

The Relationship between Exchange Rate and Stock Prices in South Asian Countries

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Globalization has reduced the barriers to international trade and investment which has created numerous opportunities for investors to invest in different markets. Stock markets and foreign exchange markets are two major sources for investment vehicles to invest and maximize returns on investment. This research has been conducted to do analyse the exchange rate and stock price in the context of South Asian countries. The data for exchange rates and stock prices has been taken from 2007 to 2016 and has been analysed through the statistical tests of co-integration and error correction model (ECM). The empirical outcomes show that there is no form of association between exchange rate and stock price in Pakistan and India. However, these two financial variables are impact in both short term and long-term periods in Sri Lanka. The results of this research can help investors to use the information on the exchange rate when seeking to invest in Sri Lankan stock markets whereas, Pakistani and Indian investors can see the other trends of interest rates, GDP rate or inflation rate. This study empirically tests the theoretical relationship between exchange rate and stock prices. Various studies in the past have tested the relationship in developed countries, but no research has focused on South Asian countries. These results have implication for students, investors, and policymakers as it helps them to better understand the economic relationship and devise economic policies accordingly.

Key words: *Exchange Rate; Stock Price; Co-integration; ECM JEL Classification: E44, F31, M21.*

Introduction

Various economic theories suggest a theoretical relationship between exchange rate and stock prices such as “Flow oriented” or “Good Market” approaches, which talk about current account or trade balance and suggest that international competitiveness and trade balance is affected by currency movement which eventually creates an impact on real income and output (Dornbusch and Fischer, 1980). “Stock-oriented” or “Portfolio Balance” approaches view exchange rate as equalizing the demand and supply for financial assets such as shares and bonds. Hence, there are increases in the importance of the capital account in determining the dynamics of the exchange rate (Branson, 1983; Bildirici, 2013). Stock prices are interpreted as the present value of firms’ future cash flows which create a link between decisions related to current investment or consumption and future income or interest rate innovations. Moreover, stock market volatility affects aggregate demand through liquidity and wealth effects (Gavin, 1989). Since the present value of financial assets’ future cash flows helps in the determination of their market value, the expectation of change in the value of relative currency plays a vital role in their price fluctuations, especially for internationally held assets. Therefore, exchange rate innovations may affect or get affected by stock market dynamics.

In addition to the above classical economic theories, the East Asian crisis caught the interest of many investors who seek to determine the relationship between stock price and exchange rate, as during the crisis the affected countries witnessed turmoil in both the currency and equity markets. As per economic theory, if both the exchange rate and stock prices are related and the causation runs from exchange rate to stock prices than by controlling the exchange rate the stock market crisis could have been prevented, and foreign portfolio investment could have been increased. However, if the causation runs from stock prices to exchange rate then the stock market can be stabilized by focusing on domestic economic policies. Nevertheless, if both markets are related then the investor can utilize the information to speculate and hedge their return on foreign investment. As foreign investor’s view return on investment in terms of their domestic currency, and changes in exchange rates affect their returns, which are ultimately dependent upon the direction of movement in currency and economy of the investor country. Therefore, such a link can be exploited to catch the attention of the foreign investors to invest in the countries (Dimitrova, 2005).

The exchange rate is the differential of one currency over the other, so fluctuations and differences in currency create the demand for foreign exposure of developed country multinationals and financial institutions for investments (Rahman & Uddin, 2009). Specifically, the country financial market i.e. stock market performances, have a greater impact on exchange rates because the stock market is the most approachable market for investors due to high returns and capital gains. Thus, gaining insight and understanding of

these economic relationships will help domestic, as well as foreign investors, to diversify their investment portfolio and to hedge against the uncertainty of their return on investment (Khan, 2015). In view of investment opportunities, investors always determine exchange rate differences in order to effectively invest in the host country. Additionally, it may be observed that the exchange rate is the most important indicator for foreign investment (Kurihara, 2006; Campbell & Narayan, 2018). Hence, all the economies of the world are changing their dimension due to the era of globalization and trade liberalization. By considering the different perceptions of investors who invest in a variety of currencies it can be seen that these two financial variables need to be analysed (Kalimullah & Zulfiqar, 2015). An analysis will help reveal whether such relationships will be instructive for foreign investor in their investment activities. The competitiveness of a firm is also affected by their exposure to foreign currency as an importer/exporter, which ultimately impacts on their input and output prices. As a country's currency appreciates, the exporter loses their competitiveness in the international market and it results in low sales, or profit, that ultimately decreases their stock price. Contrarily, it will benefit the importer in the domestic market, and as a result, their profits and stock price will increase (Abdul Hadi et al., 2019; Yau & Nieh, 2006). Appreciations of currency have both positive, and negative impacts, on the domestic stock price for import, and export dominant countries, respectively.

Past research on the association of stock prices and exchange rate has presented inconclusive (both positive and inverse) results on stock performances (Aggarwal, 1981; Roll 1992). As the theory of flow-oriented exchange rate model describes that there is an inverse association between exchange rate and stock prices. This relationship exists due to the change in exchange rates and stock prices. If the exchange rate decreases, it reduces the value of the weak currency and negatively affects the prices of stock market (Soenen and Hannigar, 1988; Phylaktis & Ravazzolo, 2005). Whereas, the stock-oriented exchange rate model by Stavarek (2005) illustrated that an increase in stock prices attracts more investors who buy more local currency which leads to local currency appreciation. Furthermore, Kutty (2010) found that stock prices lead exchange rates in the short run but no long-run relationship exists between the two financial variables. Nieh and Lee (2001) proved that there is no significant long-term relationship between exchange rate and stock price in G-7 countries. In addition, they found ambiguous significant and short-run relationships for these countries. Bahmani-Oskooee & Sohrabian (1992) also failed to find any long-term association between the S&P 500 index and US dollar exchange rate.

Past research in Asian countries has also tried to find the relationship between stock prices and exchange rate. Kalimullah & Zulfiqar Ali (2015), identified in their study that both variables have a long-term association with each other in the Pakistani Stock Market. They further found that investors can analyse the direction of one market, with respect to the other, and that both variables have the propensity to move in similar trends as both are

interdependent. On the other hand, Muhammad, Rasheed, & Husain (2002), concluded that exchange rate and stock prices are able to move in two converse ways for the Sri Lankan and Bangladeshi stock market. In the same way, Bhattacharya and Mukherjee (2003) failed to find any association in Indian markets, and Muhammad and Rasheed (2003) were unsuccessful in South Asian countries (Bangladesh, India, Pakistan, and Sri Lanka). However, Granger, Huang and Yang (2000) found a direct relationship between the two variables in the Philippines and an inverse relationship in South Korea.

On the issue of causation results are also mixed. Abdalla and Murinde (1997) identified that causation runs from exchange rate to stock prices and Ajayi and Mougoue (1996) found inverse causation. Keeping in view the above evidence, it can be concluded that there is no theoretical consensus on the relationship and direction of causation between exchange rate and stock prices. This lack of consensus motivates the researchers to contribute more to the existing literature. This research is carried out to find the relationship (short term and long term) and the course of causality between exchange rate and stock market prices for the South Asian countries.

This research is directed toward the following countries and their respective stock exchanges: Pakistan Stock Exchange (KSE 100 index), India Bombay Stock Exchange (BSE 200 index) and Colombo Stock Exchange (CSE). These stock exchanges were selected because it can be seen that exchange rate fluctuations are volatile in developing countries, and this is largely due to currency differences in developed countries. The existence of this difference may impact the financial performance of developing countries for which their country's stock market plays a vital role in determining their country's financial progress. Other South Asian countries like Afghanistan, Bangladesh, Maldives, and Nepal are excluded due to non-availability of data for the required sample period. However, this research can be used in the context of other countries, with respect to their stock market and rate of foreign exchange. This research can also be applied in different industries such as accounting, finance, and investment.

Literature Review

The concept of Foreign Exchange Rate and Stock Prices

As stated by Andersen et al. (2007), the foreign exchange rate is defined as the price of a nation's currency to another nation and thus has two components, domestic and foreign currency, and can be quoted either directly or indirectly. In difference, (Kutty, 2010) described exchange rates as the rate of conversion of one currency to another currency. An increase in foreign currency rate represents an appreciation of local currency and a decline in the rate of foreign exchange determines devaluation of currency. An appreciation in currency is considered beneficial for an economy as it allows it buy foreign products at lower prices. In

contrast to this, it is detrimental as products in the nation became more expensive for other countries (Cheung et al. 2005). Hence, currency appreciation leads towards a reduction in exports of a particular economy which is not identified as a good signal.

According to Tetlock (2007) and Van Rooij et al. (2011), the stock market is defined as consisting of the primary and secondary markets. Under this definition, new issues (IPOs) are initially offered by companies and this is the primary market, whereas any later trading is the secondary market. According to Singh (2010) stock price is influenced by many factors, some of which are specific to company, sector and the environment in which a firm conducts its business. Stock price is also dependent upon macroeconomic factors, domestic and international factors, market sentiments, expectations about future economic growth, political or social events, monetary and fiscal policies of countries.

Factors Affecting Foreign Exchange Rate and Stock Prices

According to Patosa & Cruz (2013) exchange rate is priced like other assets and determined by the expectations of foreign investors, who give regard to fluctuations in exchange rates in the future, interest rate differential among countries, inflation rate, current account deficit, political and economic conditions, trade relations between countries, and the external debt of the country. It has been also been proposed that exchange rate fluctuations impose a risk to the import and export of the country, however, this is dependent upon whether the country is export or import dominant. In support of this, Ozturk (2007) stated that volatility in the exchange rate has a significant impact on the level of international trade as an increase in exchange rate leads to increased risk and transaction costs, which are both associated with the volatility of the exchange rate; ultimately this leads to a lowering international trade within the economy.

Macroeconomic factors are the external factors that impact the general environment rather than particular environments. Through focusing research on to stock prices, there is a secondary effect of studying the macro environment when measuring stock performances. Such macro factors include inflation rate, interest rate, GDP rate and exchange rate (Hong and Stein, 2007). Among these variables, Lobo (2000) has studied the behaviour of stock prices with respect to the macro variable of interest rate. In which he found that interest rate is inversely related with stock prices. It was suggested that this finding arose because the rate of interest is the rate of borrowing money in order to invest in assets, which can also be used as a discounting rate to find the valuation of future cash flows generated by these assets; this creates an inverse relationship among these variables.

Many researchers and analysts who found the association between the inflation rate and stock prices have also studied the behaviour of other macro variables. It has been found that there is

a significant relationship between inflation rates and stock prices. Increases in stock price lead to a decrease in the rate of inflation (Rano, 2011). Such an indirect relation between inflation rate and stock prices exists, because whenever there is a decline in the inflation rate, the interest rate also declines which ultimately results in a rise of stock prices (Fornell et al., 2006). Such indirect results appear on stock prices due to unsteady living expenditure. The foremost variable of this research has also been found as a factor for consideration when studying the performances of the stock market. It was identified in Muhammad and Rasheed (2003), that the association between exchange rate and stock prices is insignificant in the case of South Asian countries (i.e. Pakistan, India, Bangladesh, and Sri Lanka). Nevertheless, they found a two-way direction between the two variables in Sri Lanka and Bangladesh.

Theories and Models of Foreign Exchange Rate and Stock Prices

As exchange rates are the method of identifying differentials between two currencies, there has always been a need to use in-depth analysis and techniques to set the rate of exchange. Exchange rate determinations are always a pivotal part for policymakers, who generally follow the fundamental theories of exchange rates. Theories like purchasing power parity (PPP), interest rate parity and international Fisher effect, were developed to determine exchange rates. The Purchase Power Parity (PPP) theory proposed a linkage between settled exchange rate and price level of the nation. The Interest Rate Parity (IRP) theory connected the settled exchange rate, the future exchange rate and nominal rate of interest rate (Rossi, 2005). Lastly, the theory of Fisher effect (IFC) relates to the rate of exchange and nominal interest rate of the nation.

Alba and Papell (2007) state that the most extensively used model by the policymakers is purchase power parity (PPP), also known as price-based criteria. This theory states that due to the liberalization of trade, nominal exchange rates between two countries are equivalent to the proportion of inflation level, or price level, between two countries. Moreover, this concept is based on the flow theory of exchange rates, when there is demand for a country's currency it leads to exports and the supply of currency leads to more imports. According to Carr and Wu (2009), it is mandatory for any investor to analyse the worthiness of assets before investing in them. Likewise, investors also do valuations before investing in securities and for such valuations, many models and techniques have been developed by security analysts. The valuation of stock includes many different techniques and tools depending upon the stock characteristics, industry nature, and external factors.

The methods of stock valuation are divided into two categories, namely Absolute technique, and Relative technique. The absolute technique or valuation is formed under the value of intrinsic characteristics, also known as true characteristics. The intrinsic value of any firm is defined as the true value of the firm, which includes both tangible and intangible elements of

the firm. Current value of a firm is found, and the divergence of its true value and current market value is identified (Rjoub, 2012). Fundamentally, such models are the dividend discount model, discounted cash flow model, residual income model, and asset-based model. In contrast, the relative technique or valuation is the procedure for measuring the stock value of one firm with its competitors'. Relative model valuations use different multiple calculations such as price to earnings multiple (P/E), price to sales multiple (P/S), and price to cash multiple (P/CF). This is the easiest approach for the investor to use because it does not require lengthy calculations and analysis (Joseph, 2010).

The relationship between Exchange Rate and Stock Market Prices

The exchange rate value in a specific country, at a particular point in time, influences the prices in the stock market. An increase in exchange rate suggests an appreciation in national currency, therefore enhancing of profits of an organization. High profits for a corporation lead to increased stock prices. It is identified that the association between exchange rate and stock prices is only observed in the short-term (Farooq et al., 2004) and (Agrawal et al., 2010). Moreover, there is no such interconnection found on a long-term basis between these two variables. In contrast to this Muhammad et al. (2002), stated that there are different variables that influence exchange rate, such as positive or negative news. Furthermore, it has been described that the factors that affect fluctuations in stock market prices are different and include political condition, industry growth, etc.

According to Adjasi et al. (2008), the association between currency rate and stock market prices are understood through various theories on exchange rates, including the flow-oriented model and stock oriented model. The stock-oriented model suggests that stock prices and exchange rate are related; a change in stock prices alters the exchange rate of a particular nation. A positive increase in stock prices serves as a trigger to attract investors in foreign markets (Phylaktis, and Ravazzolo, 2005). Which leads towards the high demand of local currency and results in an appreciation of the exchange rate. The research gap is defined as areas that have not been covered in past studies (Zikmund et al., 2012). It has been observed in past studies that there are different factors that affect exchange rates such as gross domestic product, inflation level, interest level, and other macroeconomic indicators. Furthermore, it has been discussed that there is an interconnection between exchange rate and stock market prices. Moreover, there were various studies that have clearly identified and justified association of these two research variables. Hence, the current study fulfils this gap by focusing on identifying an association between exchange rate and stock market prices in South Asian economies.

Research Methodology

The selection of research design has an impact on collection and analysis of data. In this research, explanatory research design has been adopted to examine the association between stock prices and foreign exchange rate. Data collection is an important part of research methodology in a research study. Secondary sources have been taken into account to obtain the objectives of this study. To measure the relationship between stock price and the exchange rate of South Asian countries, the researcher used daily time series data from 2007 to 2016. The data on stock prices is collected from the websites of the Karachi Stock Exchange, Bombay Stock Exchange and Colombo Stock Exchange. Furthermore, the data on foreign exchange rates is gathered by Thomson Reuters DataStream. The statistical analysis involves an explanation of the tests that were conducted for the research. The tests that have been utilized are unit root tests, cointegration tests, error correction model, and residual diagnostic tests.

Unit Root Test

The unit root test examines whether data is stationary or not. In this study we used Augmented Dickey-Fuller (ADF) tests to check the integrated level of our data series. Early pioneering work on unit root testing is attributed to Dickey and Fuller, whose basic objective was to examine the Null hypothesis, that $\phi = 1$ in a white-noise process of the form (Brooks, 2002):

$$\Delta y_t = \psi y_{t-1} + \mu_t \quad (1)$$

Where μ_t is an error term. The one-sided alternative hypothesis is that $\phi < 1$. Brooks states that the Dickey-Fuller (DF) tests are also known as τ -tests: $\tau, \tau_\epsilon, \tau_\tau$ where the second and the third tests, τ_ϵ, τ_τ , are the same as the first, except that the second allows for a constant while the third allows for a constant and deterministic trend. The problem with this test is that it assumes that the error term follows a white-noise process and is thus not auto-correlated.

However, Brooks (2002) notes that if there was autocorrelation in the variable Y_t in Equation 3.2, then the error term μ_t is also expected to be autocorrelated; thus the test will be oversized compared to the ordinary significant levels. To address this problem, the test is augmented by using lags of the dependent variable; however, the optimum number of lags to be used creates another problem which might compromise the robustness of the test results. The solution to this problem is to “augment” the test using p lags of the dependent variable. The new model is:

$$\Delta y_t = \psi y_{t-1} + \sum_{i=1}^p \alpha_i \Delta y_{t-1} + \mu_t \quad (2)$$

Now any dynamic structure present in the dependent variable will be soaked up by lags of Δy_t and it will make sure that μ_t is not serially correlated. Hence, this test is called Augmented Dickey Fuller (ADF) test statistics.

Lag Length Criteria

The test of co-integration is performed when data is stationary, because the data in time series will be only analysed if it is stationary; this condition is met. The next step before analysing the co-integration test is to do lag selection, because lag selection at every interval, determines the most appropriate value to analyse the co-integration test. So, the lag length selection was done for each country by minimizing AIC.

Johansen Co-integration

Co-integration helped to assess the long-term association between selected variables such as stock prices and exchange rate. In order to test for co-integration, we use the Johansen (1988) and Johansen and Juselius (1990) full information maximum likelihood inference, which concerns co-integrating vectors in non-stationary vector autoregressive (VAR) models assuming Gaussian errors. Consider the following VAR with k lags:

$$Y_t = A_1 Y_{t-1} + A_2 Y_{t-2} + A_k Y_{t-k} + U_t \quad (3)$$

Where

$t = 1, 2, \dots, T$ and Y_t is an n-vector of I(1) variables.

According to Brooks (2002), in order to use the Johansen test, the VAR above needs to be turned into a vector error correction model (VECM) of the form:

$$\Delta Y_t = \pi Y_{t-k} + \Gamma \tau_1 \Delta Y_{t-1} + \Gamma \tau_2 \Delta Y_{t-2} + \dots + \Gamma \tau_{k-1} \Delta Y_{t-k+1} + U_t \quad (4)$$

Where

$$\pi = [\sum_{i=1}^k A_i] - 1 \text{ and } \Gamma \tau_i = [\sum_{j=1}^i A_j] - 1$$

Since $\Delta Y_t, \dots, \Delta Y_{t-k+1}$ are all I(0) but Y_{t-1} is I(1), for this equation be consistent, π should not be of full rank and if this rank is r therefore:

$$\pi = \alpha\beta' \quad (5)$$

Where α is an $n \times r$ matrix and β' is an $r \times n$ matrix, in this case then $\beta'Y_{t-1}$ are the r co-integrating variables, β' is the matrix of coefficients of the co-integrating vectors and α has the interpretation of the matrix of error correction terms.

In this regard, Brooks (2002) notes that the Johansen test centers on an examination of the π matrix, which can be interpreted as a long-run coefficient matrix. According to Maddala, G. S. and S Wu (1999) co-integration is interested in α and β' , eliminate $\tau_1, \dots, \tau_{k-1}$. This is achieved by regressing ΔY_t on $\Delta Y_{t-1}, \dots, \Delta Y_{t-k+1}$, obtaining the residuals from this regression and calling them R_{0t} , then regressing Y_{t-1} on the same variables and calling the residuals R_{1t} . The ensuing regression equation is condensed to the following multivariate regression problem:

$$R_{0t} = \alpha\beta'R_{1t} + \mu_t \quad (6)$$

Let $\begin{bmatrix} S_{00} & S_{01} \\ S_{10} & S_{11} \end{bmatrix}$ be the matrix of sum of squares and sum of products of R_{0t} and R_{1t} . Maddala, G. S. and S Wu (1999) point out that each of these matrices is of order $n \times n$. Johansen (1991), when presenting likelihood methods for analysing co-integration in VAR models with Gaussian errors, states that is also “.....shows that the asymptotic variance of $\beta'R_{1t}$ is $\beta'\Sigma_{11}\beta$, the asymptotic variance of R_{0t} is Σ_{00} and the asymptotic covariance matrix of $\beta'R_{1t}$ and R_{0t} is $\beta'\Sigma_{10}$ where Σ_{00}, Σ_{10} , and Σ_{11} are the population counterparts of S_{00}, S_{10}, S_{11} .” (Maddala and Wu 1999).

Johansen (1991) says this function is easily minimized for fixed β to give:

$$\hat{\alpha}(\beta) = S_{10}\beta(\beta'S_{11}\beta)^{-1} \text{ Where } \alpha \text{ is an } r \times n \text{ matrix,} \quad (7)$$

$$\hat{\vartheta}(\beta) = S_{00} - S_{10}\beta(\beta'S_{11}\beta)^{-1}\beta'S_{01},$$

$L_{\max}^{-\frac{2}{T}}(\beta) = |S_{00} - S_{01}\beta(\beta'S_{11}\beta)^{-1}\beta'S_{10}|$ which is the conditional maximum of the likelihood function. This is minimized by the choice $\hat{\beta} = (\hat{v}_1 \dots \dots, \hat{v}_r)$, where $\hat{V} = (\hat{v}_1 \dots \dots, \hat{v}_p)$ are eigenvectors of the equation:

$$|\lambda S_{11} - S_{10}S_{01}S_{00}^{-1}| = 0 \quad (8)$$

According to Johansen (1991), this is normed by $\hat{V}'S_{11}\hat{V} = I$ and ordered by $\hat{\lambda}_1 > \hat{\lambda}_2 > \dots > \hat{\lambda}_p > 0$ and the maximum likelihood function is found from:

$$L_{\max}^{-\frac{2}{T}}(r) = |S_{00}| \prod_{i=1}^r (1 - \lambda_i) \quad (9)$$

According to Brooks (2002), there are two test statistics for co-integration under the Johansen approach, which are formulated as:

$$\lambda_{\text{trace}}(r) = -T \sum_{i=r+1}^n \ln(1 - \hat{\lambda}_i) \text{ and} \quad (10)$$

$$\lambda_{\text{max}}(r, r+1) = -T \ln(1 - \hat{\lambda}_{r+1}) \text{ and} \quad (11)$$

Where r represent numbers of co-integrating vectors under the Null hypothesis and $\hat{\lambda}_i$ is the estimated value of the i th ordered eigenvalue from π matrix above. Maddala, G. S. and S Wu (1999) say that the trace test examinations of the hypothesis reveal that there are at most r co-integrating vectors, while the maximum eigenvalue examination of the hypothesis reveals that there are $r+1$ co-integrating vectors.

Critical values for the trace and the maximum eigenvalue tests are given by Johansen and Juselius (1990), and the complete set was further developed by Osterwald-Lenum (1992). Brooks (2002) notes that if the statistic value is more than the critical value from the tables, Null hypothesis provides that there are r co-integrating vectors which should be rejected in favor of the alternative that there are $r+1$ (for λ_{trace}) or more than r (for λ_{max}). This testing is conducted in a succession and under the null, $r = 0, 1, \dots, n-1$, so that the hypotheses for max are:

- $H_0: r = 0$ versus $H_1: 0 < r \leq n$
- $H_0: r = 1$ versus $H_1: 1 < r \leq n$
- $H_0: r = 2$ versus $H_1: 2 < r \leq n \dots$ until
- $H_0: r = n - 1$ versus $H_1: r = n$

If, after the first test, the researcher fails to reject Null hypothesis then Brooks (2002) concluded that there are no co-integrating vectors, hence the test should be ended. However, if $H_0: r = 0$ is rejected then the next null hypothesis provides that there is at least one co-integrating vector that should be tested, if rejected then two should be tested, and if it continues to be rejected then r has to be increased till the null cannot be rejected anymore.

Error Correction Model

ECM is used for the time series model which directly measures the speed at which dependent variable Y returns to the equilibrium after a change in independent variable X . ECM is useful for estimating the short and long-term effects of one-time series on another. The precondition for the ECM model is that variables should be stationary and co-integrated. To measure whether variables are stationary a unit root test is performed, in which if first difference variables become stationary, and to continue with the model, the researcher should check the spurious or non-sense of the model, which requires them to run the regression model. The symptoms for spurious finding of the model is that R square should be greater than Durbin Watson Statistics, which is not an acceptable finding. If the residual of this model is stationary then the estimated model is no longer spurious, and the guidelines for residual being stationary provide that t -statistics should be greater than absolute Engle-Granger critical value which is -3.04 . The error correction model is then applied to prove the hypothesis.

$$D(SP) = B_1 + B_2 * D(ER) + B_3 * U_{t-1} + V$$

(12)

Where SP and EX are first difference variables, B_1 is intercepted, B_2 is short-run coefficient, V is white noise error term and U_{t-1} is an error correction term that guides the variables of the system to restore back to equilibrium. In other words, it actually corrects disequilibrium. The sign before β_3 should be negative after estimation, as it tells the rate at which it corrects the previous disequilibrium in the system and when β_3 is significant it validates that there is long-term equilibrium.

Lastly, the residual diagnostic test is used to evaluate the serial correlation and normality of data series.

Hypothesis

The hypotheses for the present research study are given below:

H_{a1}: There is an affiliation between stock prices and exchange rate in Pakistan.

H_{a2}: There is an affiliation between stock prices and exchange rate in India.

H_{a3}: There is an affiliation between stock prices and exchange rate in Sri Lanka.

H_{a4}: The correlation between stock prices and exchange rates is significant in the short run in Pakistan, India and Sri Lanka

H_{a5}: The correlation between stock prices and exchange rates is significant in the long run in Pakistan, India and Sri Lanka.

Statistical Analysis

Descriptive Test

The results of descriptive statistics are presented below in table 1.

Table 1: Descriptive Statistics of South Asian Countries.

	India Ex-Rate	India stock Price	Pakistan Ex-Rate	Pakistan Stock Price	Sri Lanka Ex-Rate	Sri Lanka Stock Price
Mean	50.72128	15354.97	87.0954	13171.15	118.6426	3892.272
Std. Deviation	6.853367	5397.112	11.40096	6510.72	9.206114	2040.139
Observations	2633	2633	2633	2633	2633	2633

Table 1 provides a summary of total data obtained with regards to the exchange rate and stock prices of the target countries (India, Pakistan, and Sri Lanka). The average exchange rate and stock price for India is 50.72 and 15354.97 respectively. The average exchange rate and stock price for Pakistan is 87.0954 and 131371.15 respectively. The average exchange rate and stock price in Sri Lanka is 118.6426 and 3892.272 respectively.

A comparison the three countries, in terms of economic stability, identifies that India is more stable than Pakistan and Sri Lanka. This finding is because India has the highest stock price, which is a positive indicator for investors because the higher the stock prices the higher the returns. India's exchange rate is also more desirable than Pakistan's and Sri Lanka's, because the lower the exchange rate the higher the country's currency appreciation. Analysis of the volatility of the data shows that the exchange rate of India is less volatile as is has a lower value than the other two countries. A similar result is found stock market volatility, where India is found to have lower volatility than Pakistan and Sri Lanka.

Unit Root Testing

Unit root testing is conducted to check whether the data is stationary or not. So, for the unit root test, Augmented Dickey-Fuller (ADF) is applied. The guideline of Augmented Dickey-Fuller (ADF) is that the variable has a unit root or non-stationary at H_0 and variable has no unit root or stationary at H_a . The model set the Hypothesis like below:

H_0 : Data has a unit root (Non-stationary)

H_a : Data has no unit root (Stationary)

Table 2: Unit Root Test Analysis for Exchange Rates

Augmented Dickey-Fuller Test (ADF)					
Pakistan					
Levels			1st Difference		
T values	Prob	Decision	T values	Prob	Decision
-2.553710	0.1030	Non-stationary	-23.65962	0.0000	Stationary
India					
Levels			1st Difference		
T values	Prob	Decision	T values	Prob	Decision
-1.012554	0.7509	Non-stationary	-10.15682	0.0000	Stationary
Sri Lanka					
Levels			1st Difference		
T values	Prob	Decision	T values	Prob	Decision
-0.998765	0.8891	Non-stationary	-22.00398	0.0000	Stationary

Table 3: Unit Root Test Analysis for Stock Prices

Augmented Dickey-Fuller Test (ADF)					
Pakistan					
Levels			1st Difference		
T values	Prob	Decision	T values	Prob	Decision
1.742383	0.9997	Non-stationary	-44.19592	0.0001	Stationary
India					
Levels			1st Difference		
T values	Prob	Decision	T values	Prob	Decision
-0.728182	0.8378	Non-stationary	-47.26762	0.0001	Stationary
Sri Lanka					
Levels			1st Difference		
T values	Prob	Decision	T values	Prob	Decision
-0.20392	0.9356	Non-stationary	-41.7407	0.0000	Stationary

Table 2 and 3 show the results of the ADF test for the selected variables. Exchange rate and stock price, of all the three countries, are non-stationary at level i.e. $LEX \sim I(1)$, $LSP \sim I(1)$ and

it is stationary at first difference which means that at the level our null hypothesis is accepted, but at first difference, our null hypothesis is rejected. The guideline provided that if the value of our test-statistics are less than the critical value and the P-value is greater than 0.05 then we will accept the null hypothesis i.e. the data has a unit or it is non-stationary. But if the value of test-statistics is greater than the critical value and the P-value is less than 0.05 then we will reject the null hypothesis i.e. the data has no unit root or it is stationary. In conclusion, we found that our data is stationary at first difference. If the data is found to be stationary, we can further analyse the tests in order to find the co-integration between set variables.

Leg Length Selection

We analysed the Johansen co-integration test to identify the association between the variables and to find out their short and long run association. This test has answered hypothesis 1, 2 and 3 for each of the countries selected. Lag length selection results are presented in Table 4.

Table 4: Lag Length Selection

INDIA		
Lag Selection		
Akaike Information Criterion (AIC)		
Akaike information criterion	whole model at lag 1	13.8620
Akaike information criterion	whole model at lag 2	13.8049
Akaike information criterion	whole model at lag 4	13.7614
PAKISTAN		
Lag Selection		
Akaike Information Criterion (AIC)		
Akaike information criterion	whole model at lag 1	14.45319
Akaike information criterion	whole model at lag 2	14.35055
Akaike information criterion	whole model at lag 4	14.30952
SRI LANKA		
Lag Selection		
Akaike Information Criterion (AIC)		
Akaike information criterion	whole model at lag 1	11.94833
Akaike information criterion	whole model at lag 2	11.88297
Akaike information criterion	whole model at lag 3	11.82437

Lag selection for the co-integration test can be done in many ways, one of which is to choose the lag value through Akaike Information Criterion (AIC), which suggests that the lowest the AIC value, the better the model. Subsequently, the AIC value selected from Table 4 is; India - 13.7614, Pakistan - 14.30952, and Sri Lanka - 11.82437.

Johansen Co-Integration

Co-integration is a modern empirical technique which is primarily used to ascertain the degree to which variables are related in the long run. Table 5 represents the results of the Johansen co-integration test.

Table 5: Johansen Co-integration Test

INDIA							
Hypothesized No. of CE (s)	Trace Statistics	Critical Value 0.05	Prob.**	Max-Eigen Value	Critical Value 0.05	Prob.**	Decision
None	4.804937	15.4947	0.8292	4.6827	14.2646	0.7812	Non-Co-integrated
At most 1	0.122234	3.84147	0.7266	0.12223	3.84147	0.7266	Non-Co-integrated
PAKISTAN							
None	8.888866	15.4947	0.3758	8.79329	14.2646	0.3038	Non-Co-integrated
At most 1	0.095575	3.84147	0.7572	0.09558	3.84147	0.7572	Non-Co-integrated
SRI LANKA							
None	32.48819	15.4947	0.0001	31.8859	14.2646	0.0000	Co-integrated
At most 1	0.602331	3.84147	0.4377	0.60233	3.84147	0.4377	Co-integrated

After the lag selection, we run the Johansen co-integration test. The results shown in Table 5, provided that there is no cointegration between the exchange rate and stock price for India and Pakistan because the P-value is greater than 5% (Trace statistics and Max-Eigen values are less than its critical values) which means that we cannot reject our null hypothesis, that there is no co-integration among variables. For Sri Lanka, the results shown in Table 5 provide that there is a co-integration between the variables because the P-value is less than 5% (Trace statistics and Max-Eigen values are more than its critical values) which means that we can reject our null hypothesis and conclude that there is a co-integration among variables. So, after the test of co-integration, it is concluded that the variables are non-co-integrated for India and Pakistan, which means that the exchange rate is not a significant variable to explain the stock price. For Sri Lanka, the exchange rate is a significant variable to explain the stock price, or exchanges rates have a long run relationship with stock prices.

Error Correction Model (ECM)

Finally, the error correction model (ECM) is used to check the long run and short run causality among variables to evaluate the hypothesis.

Table 6: Augmented Dickey-Fuller Test on D(U)Residual

Country	T-statistics	Engle-Granger	R-square	Durbin-Watson
India	-17.996	-3.04	0.44	2.00008
Pakistan	-41.062	-3.04	0.572977	2.002
Sri Lanka	-20.61	-3.04	0.6008	1.99

Table 7: Error Correction Model

Country	Coefficient D(ER)	Coefficient Prob	Coefficient U(-1)	Coefficient Probability	Significance
India	1.928053	0.9043	-0.002279	0.0782	Insignificant
Pakistan	0.2077	0.9728	0.00072	0.297	Insignificant
Sri Lanka	2.764	0.0293	0.00374	0.0003	Significant

To estimate the accuracy of the Error Correction Model, we checked the unit root test of ADF residual and found that it was stationary at first difference for India, Pakistan and Sri Lanka. This finding is per the guideline that the T-statistics value is greater than the Engle-Granger critical value at 10%, which is -3.04. It was also found that the model is no longer spurious as the value of R-square is less than the value of Durbin Watson for all countries in Table 6.

After estimation of the ECM, the short-term coefficient D(ER) is 1.9285 and 0.2077 for India and Pakistan respectively, which is an insignificant finding. The coefficient for the error term is -0.002279 and 0.00072 which is also insignificant finding for both countries, which means that there is no long or short run equilibrium validated by the model for India and Pakistan. The short-term coefficient for Sri Lanka is found significant. The coefficient of the error term is 0.0374 which means that system corrects its previous period disequilibrium at the speed of 3.74% on a daily basis, which is significant.

Residual Diagnostic Techniques

The purpose of the residual diagnostic technique is to fit the data series and free it from autocorrelation and normality problems. This process checks through two tests, both of which have the following hypothesis:

Histogram normality Test:

- H₀: Residuals are not normally distributed
- H_A: Residuals are normally distributed

Serial Correlation LM-Test:

H_0 : There is no serial correlation

H_A : There is a serial correlation

Table 8: Residual Diagnostic Test

Country	Serial Correlation	Normality
India	Obs R-Squared = 18.867 P value = 0.0001	Jarqua-bera=3410.863 P value=0.00000
Pakistan	Obs R-Squared = 56.523 P value = 0.0000	Jarqua-bera=2482.338 P value=0.00000
Sri Lanka	Obs R-Squared = 100.9715 P value = 0.000	Jarqua-bera=5651.379 P value=0.00000

To best fit the models, all null hypothesis should be accepted, and the decision rule is that P-value should be greater than 0.05. In Table 8, residual diagnostic test of the model reveals that there is serial correlation in the model for all three countries as their R-square values are 18.867, 56.523, and 100.9715 (India, Pakistan and Sri Lanka respectively). Additionally, their P-values are less than 5%, which means that H_0 must be rejected, this reflects that there is serial correlation in the model which is not desirable. Through a normality test of the data, it is shown that the data is not normally distributed because P-values for all three countries are less than 5%, which means that we cannot accept the null hypothesis of residuals being normally distributed. However, the removal of the diagnostic test is possible.

Conclusion & Recommendations

This research has been carried out in order to find the association between exchange rates and stock prices for South Asian countries. South Asia was selected due to the existence of a high volatility ratio between the two variables. Exchange rate and stock price data is tested through the co-integration and error correction models, to determine the association and form of association between these variables. The results of these tests made known that there is no association between the variables for Pakistan and India, but in Sri Lanka there was an association found between the variables in both the short and long term.

Our research results are related to the research results of Muhammad and Rasheed (2003), Rahman and Uddin (2009). However, this research is useful for both foreign and local investors who seek to invest opportunity in Sri Lanka, for Pakistan and India investors cannot forecast the stock markets on the basis of exchange rate fluctuations. The finance authorities of these countries also cannot use the information of exchange rate and stock price as an instrument of procedure in making foreign investment assortment. But they can use other factors (i.e. GDP rate, inflation rate, interest rate etc.) for investigation. It is seen that the

most frequent observations of exchange rate are also not impacting stock prices. It is suggested that other macroeconomic factors determine the fundamental valuation of stock.

Further research on Sri Lanka can be carried out in order to find the direction of causality between the exchange rate and stock prices. Moreover, research can be undertaken in emerging economies like China, Brazil, and Russia, where economy trends are also volatile, to find the association between these variables.

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