parametric and nonparametric tests, we draw the same conclusion which is the Mauritian Forex market exhibits the weak form of the EMH. The relevance of these results informs us about the EMH in Mauritius. For instance, the non-stationary variables imply that financial time series behave in a random walk manner, thus leading to a weakly efficient market. Therefore, these results support the work of Palermo (2003), Wickremasinghe (2005), Mlambo and Biekpe (2007) and Noman and Ahmed (2008).

5. Conclusion

This study was conducted with the objective to study if the Mauritian Forex market is weakly efficient. Daily foreign exchange rates from July 2001 to July 2014 are examined for random walks using the traditional unit roots tests namely ADF test, PP test and KPSS test. The results of the different unit root tests using both natural and log terms reveal that there exists market efficiency in Mauritian Forex market. The Mauritian Forex market exhibits the weak form of the EMH. This indicates that the values for earlier period cannot be used to forecast the present values of the exchange rate, in other words, past history movements of the exchange rates cannot be used to forecast present exchange rates. Therefore, participants in the Forex market cannot develop any statistical technique to gain from the Forex market transactions consistently.

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