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Semi-Strong Form of Efficiency in South Asian Foreign Exchange Markets

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Abstract

The purpose of this study is to test the weak and semi-strong form efficiency of the four major foreign exchange markets of South Asia (Pakistan, India, Sri Lanka and Bangladesh) using three bilateral spot foreign exchange rates: the US dollar, the British pound and the Japanese yen for the period January 1995 to December 2015. The results of this study indicate that all four foreign exchange markets are in confirmation with the weak form of the market efficiency. However, the findings do not support the semi-strong form of market efficiency in these four markets. The results further suggest that the regime shifts in the exchange rates in studied markets remain inefficient in semi-strong sense. These results imply that the foreign exchange markets of all four countries can devise strategies for profitable earnings in both the short run and long run and have implications for the policy makers and market participants.

JEL classification: F31; G14

Keywords: Exchange rates; Market efficiency; Cointegration; Granger causality; South Asian countries

1. Introduction

The South Asian countries are tied together in trade relations by Agreement of South Asian Free Trade (SAFTA). The foreign exchange market efficiency hypothesis is tested for some South Asian markets having inconclusive results (Ahmad, Ashraf & Ahmed, 2007; Wickremasinghe, 2004; Chakrabarti, 2005; Nath, 2006, Noman & Ahmed, 2008). However, these markets have regime shifts in foreign exchange policy from 1995 to 2015. It is not tested empirically whether after these regime changes market efficiency hypothesis holds or not.

The efficient market hypothesis (EMH) was proposed as an academic concept of study in the 1960s by Eugene Fama, where he describes an efficient market as a market in which prices fully reflect all available information. In such a situation, attempting to outperform the market through buying and selling of securities is a game of chance rather than skill. Further, Fama (1991) divided market efficiency into three categories, namely, weak-form efficiency, semi-strong form efficiency and strong form efficiency. Initially, the term 'efficient market' was used for the stock market only, but soon the idea was generalised to other asset markets.

Despite the popularity of the efficient market hypothesis and the fact that it is considered a foundation stone of modern financial theory, it is an extremely controversial and repeatedly disputed notion. The main reasons for the controversy and dispute are the evidences of market inefficiency discovered by various researchers, which make us, realise that information alone does not cause a change in price. These evidences are referred to as anomalies (Domowitz & Hakio, 1985; Hodrick & Srivastava, 1986; Makovský, 2014; Salisu *et al*., 2016).

The informational efficiency of stock prices or in our case foreign exchange matters in two main ways. First, investors are concerned about whether various trading strategies can produce excess returns (i.e., if they will be able to successfully "beat the market"). Second, if currency prices precisely reflect all available information. This is the main motivation to undertake this study with reference to regional trade between South Asian countries to see whether exchange rates can be predictable or not in these countries.

Efficient market hypothesis is a topic of intense debate among financial professionals and academics. The implications of the hypothesis are truly profound. Theoretically, when talking about the foreign exchange market, the profit opportunities represented by the presence of "overvalued" and "undervalued" currencies motivate investors to trade, and their trading moves the prices of currencies towards the present value of future cash flows. Thus, investment analysts search for mispriced currencies and their subsequent trading makes the market efficient and causes prices to reflect intrinsic values. Because new information is randomly unfavourable or favourable relative to expectations, changes in currency prices in an efficient market should be random, resulting in the well-known random walk. Thus, investors cannot earn abnormally high risk-adjusted returns in an efficient market where prices reflect intrinsic value.

The debate about efficient markets has resulted in hundreds and thousands of empirical studies attempting to find out whether specific markets are in fact efficient, and if so, to what degree. Various methodologies have been adopted by the researchers to test for market efficiency. Most of the empirical studies applied the univariate and multivariate cointegration techniques or OLS estimation to test for semi-strong form efficiency. To test weak-form efficiency, various tests have been employed, including the random walk model, unit root tests, variance ratio test, and autocorrelation tests. The results of all these tests provide mixed evidence (Ahmad, Ashraf & Ahmed, 2007; Chakrabarti, 2005; Noman & Ahmed, 2008).

The main aim of this study is to examine two of the main forms of the efficient market hypothesis with respect to the foreign exchange spot markets of four major South Asian countries, namely, Pakistan, India, Bangladesh, and Sri Lanka. The weak form of efficiency is tested using two unit root tests–Augmented Dickey-Fuller and Phillips-Perron tests. The semi-strong form of efficiency is investigated by testing the existence of long run relationship, causal relationship and variance decomposition analysis.

The remainder of the study proceeds as follows. Section 2 provides the brief overview of the foreign exchange market. The literature review is presented in Section 3. The methodology and data are discussed in Section 4. Section 5 presents the empirical results. The conclusion and policy implications are offered in last section.

2. Overview of South Asian Foreign Exchange Markets

The past five decades have witnessed the foreign exchange of Pakistan is heading in the direction of an uncontrolled and more market-oriented regime. The Pak rupee was linked to the Pound Sterling till 1971, and later to the US Dollar due the increasing economic influence of the United States. However, 1982 onwards a controlled floating exchange rate regime was adopted, with the Pak rupee tied to a band of trade-weighted currencies. Then from mid 1994, the Pak rupee became convertible for current international transactions after accepting the IMF Articles of Agreement. After the nuclear explosion in 1998, trade sanctions were imposed on Pakistan. In order to reduce the pressure on official reserves and to prevent the economy from the undesirable effects of the sanctions, a multiple exchange rate system was introduced. This included an official-rate (linked to the US Dollar), a Floating-Interbank rate (FIBR), and a compound rate that combined the official and FIBR rates. As the economy recovered from the economic crisis, the three exchange rates were integrated and linked to the US Dollar within a definite bandwidth. However, effective from 2000, the State Bank of Pakistan is following a floating exchange rate system.

The origin of the foreign exchange market of India, as we know today, can be traced back to the year 1978, when the banks in India were allowed to embark on intra-day trade in foreign exchange. Until the middle of December 1973, Indian Rupee was linked to the Pound Sterling, except for the devaluations of the currency in the years 1966 and 1971. Later, it was tied to the US Dollar until the year 1975. At this point, India took up a managed floating exchange rate regime with the rupee coupled with a trade-weighted band of currencies (i.e. the currencies of India's major trading partners). However, in the early 1990 due to the rigorous pressure from the increasing trade deficit the Reserve Bank of India (RBI) was forced to take on a downward regulation of the Rupee. This regulation led to the introduction of the Liberalised Exchange Rate Management System (LERMS) in the early 1992 and hence the implementation of, for the first time, a dual exchange rate regime in India. These events, eventually in 1993, led to the substitution of the Liberalised Exchange Rate Management System (LERMS) by a unified exchange rate regime and therefore a market based exchange rate system was implemented. Since then, the rate of exchange for the Indian rupee is mainly determined by the market forces of demand and supply. Further, in the recent years the exchange rate strategy has been directed by the principles of cautious supervising and administration of exchange rates with flexibility, without a set target.

The Bangladesh Bank and the Ministry of Finance together govern the exchange rate policy of Bangladesh. However, certain exchange rate transactions are assigned to the authorised commercial banks. Bangladeshi Taka (BDT) replaced the Pakistani Rupee in 1972, as the official currency of Bangladesh. From 1972 till 1979, the Taka was pegged to the British Pound Sterling and later, from 1980 to 1982, to a band of currencies of its major trading partners with the British Pound as the superseding currency. However, this changed in 1983 and till 1999 the Taka was linked to a band of trade-weighted currencies but this time with US Dollar as the overruling currency. Then, for the next three years, from the year 2000 to the year 2003, Bangladesh followed an adjustable pegged exchange rate regime. Starting May 2003, Bangladesh replaced the adjustable pegged exchange rate regime with a floating-exchange rate system. This conversion to a floating exchange rate regime was smooth with the first year considered as a 'honeymoon' period as the exchange rate for Bangladesh stayed rather steady. However, the exchange rate depreciated gradually till 2006 but since then, it has remained quite stable. Therefore, the floating-exchange rate regime in Bangladesh is considered to be both volatile and stable.

In 1948, Sri Lanka, in essence, followed an unhindered policy on imports and a maintained a positive viewpoint for its foreign trade affairs, but the downfall in the export earnings of Sri Lanka led to the introduction of Exchange Control Act in 1953. The purpose of this act was to place limitations on the movement of foreign currency. Then, in 1952, Sri Lanka's exchange rate was pegged to British Pound. Later in 1961, a meticulous exchange rate system was introduced as a result of the balance of payments problems. Permits that acted as exchange licenses were granted by the regulator of international trade. In 1970, Sri Lanka adopted a dual exchange rate regime in addition to the exchange and import controls. This continued till 1977 when the exchange rate was liberalised as a result of new economic reforms, and several exchange rate controls were eradicated. Since the dual exchange rate system was brought to an end, the Sri Lankan rupee was allowed to float freely in response to the international developments and the position of balance of payments. The instant effect of this action was a devaluation of the currency. Finally, in 2001, the Central Bank of Sri Lanka announced an independent floating exchange rate regime.

3. Literature Review

The efficiency of foreign exchange markets of countries across the globe have been analysed by various researchers. Some of the earliest and most important researches include Hakio (1981) and Fama (1984). Hakio (1981) examined five exchange rates against US dollar for a period of five years during the mid 1970s. The result of their study implied the rejection of the efficient market hypothesis. Similarly, Fama (1984) rejected the market efficiency hypothesis in nine exchange rates against the US dollar employing ordinary least square regression analysis on monthly data.

Hideki (2006) analysed empirically the efficiency hypothesis on the renminbi rates in the Hong Kong FX market. His results showed a rejection of the efficiency hypothesis implying that the renminbi rates are not unbiased predictors of the future spot rates. Rose *et al.* (2008) analysed the weak form efficiency of the foreign exchange market of Kenya and found it to be inefficient. They attributed the rejections to significant patterns in the exchange rates, trend stationarity and autocorrelation in foreign exchange returns. Similarly, Kimani (2007) applied the unit root tests to the Kenya Shilling per US dollar spot rate and found proof for a unit root after differencing the data twice. He concluded that autocorrelation could be because of the presence of irrational market participants.

Some of the others that have rejected the efficiency hypothesis for developed economies include Domowitz and Hakio (1985) and Hodrick and Srivastava (1986). In these cases, the failure of efficiency hypothesis has been attributed to numerous factors, for instance the measurement of technical trading rules, the existence of risk premiums in forward rates, experimental irregularities in regression tests, negative correlation between the expected future spot rates and forward risk premia, and the lack of use of suitable econometric procedures.

A popular method to test for semi-strong of efficiency is cointegration. The existence of co-integration among different exchange rates means that it is possible to predict one exchange rate from another, a violation of the efficient market hypothesis. Baillie and Bollerslev (1989) applied the multivariate Johansen procedure to find cointegration in a sample of seven exchange rates, observing the first half of 1980s using daily rates. The result for their study confirmed the presence of cointegration among the spot rates, leading to a rejection of the efficiency hypothesis. In reference to the Asian foreign exchange markets, Jeon and Seo (2003) examined the soundness of the efficiency hypothesis in the Asian foreign exchange markets by applying the cointegration tests to the daily data of the spot and forward rates of four Asian countries; Korea, Thailand, Malaysia and Indonesia, for the period 1996-2001. Their results for the Asian foreign exchange markets were consistent with the efficiency hypothesis except for the brief period immediately after the July 1997 crisis. However, there are a few contributions that are unable to provide a satisfactory result for foreign exchange efficiency using cointegration.

A very interesting study was conducted by Oh, *et al.* (2007). They investigated the market efficiency of the financial time series of the foreign exchange rates for 17 countries, including both developed and developing nations. Their results indicate higher market efficiency for the

European and North American foreign exchange markets than other foreign exchange markets under investigation. They concluded that with an increase in liquidity the efficiency of markets improved significantly after the Asian currency crisis especially in Asian foreign exchange markets.

Although there have been numerous studies investigating the efficiency of foreign exchange markets for countries all around the globe, there is a shortage of research involving the South Asian markets. With reference to India, Chakrabarti (2005) applied unit root tests—both the Augmented Dickey Fuller and Phillips Perron—to test whether the Indian rupee followed a random walk. The results showed that the rupee to dollar exchange rate, for the period 1997 to 2002, failed to reject the null hypothesis of a unit root (that is random walk) at the 5% confidence level, although they both reject the same at the 10% level. However, when an extended period from 1997 to 2004 is considered, both tests credibly reject the null hypothesis of a random walk. This result supports the weak form of efficient market hypothesis. Similarly, Nath (2006) tested the efficiency of the foreign-exchange market of India using data for the period, March 1993 to May 2004. The results of Augmented Dickey-Fuller (ADF) test implied that the weak form of the market efficiency cannot be rejected. The results also showed the acceptance of the mean reversion hypothesis. No evidence was found of the `day effect' although all the "days' mean" returns were significantly non-zero. Further, it was realised that the AR (2) and AR (3) models track the market volatility better than the other models.

Wickremasinghe (2004) investigated the weak and semi-strong form of efficiency for the foreign exchange market of Sri Lanka using six bilateral foreign exchange rates. The stationary tests were employed to test for the efficiency in weak sense while efficiency in semi strong sense was tested applying the Johansen and Juselius multivariate cointegration approach, causality test and variance decomposition analysis. The results of their study implied that the Sri Lanka's foreign exchange market supports the market efficiency in weak sense. However, the results presented findings that are not in confirmation with efficiency in the semi strong sense.

Noman and Ahmed (2008) applied various unit root tests and the variance ratio test, developed by Lo and MacKinlay (1988), to test for the weak-form efficiency of seven SAARC countries; namely, Pakistan, India, Bangladesh, Sri Lanka, Bhutan, Nepal and Maldives. They employed monthly data for each of these markets for the period 1985 to 2005. The results of their study supported the weak-form of market efficiency. On the other hand, Ahmed *et al*. (2005) showed that the foreign exchange markets of South Asia were not efficient in weak sense for period 1999-2004. The results of summary statistics for exchange rates revealed non-normal distributions. Although the return series on exchange rates were found to be stationary, however, the autocorrelation functions were found highly significant at various lags and Ljung-Box (Q) test also confirmed the presence of no auto-correlations. The non-parametric Runs test also indicated the random walk model was not accepted. Further, The K-S-Z test revealed that the returns distribution was non-normal and the BDS test showed that the returns relationship was nonlinear in nature.

Chiang, Lee, Su, and Tzou, (2010) used the traditional variance ratio test of Lo and MacKinlay (1988,1989), The non-parametric based variance ratio test of Wright (2000) and the multiple- variance ratio test of Chow and Dening (1993) were applied to re-examine the floating rate markets in neighboring Asian economies (Japan, South Korea, Taiwan, and the Philippines). Their finding showed that the random walk patterns of the exchange rate return series could not be rejected, with the one exception of Taiwan, where inefficiency was shown to be most prominent. Therefore, the researcher concluded that the foreign exchange markets of Japan, South Korea and the Philippines were weak form efficient, while foreign exchange market of Taiwan was inefficient.

Makovský (2014) studied to verify the efficiency hypothesis of forex market in the sample of panel data set of the Central European countries. He used the Perdroni panel cointegration method that includes non-linear co integration into non-stationary time series. They concluded that the rejection or the confirmation of the market efficiency highly influence the regulation or liberalization of financial services.

Andrianto and Mirza (2016) tested efficient market hypothesis for Indonesia stock market during the period of 2013 until 2014. They used runs test and serial correlation test to examine weak form of efficiency and showed that Indonesia stock market confirmed weak form efficiency. Salisu and Ayinde (2016) tested for martingale difference hypothesis (MDH) in nine selected foreign exchange markets from Asia Pacific countries. They used Perron (2006) unit root test with structural break and adopted Wild Bootstrap Automatic Variance Ratio test by Kim (2009) and the Wild Bootstrap Generalized Spectral test by Escanciano and Velasco (2006) to test for MDH. Empirical results showed that foreign exchange market efficiency was inconsistent over time due to changes in policies and events.

The above literature review suggests that there is a need of comprehensive study for testing the efficiency of the foreign exchange markets of South Asia. This study tries to fill this gap by extending our earlier work by incorporating the impact of regime changes of the foreign exchange of four major countries of South Asia: Pakistan, India, Bangladesh, and Sri Links (Chaudhry & Javid, 2012).[1]

4. Data and Methodology

The methodology adopted to test the efficiency is a variation of the model adopted by Wickremasinghe (2004). This section discusses the methodological framework and sources of data.

4.1 Data and Sample

The data employed in this study consist of the average monthly spot exchange rates for the US Dollar, the British Pound and the Japanese Yen against the Pak Rupee, the Indian Rupee, the Sri Lankan Rupee and the Bangladeshi Taka for the period January 1995 to December 2015All the foreign exchange series are converted in to natural logarithmic transformation. The data set is obtained from the website of Pakistan's foreign exchange market (www.forex.pk).[2]

4.2 Methodological Framework

This study applies unit root tests (Augmented Dickey-Fuller and Phillips-Perron), Johansen (1991, 1995) multivariate co-integration and Granger (1969) causality tests to examine the Efficient Market Hypothesis in relation to India, Bangladesh, Sri Lanka and Pakistan's foreign exchange market. Further, variance decomposition analysis is used to find contribution of each foreign exchange in the total variability beyond the sample period. Given below is a brief explanation of these tests.

[1] Research work in progress is presented in Nurturing Mind Seminar Series at PIDE.
[2] These are the major trade partners in the SAARC region and monthly data of some countries are available from 1995.

Unit Root Test

The stationarity tests are employed to test that random walk process is present in exchange rates or not, that is to say the exchange rates are weak-form efficient and also to check the order of integration of the exchange rates. Two tests that are carried out for this purpose are the augmented Dickey-Fuller (1981) (ADF) test and the Phillips-Perron (1988) (PP) test. Tests for stationarity are applied to the natural logs of the data series.

Tests for Cointegration

The cointegration and Granger causality tests are conducted to test the semi-strong form of the market efficiency. The prerequisite for the co-integration tests is that the foreign exchange rate series must be integrated of the same order most commonly integrated of order one, then Johansen's co-integration is applied.

The three exchange rates are interdependent therefore relationships between them can be estimated by using Vector Autoregressive (VAR) model. However, VAR analysis requires stationarity of the variables. In case, variables are non-stationary but integrated of same order, then analysis can be done by Vector Error Correction Model (VECM) framework (Hamilton, 1995). In this analysis, first difference is obtained of each exchange rate to convert into stationary series and then these differenced exchange rates or returns are used in the VECM applying Granger's representation theorem (Engle & Granger 1987). The linear combination of these returns is considered as long run static equilibrium relationships, (Johansen, 1988; & Johansen and Juselius, 1990). Each equation is then estimated including an error correction term which represents the speed of adjustment to disequilibrium movements in any of the exchange rate. The Johansen and Juselius approach of cointegration is relied on VAR model which can be written as:

$$ER_t = \alpha + \sum_{i=1}^{n} \Pi_k ER_{t-1} + \varepsilon_t \tag{1}$$

where ER_t is a vector of three exchange rates used in the analysis that are required to be integrated of order one, α is a vector of constants and ε_t is a vector of white noise error terms with zero mean and constant variance, n is a lag length and is selected based on Schwatz Baysian Criteria. Π is coefficient matrix for three exchange rates. The VAR model is expressed in the following first difference form:

$$\Delta ER_t = \alpha + \sum_{i=1}^{n-1} \Gamma_k \Delta ER_{t-n} + \Pi ER_{t-1} + \varepsilon_t \tag{2}$$

where all the variable are same as in above equation. The coefficient matrix Π is used to examine the existence of long-run relationship. The rank(r) of this matrix tells about the number of co-integrating vectors. To determine the number of cointegrating relations, two statistics are commonly used; trace statistic and maximal eigenvalue statistic[3]. In trace statistic, the null hypothesis

[3]The trace statistic ($\lambda_{trace}(r)$) is given below where N is the number of observations, r is the number of co-integrating vectors, j is the number of variables and λ 's are the eigen values.

$$\lambda_{trace}(r) = -\sum_{l=r+1}^{j} \ln(1 + \lambda_l)$$

Maximal Eigen Value Test Statistics ($\lambda_m(r)$

is that there are at most r cointegrating vectors against the alternative hypothesis of r or more cointegrating vectors. The maximal eigenvalue statistic tests r cointegrating vectors against the alternative of r+1 cointegrating vectors. To test the number of cointegrating relationships, trace and maximum eigenvalue statistics are compared with the critical values tabulated by Osterwald-Lenum (1992).

Vector Error Correction Mechanism (VECM)

When the variables are co-integrated that is there is a long run relationship between them, there may be disequilibrium in the short run that is adjusted in long run. The Granger representation theorem states that if two variables are co integrated and integrated of order one, then the relationship between the two can be expressed as Vector Error Correction Model (VECM) given below Engle and Granger (1987). Though cointegration indicates the presence of causality, yet the direction of causality amongst the variables is pointed out through VECM. Moreover, VECM enables to distinguish between long run and short run granger causality. Another advantage of VECM is that the lost information due to differencing is brought back into the system through error correction term. The Granger causality test between the variables can be expressed from error correction representation. The current study examines the relationship between US dollar, British pound and Japanes Yen by applying VECM. VECM model treat three exchange rates as interdependent variables, which will follow the rule that whenever there is an adverse shock on the one exchange rate, it will also have impacts on other exchange rate as well. This model will allow three exchange rates to interact with each other in a dynamic fashion both contemporaneously as well as with a number of lags (Hamilton, 1995). Considering the advantages of VECM, which are mentioned above, this model, is selected to analyze the market efficiency hypothesis for four South Asian countries.

$$\Delta USD_t = \alpha_0 + \sum_{i=1}^{n} \alpha_i \Delta USD_{t-i} + \sum_{i=1}^{n} \beta_i \Delta BP_{t-i} + \sum_{i=1}^{n} \gamma_i \Delta JPY_{t-i} + \sum_{k=1}^{i} \alpha_k EC_{t-i} + \varepsilon_{1t-1} \cdots 3$$

$$\Delta BP_t = \alpha_0 + \sum_{i=1}^{n} \alpha_i \Delta USD_{t-i} + \sum_{i=1}^{n} \beta_i \Delta BP_{t-i} + \sum_{i=1}^{n} \gamma_i \Delta JPY_{t-1} + \sum_{k=1}^{r} \alpha_k EC_{t-i} + \varepsilon_{2t-1} \cdots 4$$

$$\Delta JPY_t = \alpha_0 + \sum_{i=1}^{n} \alpha_i \Delta USD_{t-1} + \sum_{i=1}^{n} \beta_i \Delta BP_{t-1} + \sum_{i=1}^{n} \gamma_i \Delta JPY_{t-1} + \sum_{k=1}^{r} \alpha_k EC_{t-1} + \varepsilon_{3t-1} \cdots 5$$

where USD is US dollar, BP is British pound and JPY is Japanese yen. The α, β, and γ are parameters. The EC_{t-1} terms in set of three equations are the cointegrating equations error terms, therefore, these terms are indicating each of the adjustment coefficients. The optimal lag lengths selected by SC criteria are indicated by *r* and *n,* such that each of the error terms is white noise.

Granger Causality/Block Exogeneity Wald Test

The error-correction model introduces a different side of causality through the error-correction term that is not considered in standard Granger causality tests. Granger (1988) postulates in Granger representation theorem that if two variables are stationary of order one and co-integrated then either first variable granger cause second variable or second variable granger cause first variable. In this analysis multivariate granger causality test based on VECM is employed to discover all possible sources of the causality among foreign exchange rates. The inclusion of error correction term in vector error correction model gives an additional source for long run causality that is not considered by Sims and Granger (1972) standard causality tests. The long-run causality is established by presence of significant coefficient of lagged error term whereas short run causality is established by the joint significance of coefficients of lagged variables. The χ^2 test is applied to check joint significance of the coefficients of the lagged variables and t-test is used to check significance of the lagged error term.

Generalized Variance Decomposition Analysis

To detect causality after the sample period, the generalized variance decomposition analysis is employed. In this analysis, the variance of the forecast error of a particular foreign exchange rate is divided into parts; contribution made by shocks or innovations in each exchange rate in the system of three exchange rates as well as its own contribution in the total variability.

5. Empirical Results

The results of testing Market Efficiency Hypothesis for four currencies of important countries of South Asia with respect to three international currencies are presented in this section. The graphical representations in Figure A1 of three exchange rates for four countries separately show a declining trend. Likewise country-wise behavior of three exchange rates also have same trend as shown in figure A2. The summary statistics of the data for British Pound (BP), Japanese Yen (JY) and US dollar (USD) for Pakistan, India, Bangladesh and Sri Lanka from the period 1995 to 2015 is presented in Table A1, in the appendix.

5.1 Weak Form of Efficiency

As a first step, the order of integration for each of the three exchange rates used is determined for all four currencies. This is done by using the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests. The tests are carried out at the levels and first difference of the natural logarithm values, once by including a constant and then by including a constant and a time trend in the test equations. All currencies are stationary at their first differences. Table 1 (A, B, C , and D) reports the ADF and PP test results for the Pak Rupee (PKR), the Indian Rupee (INR), the Sri Lankan Rupee (LKR) and the Bangladeshi Taka (BDT).

From the results of both the augmented Dickey-Fuller and Phillips-Perron test for the four currencies, it can be seen that all three exchange rates are not stationary in their levels but become stationary when they are first differenced. These results are in line with the weak form of market efficiency. Hence, it can be concluded that the foreign exchange markets of Pakistan, India, Sri Lanka and Bangladesh are efficient of the weak form of Efficient Market Hypothesis. That is, past exchange rates cannot be used to predict future exchange rates and hence no trading rule can be devised to consistently gain by trading in the foreign exchange market.

5.2 Semi-Strong Form of Market Efficiency

Once it has been established that all variables are integrated of the same order, move on to the next step, that is, to find a cointegrating relationship between the variables. Table 2 (A, B, C and D) reports the Johansen cointegration results carried out to test for long-run co-movement among the three exchange rates for all four countries. The cointegrating properties are examined using two test statistics, trace and maximum Eigen value. The values of trace statistics are given in column two, with five percent critical and one percent critical values in columns three and four respectively. Similarly the values of maximum Eigen value are shown in column five, with five and one percent critical values and five percent critical values in columns six and seven, respectively.

Table 1: Unit Root Test

A: Unit Root Test for Pakistan Rupee				
Currency	Augmented Dickey Fuller Test		Phillips Perron Test	
USD	-1.426	-8.857 *	-2.483 (3)	-8.696*
BP	-2.534	-8.281 *	-1.919	-10.005*
JPY	2.713	-7.819*	-1.827	-8.322*
B: Unit Root Test for Indian Rupee				
USD	-1.366	-8.857*	-2.588	-5.197*
BP	-1.488	-7.991*	-1.789	-9.306*
JPY	2.033	-9.533*	-0.915	-7.539*
C: Unit Root Test for Sri Lankan Rupee				
USD	-1.239	-10.608 *	-1.092	-9.919*
BP	-1.316	-10.165*	-0.773	-9.773*
JPY	-0.236	-10.679*	-0.711	-8.906*
D: Unit Root Test for Bangladeshi Taka				
USD	-1.168	-9.244*	-1.487	-10.720*
BP	-0.762	-11.312*	-1.199	-10.129*
JPY	-0.526	-8.905*	-0.041	-10.461*

Notes: For the above Tables 1(A, B, C and D). (1). BP, JPY and USD denote the nominal exchange rates for British Pound, Japanese Yen and the US dollar respectively. (2). The null and the alternative hypotheses for both the tests respectively are H0: series is non-stationary and H1: series is stationary. (3). * implies significance. (4) 4. Figures in brackets indicate the number of lags of the dependent variable used to obtain white noise residuals. (5) 5. For the ADF test the lags of the dependent variable are determined using Akaike Information Criterion (AIC) and for the PP test the lags are determined by Newey-West using Bartlett Kernel.

The results of both the trace statistics and the maximum Eigen value statistics show the presence of one cointegrating relationship between the three exchange rates for all four countries. That is to say, the value of one currency can be used to predict the value of another currency, suggesting that the foreign exchange markets of Pakistan, India, Sri Lanka, and Bangladesh do not confirm efficiency in the semi-strong sense.

To further examine the effect of regime shift in the foreign exchange policy on the long-run relationship between the three currencies: British Pound, US dollar, and Japanese Yen in south Asian countries. For Pakistan the three exchange rates are integrated and linked to the US Dollar within a definite band-width effective from 2000, therefore, dummy is constructed which take value 1 for the period 2000 onwards and zero otherwise. Bangladesh has followed an adjustable pegged exchange rate regime from May 2003 and dummy takes value one for the period 2003 onwards and zero otherwise. In the case of Sri Lanka, a dummy is introduced which takes value 1 for the period 2001 and onwards and zero otherwise as in 2001 the Central bank of Sri Lanka announced an independent floating exchange rate regime. All these dummies are incorporated in the VAR model by multiplying with the exchange rates of the respective country and cointegration is tested by Johansen cointegration method. The results reported in Table 3 indicate cointegration exists for all the three exchange rates in three countries based on trace statistics and maximum Eigen values.

Table 2: Results of Johansen Cointegration Test

Null Hypothesis	Trace Statistics	5% Critical Value	1% Critical Value	Maximal Eigen Value Statistics	5% Critical Value	1% Critical Value
A: Johansen Co-integration Test Results for PKR						
0=r	82.2.45*	47.85	51.07	54.461*	27.58	29.81
1≤r	27.743	19.96	24.60	20.178	21.13	23.20
2≤r	7.565	15.49	16.97	5.727	14.26	15.97
B: Johansen co-integration Test Results for INR						
0=r	28.2122*	42.44	48.45	14.773*	25.54	30.34
1≤r	13.4390	25.32	30.45	9.533	18.96	23.65
2≤r	3.9056	12.25	16.26	3.906	12.52	16.26
C: Johansen co-integration Test Results for LKR						
0=r	27.85*	0.30	48.45	18.3225*	25.54	30.34
1≤r	9.5328	0.91	30.45	6.8474	18.96	23.65
2≤r	2.6853	0.87	16.26	2.6853	12.52	16.26
D: Johansen co-integration Test Results for BDT						
0=r*	74.02*	54.08	0.17	45.01*	28.58	0.19
1≤r	28.91	35.19	0.23	18.56	22.30	0.36
2≤r	10.36	20.26	0.27	7.27	15.99	0.27

Note (1) BP, JPY and USD are the nominal exchange rates for British Pound, Japanese Yen and the US dollar respectively.(2) The * indicates the number of cointegrating equations corresponding to that row of the Table.(2) Two lags are included in the vector autoregressions are determined using the Likelihood Ratio (LR) test.

The regime changes has not affected the results confirming that the foreign exchange markets of Pakistan, India, Sri Lanka, and Bangladesh are all not efficient of the semi-strong form.[4] Nevertheless, the results of co-integration test are not conclusive. To further check for the presence of any relationship between exchange rates, analysis proceeds to carry out the Granger Causality test. Therefore, the short-run causality from one exchange rate to the other exchange rate is assessed by testing the null hypothesis that each coefficient (α, β, and γ) on the independent variable is zero. If this hypothesis is not accepted, it is concluded that independent variables Granger cause the dependent variable. The Granger causality tests based on VECM are documented in Table 4.

The χ^2-statistic and probability values show the presence of various causal relationships in Table 4 (a, b, c and d). In the case of Pakistan, there exists only one bi-directional causal relationship from the US Dollar to the Japanese Yen. For India, there is evidence of causal relationship from the Japanese Yen to the US Dollar and also from the Japanese Yen to British Pound. However, for Sri Lanka two causal relationships are found; one from the US Dollar to the Japanese Yen and one two way causal relationship from the British Pound to the US Dollar. Lastly, for Bangladesh, there is evidence of the existence of only one causal relationship, that is, from the US Dollar to British Pound. The existence of causal relationships indicates that one

[4]Separate cointegration analysis for the different exchange rate regime based on sub-samples will give similar results.

exchange rate can be predicted by one or more of the other exchange rates. These results confirm that semi-strong form of the Efficient Market Hypothesis does not hold.

Table 3: Results of Johansen Co-integration test with Regime Changes

Null Hypothesis	Trace Statistics	5% Critical Value	p-value	Maximal Eigen Value Statistics	5% Critical Value	p-value
A: Johansen co-integration Test Results for Pakistan Rupee with Regime Shift						
0=r*	204.89*	117.71	0.00	79.82*	44.49	0.00
1≤r*	125.07*	88.80	0.00	62.72*	38.33	0.00
2≤r	58.93	63.88	0.73	17.14	32.11	0.55
3≤r	19.81	42.91	0.96	9.78.	25.82	0.97
4≤r	10.03	25.87.	0.92	7.31	7.31	0.88
5≤r	2.72	12.51	0.91	2.72	12.51	0.91
B: Johansen co-integration Test Results for LKR with Regime Shift						
0=r*	103.85*	97.50	0.00	40.96*	30.05	0.00
1≤r	67.45	76.97	0.21	28.27	34.81	0.24
2≤r	39.45	54.07	0.51	20.71	28.58	0.37
3≤r	18.44	35.19	0.81	9.21	22.29	0.89
4≤r	9.23	20.26	0.71	6.57	15.89	0.74
5≤r	2.82	9.16	0.60	2.85	9.16	0.61
C: Johansen co-integration Test Results for BDT with Regime Shift						
0=r*	103.85*	97.50	0.00	40.96*	30.05	0.00
1≤r	67.45	76.97	0.21	28.27	34.81	0.24
2≤r	39.45	54.07	0.51	20.74	28.58	0.37
3≤r	18.44	35.19	0.81	9.21	22.29	0.89
4≤r	9.23	20.26	0.71	6.37	15.89	0.74
5≤r	2.82	9.16	0.60	2.85	9.16	0.61

Note (1) BP, JPY and USD are the nominal exchange rates for British Pound, Japanese Yen and the US dollar respectively. (2) Multiplicative Dummy variables are used as for regime shift in exchange rate for each country. (2) The [2]* Indicates the number of cointegrating equations corresponding to that row of the table. (3) Two lags included in the vector auto regressions are determined using the Likelihood Ratio (LR) test.

Table 5 (A, B, C, and D) present the variance decomposition of the three exchange rate for four South Asian countries. The results show the percentage of the forecast error variance for each exchange rate that is attributable to its own shocks and to shocks in the other two exchange rates in the system. The key finding from the variance decomposition is that for all three-exchange rates, the main source of variation are own shocks. According to the results for Pakistan Rupee reported in Table 5, USD explains up to 98% of its variance which decreases to about 91% in 9 months and then increase to 93.7%, 94.7%, 95.6% in 18, 24 and 36% respectively. The British Pound 0.25% in 3 months which increases to 0.63% in 36 months. For BP, it explains up to 81% of its own variance and the major proportion of the remaining 19% is explained by USD. On the other hand, JPY explains almost 98% of its own variance in 3 months which decreases to 35% in 36 months. However, in the case of JPY, even after 60 the month's period, almost 40% of its variance is explained by USD.

As the results presented in Table 5(B) illustrate, USD explains up to 99% of its variance in first 3 months which reduces to 95% even after 36 months following the one time only shock in USD for India and out of the remaining 4% to 13% is explained by BP and the rest 0.14% to

3.55% by JPY over 36 months. For BP, it explains up to 86% of its own variance in 3 months, which reduces to 80%. 75% and 71% in 12, 24 and 36 months respectively. The remaining 12% is explained by USD, which reduces to 21% in 36 months and out of the remaining 0.19% is explained by JPY, which increases to 6.04% by JPY. However, when JPY is considered, almost 78% of its variance is accounted for by its own variance and 28.83% of it by USD and 0.78% by BP.

Table 4: Result of VAR Granger Causality/Block Exogeneity Wald Tests

Null Hypothesis (H0)	Chi-sq	Prob.	Conclusion
A: Block Exogeneity Wald Tests for Pakistan Rupee			
PJPY does not Granger cause the PUSD in VAR framework	2.571*	0.100	Reject H0
PBP does not Granger cause the PUSD in VAR framework	0.045	0.832	Accept H0
PUSD does not Granger cause the PJPY in VAR framework	3.763*	0.052	Reject H0
PBP does not Granger cause the PJPY in VAR framework	0.129	0.728	Accept H0
PUSD does not Granger cause the PBP in VAR framework	0.036	0.841	Accept H0
PJPY does not Granger cause the PBP in VAR framework	0.631	0.426	Accept H0
B: Block Exogeneity Tests for Indian Rupee			
Null Hypothesis (H0)	Chi-sq	Prob.	Conclusion
IJPY does not Granger cause the IUSD in VAR framework	1.573	0.455	Accept H0
IBP does not Granger cause the IUSD in VAR framework	0.054	0.831	Accept H0
IUSD does not Granger cause the IJPY in VAR framework	2.699*	0.259	Accept H0
IBP does not Granger cause the IJPY in VAR framework	2.653	0.265	Accept H0
IUSD does not Granger cause the IBP in VAR framework	1.419	0.491	Accept H0
IJPY does not Granger cause the IBP in VAR framework	8.445*	0.014	Reject H0
C: Block Exogeneity Wald Tests for Sri Lanka			
Null Hypothesis (H0)	Chi-sq	Prob.	Conclusion
SJPY does not Granger cause the SUSD in VAR framework	0.137	0.934	Accept H0
SBP does not Granger cause the SUSD in VAR framework	6.329*	0.042	Reject H0
SUSD does not Granger cause the SJPY in VAR framework	5.432*	0.066	Reject H0
SBP does not Granger cause the SJPY in VAR framework	2.408	0.300	Accept H0
SUSD does not Granger cause the SBP in VAR framework	7.708*	0.021	Reject H0
SJPY does not Granger cause the SBP in VAR framework	2.924	0.232	Accept H0
D: Block Exogeneity Wald Tests for Bangladesh			
Null Hypothesis (H0)	Chi-sq	Prob.	Conclusion
BJPY does not Granger cause the BUSD in VAR framework	0.733	0.693	Accept H0
BBP does not Granger cause the BUSD in VAR framework	2.994	0.223	Accept H0
BUSD does not Granger cause the BJPY in VAR framework	1.500	0.472	Accept H0
BBP does not Granger cause the BJPY in VAR framework	3.503	0.173	Accept H0
BUSD does not Granger cause the BBP in VAR framework	5.803*	0.054	Reject H0
BJPY does not Granger cause the BBP in VAR framework	2.551	0.279	Accept H0

Note: (1) BP, JPY and USD are the nominal exchange rates for British Pound, Japanese Yen and the US dollar respectively.(2) The * indicates the rejection of null hypothesis. (3) Two lags included in the vector autoregressions are determined using the Likelihood Ratio (LR) test.

However, since Granger causality test only allows to test causality within the sample period, therefore, to draw conclusions about causality after the period of study, the variance decomposition analysis is applied. Results of this analysis are tabulated below. Column three through five indicate how much of an exchange rate's innovation is described by its own variance and how much by other exchange rate variance over the forecast horizon that is 36 months.

Table 5: (A) Results of Variance Decomposition for Pakistan Rupee

Variance Decomposition of PUSD				
Months	S.E.	PUSD	PBP	PJPY
3	0.001	98.202	0.246	1.552
6	0.001	92.039	0.557	7.404
9	0.001	91.262	0.499	8.239
12	0.001	92.117	0.477	7.406
18	0.002	93.702	0.510	5.787
24	0.002	94.702	0.555	4.743
30	0.002	95.289	0.595	4.116
36	0.002	95.637	0.628	3.735
Variance Decomposition of PBP				
Months	S.E.	PUSD	PBP	PJPY
3		0.574	99.310	0.116
6	0.047	0.594	99.030	0.375
9	0.047	0.677	98.853	0.470
12	0.047	0.728	98.781	0.490
18	0.047	0.805	98.678	0.517
24	0.047	0.868	98.602	0.529
30	0.047	0.921	98.545	0.534
36	0.047	0.964	98.499	0.537
Variance Decomposition of PJPY				
Months	S.E.	PUSD	PBP	PJPY
3	0.134	30.590	0.087	69.324
6	0.190	45.158	0.871	53.971
9	0.219	52.277	1.167	46.556
12	0.240	56.587	1.231	42.181
18	0.270	62.461	1.278	36.261
24	0.292	66.350	1.285	32.365
30	0.308	69.082	1.279	29.639
36	0.320	71.075	1.269	27.656

Ordering: PUSD PBP PJPY

(B) Results of Variance Decomposition for India Rupee

Variance Decomposition of IUSD				
Months	S.E.	IUSD	IBP	IJPY
3	0.001	95.544	4.319	0.138
6	0.001	90.921	8.873	0.206
9	0.001	88.203	11.638	0.159
12	0.001	86.118	13.650	0.231
18	0.001	82.924	16.285	0.791
24	0.001	80.674	17.645	1.681
30	0.001	79.129	18.218	2.654
36	0.001	78.085	18.360	3.555
Variance Decomposition of IBP				
Months	S.E.	IUSD	IBP	IJPY
3	0.158	12.667	86.134	1.199
6	0.223	12.652	84.576	2.772
9	0.260	13.703	82.721	3.576
12	0.283	14.942	80.969	4.089
18	0.310	17.307	77.853	4.840
24	0.323	19.226	75.327	5.447
30	0.331	20.643	73.393	5.964
36	0.335	21.628	71.969	6.403
Variance Decomposition of IJPY				
Months	S.E.	IUSD	IBP	IJPY
3	0.001	20.346	0.870	78.784
6	0.001	17.808	0.450	81.742
9	0.001	17.219	0.515	82.266
12	0.001	17.037	0.815	82.148
18	0.002	17.040	1.731	81.229
24	0.002	17.212	2.703	80.085
30	0.002	17.437	3.529	79.034
36	0.002	17.666	4.157	78.177

Cholesky Ordering: PUSD PBP PJPY

(C) Results of Variance Decomposition for Sri Lanka

Variance Decomposition of SUSD				
Months	S.E.	SUSD	SBP	SJPY
3	0.000	97.715	2.279	0.006
6	0.000	97.153	2.839	0.009
9	0.001	97.227	2.766	0.007
12	0.001	97.399	2.596	0.006
18	0.001	97.735	2.256	0.009
24	0.001	97.989	1.987	0.024
30	0.001	98.167	1.784	0.049
36	0.001	98.289	1.630	0.080
Variance Decomposition of SBP				
Months	S.E.	SUSD	SBP	SJPY
3	0.000	10.658	89.102	0.240
6	0.000	16.891	81.772	1.337
9	0.000	23.643	73.559	2.798
12	0.000	29.954	65.854	4.192
18	0.001	40.268	53.548	6.184
24	0.001	47.722	45.116	7.162
30	0.001	53.104	39.391	7.505
36	0.001	57.070	35.408	7.522
Variance Decomposition of SJPY				
Months	S.E.	SUSD	SBP	SJPY
3	0.066	0.804	0.333	98.862
6	0.090	2.853	0.357	96.790
9	0.103	6.136	0.533	93.331
12	0.112	10.231	0.734	89.035
18	0.124	19.286	1.069	79.645
24	0.133	27.763	1.260	70.976
30	0.141	34.823	1.335	63.842
36	0.148	40.430	1.343	58.227

Cholesky Ordering: SUSD SBP SJPY

(D) Results of Variance Decomposition for Bangladesh

Months	S.E.	BUSD	BBP	BJPY
Variance Decomposition of BUSD:				
3	0.000	99.315	0.677	0.009
6	0.000	99.347	0.602	0.051
9	0.001	99.300	0.413	0.288
12	0.001	98.892	0.385	0.723
18	0.001	97.215	0.745	2.040
24	0.001	94.909	1.395	3.696
30	0.001	92.437	2.117	5.446
36	0.001	90.060	2.800	7.140
Variance Decomposition of BBP				
Months	S.E.	BUSD	BBP	BJPY
3	0.000	17.411	82.346	0.243
6	0.001	21.395	77.198	1.407
9	0.001	23.497	73.230	3.273
12	0.001	24.978	69.561	5.461
18	0.001	27.056	63.068	9.876
24	0.001	28.521	57.825	13.654
30	0.001	29.669	53.734	16.597
36	0.001	30.629	50.576	18.795
Variance Decomposition of BJPY				
Months	S.E.	BUSD	BBP	BJPY
3	0.115	10.860	1.694	87.446
6	0.157	11.175	1.212	87.613
9	0.180	12.867	1.326	85.807
12	0.194	15.033	1.625	83.342
18	0.209	19.829	2.468	77.703
24	0.219	24.479	3.407	72.115
30	0.227	28.488	4.275	67.237
36	0.234	31.709	4.997	63.294

Cholesky Ordering: PUSD PBP PJPY

Note: (1) BP, JPY and USD denote the nominal exchange rates for British Pound, Japanese Yen and the US dollar respectively. (2) Figures in column 1 refer to months after a once-only shock. Cholesky ordering for the variance decomposition I s log (USD), log (BP) and log (JPY). (4) Variance decompositions for the months 3, 6, 9, 12, 18, 24, 30 and 36 have only been reported. All figures in columns three through five have been rounded to three decimal places.

As the results for Sri Lanka given in Table 5 (C) show, USD explains up to 98% of its variance and BP explains up to 2.27% of the remaining 0.06%, which remains approximately the same even after the 36 months following the once only shock in USD. When BP is considered, it explains up to only 89% of its own variance in 3 months, which declines, to 35% in 36 months. The more than 10% of its variance is accounted for by USD in 3 months, which increases to 35%

after 36 months following the one time only shock. On the other hand, JPY explains only 98% of its own variance in 3 months which declines to 52% in 36 months and again most of its variance (almost 32%) is explained by USD after the 36 months

The results for Bangladesh are presented in Table 5 indicate that USD explains more than 99% of even after the 36 months following the once only shock. However, BP explains less about 82% of its own variance which decreases to 50% in 36 months in 36 months and the major proportion of the remaining 50% is explained by USD after 36 months. On the other hand, JPY explains almost 78% of its own variance, which is 63% even after the 36 months. Nonetheless, 42% of its remaining 50% is accounted for by USD.

The results of the variance decomposition analysis for all four countries above reveal that the forecast variance of one exchange rate is explained by others exchange rates in the system indicating future causal relationships between currencies. The presence of such causal relationships can be applied to forecast the future value of a particular currency from the past values of one or more of the other currencies. These results suggest that the semi-strong form of the Efficient Market Hypothesis is not valid in the South Asian countries; Pakistan, India, Sri Lanka and Bangladesh.

6. Conclusions

This study examines the weak form and the semi-strong form of the efficient market hypothesis for the foreign exchange markets of Pakistan, India, Sri Lanka, and Bangladesh. The data used consists of the log of average monthly spot exchange rates for these four currencies against the US Dollar, the British Pound and the Japanese Yen for the period January 1995 to December 2015. To tests the weak form of efficient market hypothesis, unit root tests (the Augmented Dickey-Fuller and Phillips-Perron) are used, however, to test for the semi-strong form of the efficient market hypothesis the Johansen's multivariate co integration test, Granger causality test and variance decomposition analysis are used.

The results of both the ADF and PP tests show that the currencies of all four countries follow random walks. These results provide evidence in favor of the weak form of efficient market hypothesis. The implications that emerge from these results are that the participants of the foreign exchange markets of Pakistan, India, Sri Lanka and Bangladesh cannot formulate a trading rule that can be applied to forecast the future movements of an exchange rate from its past values. On the other hand, the Johansen's cointegration test, Granger causality/block exogeneity Wald test and variance decomposition analysis do not support the semi-strong form of the efficient market hypothesis. The results of cointegration after introducing the multiplicative dummies for regime shift further confirms the markets are inefficient in semi-strong form. The results of all three tests signify that the movement of one or more exchange rates can be predicted from the movements of the other exchange rates; implying that in this case the participants of the foreign exchange markets of all four countries can devise strategies for profitable earnings in both the short run and long run.

The results of the present research have important implications for the government policy making institutions as well as for the participants of the foreign exchange markets. The government can make well-versed decisions on exchange rates. They can take actions to minimize exchange rate instability and appraise the effects of different economic policies for exchange rates. The participants of the foreign exchange market can benefit by devising trading rules or strategies to make huge amounts of profits from transactions in the foreign exchange market.

References

Andrianto, Y., & Mirza, A. R. (2016). A testing of efficient markets hypothesis in Indonesia stock market. *Procedia-Social and Behavioral Sciences, 219(2016)*, 99-103.

Ahmad, K. M., Ashraf, S., & Ahmed, S. (2005). Is the Indian stock market integrated with the US and Japanese markets? An empirical analysis. *South Asia Economic Journal*, *6*(2), 193-206.

Baillie, R.T., and Bollerslev, T. (1989). Common stochastic trends in a system of exchange rates. *Journal of Finance,* 44(1), 167-181.

Chakrabarti, R. (2005). Foreign exchange markets in India. *Indian School of Business, Working Paper Series.*

Chaudhary, S. A. and Javid, A. Y. (2012). Efficiency of the foreign exchange markets of South Asian countries. PIDE Working Paper No 82, PIDE, Islamabad.

Chiang, S. M., Lee, Y. H., Su, H. M., & Tzou, Y. P. (2010). Efficiency tests of foreign exchange markets for four Asian countries. *Research in International Business and Finance*, *24*(3), 284-294.

Dickey, D.A., and Fuller, W.A. (1979). Distribution for the estimates for auto regressive time series with a Unit Root. *Journal of the American Statistical Association,* 74(366a), 427-31.

Dickey, D.A., and Fuller, W.A. (1981). Likelihood ratio statistics for autoregressive time series with a Unit Root. *Econometrica,* 49(4), 1057-72.

Domowitz, I., and Hakio, C.S. (1985). Conditional variance and the risk premium in the foreign exchange market. *Journal of International Economics,* 19(1-2), 47 – 66.

Fama, E.F. (1965). The behavior of stock market prices. *Journal of Business,* 38(1), 34- 105.

Fama, E.F. (1984). Forward and spot exchange rates. *Journal of Monetary Economics* 14(3), 319-338.

Fama, E.F (1991). Efficient capital markets: II. The Journal of Finance. *XLVI*(5), 1575-1611.

Granger, C.W.J. (1969). Investigating the causal relations by econometric models and cross-spectral methods. *Econometrica,* 37(3), 424-438.

Hakio, C. (1981). Expectations and the forward exchange rate. *International Economic Review,* 22(3), 663-678.

Hideki, I. (2006). An empirical test of the efficiency hypothesis on the renminbi NDF in Hong Kong market. *Kobe University Discussion Papers*, 196.

Hodrick, R.J., and Srivastava, S. (1986). The covariance of risk premiums and expected future spot exchange rates. *Journal of International Money and Finance,* 5 (1986), 5 – 21.

Jeon, B.N., and Seo. B (2003). The impact of the Asian financial crisis on foreign exchange market efficiency: The case of east Asian countries. *Pacific-Basin Finance Journal,* 11(4), 509- 525.

Johansen, S. (1991). Estimation and hypothesis testing of cointegration vectors in gaussian vector autoregressive models. *Econometrica,* 59(6), 1551–1580.

Johansen, S. (1995). Likelihood based inference on cointegration in the vector autoregressive model. *Oxford University Press*, Melbourne.

Kimani, S.W. (2007). Efficiency of foreign exchange market in Kenya: The Rational Expectation approach. *Unpublished MBA dissertation*, University of Nairobi.

Lo, A.W., and MacKinlay, A.C. (1988). Stock market prices do not follow random walks: Evidence from a simple specification test. *Review of Financial Studies* 1(1), 41–66.

Makovský, P. (2014). Modern approaches to efficient market hypothesis of FOREX–the central European case. *Procedia Economics and Finance, 14(2014)*, 397-406.

Moosa, I. (2010). International Finance : Analytical Approach, McGraw Hill. Australia.

Nath, G.C. (2006). Market efficiency and volatility in Indian FX market. *The IUP Journal of Applied Finance*. 24 (1), 13-25.

Noman, A.M., and Ahmed, M.U. (2008). Efficiency of the foreign exchange markets in South Asian countries. *AIUB Bus Econ Working Paper Series*, No. 2008-18.

Oh, G., Kim, S., & Eom, C. (2007). Market efficiency in foreign exchange markets. *Physica A: Statistical Mechanics and its Applications*, *382*(1), 209-212.

Phillips, P. C., & Perron, P. (1988). Testing for a unit root in time series regression. *Biometrika*, *75*(2), 335-346.

Rose, N. W., Kisaka, S. E., Ganesh, P. and Gituro, W. (2008). An analysis of the efficiency the foreign exchange market in Kenya. *Economics Bulletin,* 14 (2), 1-13.

Salisu, A. A., & Ayinde, T. O. (2016). Testing the Martingale Difference Hypothesis (MDH) with structural breaks: Evidence from foreign exchanges of Nigeria and South Africa. *Journal of African Business*, *17*(3), 342-359.

Wickremasinghe, G. (2004). Efficiency of foreign exchange markets: A developing country perspective. *ABERU Discussion Paper* 3.

Appendix

Figure A1: Country-wise Trend of British Pound (BP), Japanese Yen (JY) and US dollar (USD).

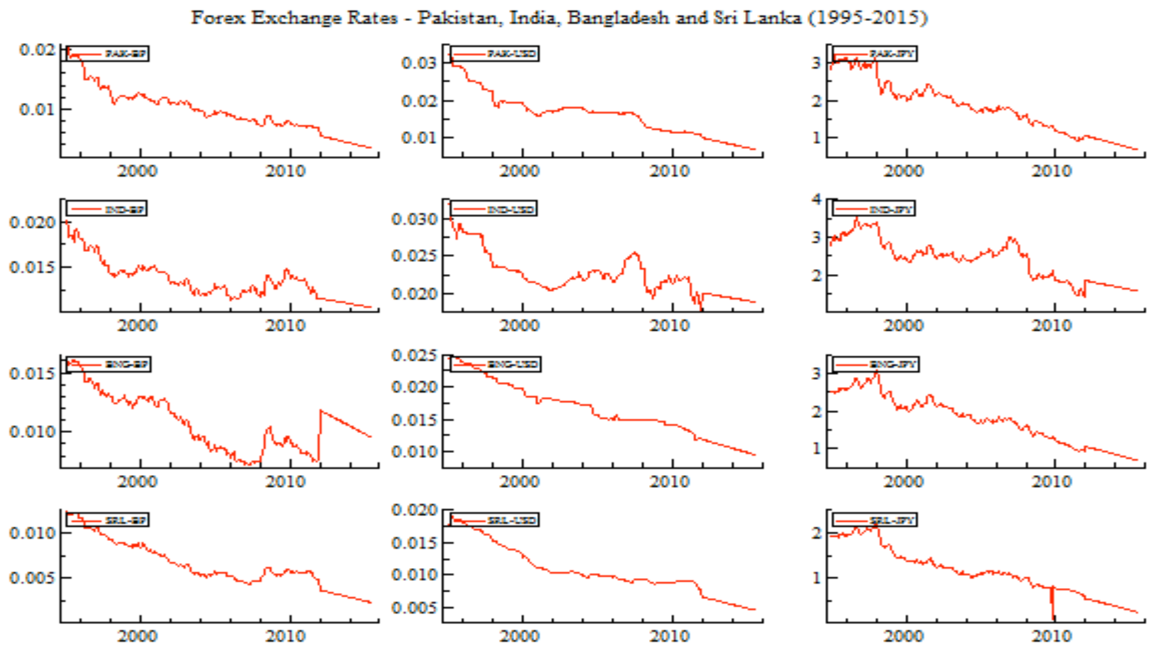

Figure A2: Trend of Forex Rates in Pakistan, India, Bangladesh and Sri Lanka

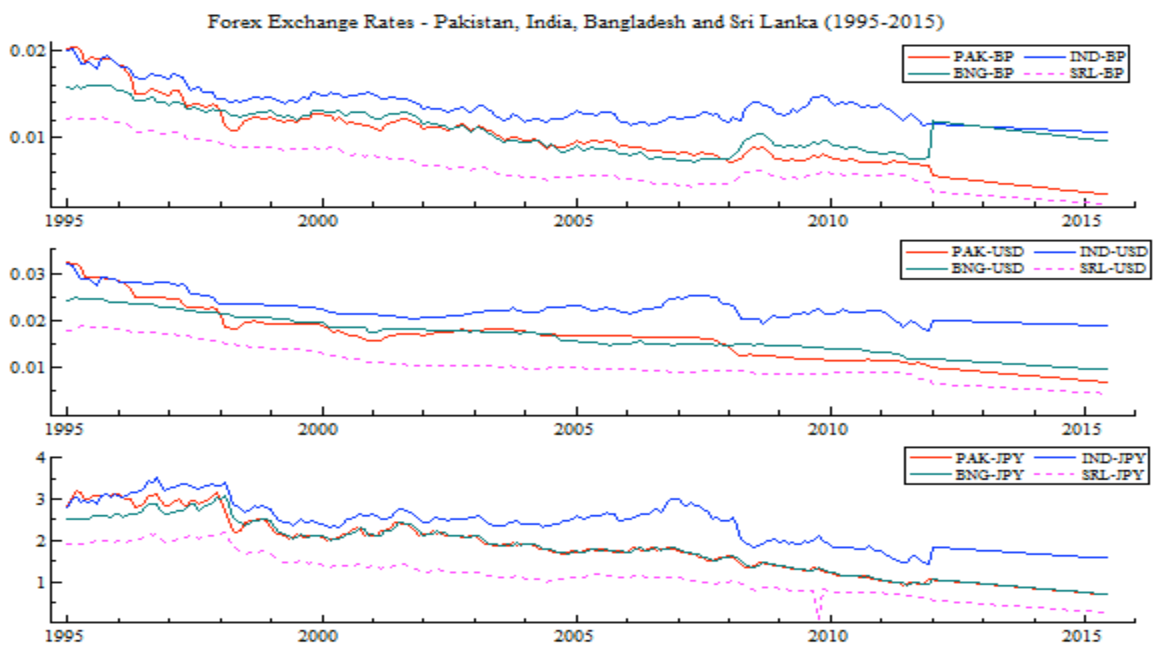

Table1: Summary Statistics of Monthly BP, PJPY, and PUSD

Pakistan			
	PAKBP	PJPY	PUSD
Mean	0.019	2.161	0.019
Std. Dev.	0.076	0.543	0.005
Skewness	12.403	0.277	1.189
Kurtosis	6.732	2.539	3.751
Q(6) (p-value)	781.05 (0.000)	753.63 (0.000)	819.02 (0.000)
Q(12) (p-value)	1164.3 (0.000)	1167.9 (0.000)	1268.0 (0.000)
Jarque-Bera (p-value)	191211.3 (0.000)	3.903 (0.142)	46.651 (0.000)
India			
	IndBP	IJPY	IUSD
Mean	0.014	2.657	0.024
Std. Dev.	0.002	0.369	0.003
Skewness	1.050	0.166	1.174
Kurtosis	3.276	2.834	3.529
Q(6) (p-value)	881.06 (0.000)	674.72 (0.000)	829.56 (0.000)
Q(12) (p-value)	1484.3 (0.000)	950.86 (0.000)	1265.1 (0.000)
Jarque-Bera (p-value)	33.685 (0.000)	1.037 (0.595)	43.468 (0.000)
Bangladesh			
	BBP	BJPY	BUSD
Mean	0.011	2.109	0.018
Std. Dev.	0.369	0.002	0.003
Skewness	0.073	0.154	0.466
Kurtosis	1.859	2.103	1.961
Q(6) (p-value)	970.25 (0.000)	824.80 (0.000)	943.56 (0.000)
Q(12) (p-value)	1735.5 (0.000)	1358.8 (0.000)	1644.8 (0.000)
Jarque-Bera (p-value)	9.908 (0.007)	6.737 (0.034)	14.611 (0.000)
Sri-Lanka			
	SBP	SJPY	SUSD
Mean	0.008	1.401	0.012
Std. Dev.	0.002	0.408	0.003
Skewness	0.548	0.479	0.732
Kurtosis	2.090	1.888	2.041
Q(6) (p-value)	958.96 (0.000)	905.48 (0.000)	946.46 (0.000)
Q(12) (p-value)	1705.5 (0.000)	1565.4 (0.000)	1673.9 (0.000)
Jarque-Bera (p-value)	15.242 (0.000)	16.143 (0.000)	22.987 (0.000)