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Dynamic Relationship between Stock Prices and Exchange Rates: Evidence from Three South Asian Countries

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Abstract

In this paper we have investigated the interactions between stock prices and exchange rates in three emerging countries of South Asia named as Bangladesh, India and Pakistan. We have considered average monthly nominal exchange rates of US dollar in terms of Bangladeshi Taka, Indian Rupee and Pakistani Rupee and monthly values of Dhaka Stock Exchange General Index, Bombay Stock Exchange Index and Karachi Stock Exchange All Share Price Index for period of January 2003 to June 2008 to conduct the study. Empirical result shows that exchange rates and stock prices data series are non stationary and integrated of order one. Then we have applied Johansen procedure to test for the possibility of a cointegrating relationship. Result shows that there is no cointegrating relationship between stock prices and exchange rates. Finally we applied Granger causality test to find out any causal relationship between stock prices and exchange rates. Outcome shows there is no way causal relationship between stock prices and exchange rates in the countries.

Keywords: Stock price, Exchange rate, Stationarity, Cointegration, Causality

1. Introduction

The liberalization of foreign capital controls and adoption of floating exchange rate regime in South Asian countries have widened the scope of studying the relationship between exchange rates and stock prices. Liberalization of foreign capital controls has opened the possibility of international investment and the adoption of floating exchange rate regime has increased the volatility of foreign exchange market. Thus detecting the association between stock prices and exchange rates has become crucial for the academicians, practitioners and policy makers.

There are different economic models regarding exchange rate determination. “Flow oriented” models introduce country’s current account as important determinant of exchange rate. In this perspective, asset markets determine the exchange rate at a point in time, but the current account through its effect on net asset positions, and on asset markets, determine the path of the exchange rates over time (Dornbusch and Fischer, 1980). Thus movements in the stock prices may affect the exchange rates. On the other hand, models that concentrate on the capital account of the balance of payments are known as stock models. Stock models are divided in to monetary models and asset (or portfolio) models. According to monetary model the exchange rate is seen as a relative asset price. The present value of an asset is thought to be largely influenced by its expected rate of return. Thus actual exchange rate has to be determined by expected future exchange rates (see Gavin, (1989)). Portfolio balance model states that if prices of domestic stock rise, it will persuade investors to buy more domestic assets by selling foreign assets to obtain domestic currency. Increase in demand of domestic currency will lead to appreciation of domestic currency. On the other side, if the prices of domestic asset rise that will result in growth of wealth, which will also increase the demand for money by the investors, That will give rise in domestic interest rates. More foreign capital will be attracted in this situation which will increase the foreign demand for domestic currency and ultimate result will be the appreciation of domestic currency. Thus according to portfolio balance model there is an inverse relationship between stock prices and exchange rates (for detail see, Frenkel (1976), Branson (1983), Macdonald and Taylor (1992)). So there is no theoretical harmony among the models regarding the interactions between stock prices and exchange rates.

The empirical debate regarding the interaction between stock prices and exchange rates has been started few decades ago. Since then a good number of empirical studies so far have been conducted to investigate the relationship between the variables. But the researchers have found contradictory results regarding the existence of relationship and the direction of relationship which has made the area disconcerted environs of finance literature. Some of the studies showed that there is a significant positive relationship between the variables, such as, Aggarwal (1981), Giovannini and Jorion (1987), and Roll (1992). But some of the studies counter this argument and showed a significant negative relationship between the variables, such as, Soenen and Hennigar (1988). Some other studies find that there is no significant relationship between the variables, such as, Franck and Young (1972), Solnik (1987), Chow et al. (1997), and Bhattacharya and Mukherjee (2003). Bahmani-Oskooee and Sohrabian (1992), Nieh and Lee (2001) found no long-run relationship between the variables. So there is no empirical harmony among the researchers regarding the interactions between stock prices and exchange rates which justify the need of more research in this area to contribute to the literature.

In a region like South Asia where the economies are still emerging and capital markets are still in a vulnerable condition, according to our knowledge a very few studies have been made so far to investigate the relationship between stock prices and exchange rates and found conflicting results which encourages us to conduct the study to detect the relationship between the variables.

The remainder of the paper is organized as follows. Section 2 provides literature review. Section 3 discusses the data, time frame considered right through the study and methodological issues. Section 4 provides empirical results and findings. A summary is given in section 5.

2. Literature Review

Existing literature relating to the association between stock prices and exchange rates shows diverse outlook. An early attempt to examine the exchange rate and stock price dynamics was by Franck and Young (1972) who showed that there is no significant interaction between the variables. Later, Aggarwal (1981) made a study to find the relationship between exchange rates of US dollar and changes in the indices of US stock prices and found a positive correlation. Giovannini and Jorion (1987) also considered the exchange rates and stock prices of USA and supported Aggarwal (1981). Soenen and Hennigar (1988) studied the same market but considered a different time period and contrast with prior studies by showing a significant negative relationship between stock prices and exchange rates.

Solnik (1987) made a slightly different study and tried to detect the impact of several economic variables including the exchange rates on stock prices. He concluded that changes in exchange rates do not have any significant impact over stock prices. Jorion (1990) did a similar study to show the relationship between stock returns of US multinational companies and the effective exchange rate of US dollar and found a moderate relationship between the variables.

Early studies relating to the issue used mainly statistical techniques such as regression and correlation to find out the relationship between stock prices and exchange rates. Since early nineties researchers started to use sophisticated econometric tools to find out the relationship between the variables and showed assorted results.

Bahmani-Oskooee and Sohrabian (1992) used monthly values of S&P 500 index and US dollar effective exchange rate for the period of 1973-88 and used cointegration and Granger causality test to detect the relationship between the variables. They found bidirectional causality in the short run. They found no long-run relationship between the variables. Nieh and Lee (2001) supported the findings of Bahmani-Oskooee and Sohrabian (1992) and reported no long-run significant relationship between stock prices and exchange rates in the G-7 countries. Roll (1992) also studied the US stock prices and exchange rates and found a positive relationship between the two markets. On the other hand, Chow et al. (1997) examined the same markets but found no relationship between stock returns and real exchange rate returns. They repeated the exercise with a longer time horizons and found a positive relationship between the two variables.

Ajayi and Mougoue (1996) showed a negative short-run and positive long-run impact of stock prices on domestic currency value. Yu (1997) studied Hong Kong, Tokyo and Singapore markets by using daily data for a period of 1983-94. They traced bidirectional relationship in Tokyo, no causation in the Singapore markets and also found that changes in exchange rates Granger cause changes in stock prices. Abdalla and Murinde (1997) employed co-integration test to examine the relationship between stock prices and exchange rates for four Asian countries named as India, Pakistan, South Korea and Philippines for a period of 1985 to 1994. They detected unidirectional causality from exchange rates to stock prices for India, South Korea and Pakistan and found causality runs from the opposite direction for Philippines. Ajayi *et al.* (1998) studied markets of some advanced economies such as USA and Korea and emerging economies such as Malaysia. They found out that there is a unidirectional causality from the stock prices to foreign exchange markets in case of USA and Korea and no relationship between the variables in case of Malaysia.

Mansor (2000) investigated Malaysian markets and found no long-run relationship between stock prices and exchange rates, but he found a short-run causal relationship from stock prices to exchange rates in bivariate cases. He also found a bi-directional causality in some multivariate models. Wu (2000) did a similar study using stock prices and exchange rates of Singapore and portrayed a unidirectional causality from exchange rates to stock prices. In a comprehensive study Granger, Huang and Yang (2000) studied East Asian countries using recent Asian flu data. They concluded that in the Philippines change in stock prices lead to change in exchange rates and they found a opposite relation in case of South Korea. In a similar other study Moradoglu, Taskin and Bigen (2001) tried to find out the relation between stock returns and some macroeconomic variables and concluded that there is a one way causal relationship from exchange rates to stock returns in Nigeria, Mexico, Korea, Greece, Colombia and Brazil where as a both way causal relationship between the variables in case of Mexico.

In a recent study Bhattacharya and Mukherjee (2003) investigated Indian markets using the data on stock prices and macroeconomic aggregates in the foreign sector including exchange rate concluded that there in no significant relationship between stock prices and exchange rates. In another study, Muhammad and Rasheed (2003) examined the relationship between stock prices and exchange rates of four South Asian countries named as Bangladesh, India, Pakistan and Sri-lanka and found that there is no significant relationship between the variables either in short-run or long-run in Pakistan and India. But they found a bidirectional relationship in case of Bangladesh and Sri-lanka.

3. Data and Methodology

Data used in this study include monthly average nominal exchange rates of US dollar in terms of Bangladeshi Taka (BD_{ER}), nominal exchange rates of US dollar in terms of Indian Rupee (IN_{ER}), nominal exchange rates of US dollar in terms of Pakistani Rupee (PK_{ER}) and monthly closing values of Dhaka Stock Exchange General Index (BD_{SP}), monthly closing values of Bombay Stock Exchange index (IN_{SP}) and monthly closing values of Karachi Stock Exchange All Share Price Index (SP_{SP}) for a period of January 2003 to June 2008. Then we transform all the data series into natural log form.

The data series we use in this study are time series data. Empirical work based on time series data assumes that the underlying time series is stationary (Gujarati, 2003). But many studies have shown that majority of time series variables are non stationary or integrated of order 1 (Engle and Granger, 1987). Using non stationary time series in a regression analysis may result in spurious regression which was firstly pointed out by Granger and Newbold (1974). Thus before analyzing time series data in an empirical study we should make stationarity test which is commonly done by unit root test. There are a variety of unit root tests used in econometric literature principally Augmented Dickey-Fuller (ADF) test and Phillip-Perron (PP) test. In this study we use both unit root test to investigate whether the time series data used in this study are stationary or not.

Augmented Dickey-Fuller (1979) test is obtained by the following regression

$$\Delta Y_t = \beta_1 + \beta_2 t + \delta Y_{t-1} + \alpha_i \sum_{i=1}^{m} \Delta Y_{t-1} + \varepsilon_t \tag{1}$$

where Δ is the difference operator, β, δ and α are the coefficients to be estimated, Y is the variable whose time series properties are examined and ε is the white-noise error term.

Phillips and Perron (1988) test suggests a non parametric method of controlling for higher order autocorrelation in a series and is based on the following first order auto-regressive AR(1) process:

$$\Delta Y_t = \alpha + \beta Y_{t-1} + \varepsilon_t \tag{2}$$

where Δ is the difference operator, α is the constant, β is the slope and Y_{t-1} is the first lag of the variable Y.

If the seires used in the study found out to be integrated of the same order, it is useful to test for cointegrating relationship between the integrated variables. For this purpose we employ the Johansen procedure (Johansen, 1988; Johansen and Juselius, 1990) to test for the possibility of a cointegrating relationship.

The Johansen method applies maximum likelihood procedure to determine the presence of cointegrating vectors in non-stationary time series as a vector autoregressive (VAR):

$$\Delta Y_t = C + \sum_{i=}^{K} \Gamma_i \Delta Y_{t-1} + \Pi Y_{t-1} + \eta_t \tag{3}$$

where Y_t is a vector of non-stationary variables and C is the constant term. The information on the coefficient matrix between the levels of the Π is decomposed as $\Pi = \alpha\beta$ where the relevant elements the α matrix are adjustment coefficient and the β matrix contains cointegrating vectors. Johansen and Juselius (1990) specify two likelihood ratio test statistics to test for the number of cointegrating vectors. The first likelihood ratio statistics for the null hypothesis of exactly r cointegrating vectors against the alternative r+1 vectors is the maximum eigenvalue statistic. The second statistic for the hypothesis of at most r cointegrating vectors against the alternative is the *trace statistic.* Critical values for both test statistics are tabulated in Johansen and Juselius (1990).

In the absence of any cointegrating relationship between the variables, the standard Granger causality test base on Granger (1988) method will be applied. The Granger method (Granger, 1988) seeks to determine how much of a variable, Y, can be explained by past values of Y and whether adding lagged values of another variable, X, can improve the explanation. The Granger method involves the estimation of the following equations:

$$\Delta SP_t = \beta_0 + \sum_{i=1}^{q} \beta_{1i} \Delta SP_{t-i} + \sum_{i=1}^{q} \beta_{2i} \Delta ER_{t-i} + \varepsilon_{1t} \tag{4}$$

$$\Delta ER_t = \varphi_0 + \sum_{i=1}^{r} \varphi i_{1i}\, \Delta ER_{t-i} + \sum_{i=1}^{r} \varphi_{2i}\, \Delta SP_{t-i} + \varepsilon_{2t} \tag{5}$$

in which SP_t and ER_t represent stock prices and exchange rates. ε_{1t} and ε_{2t} are uncorrelated stationary random process, and t denotes the time period. Failing to reject $H_0 : \beta_{21} = \beta_{22} = ... = \beta_{2q} = 0$ implies that exchange rates do not Granger cause stock prices. On the other hand, failing to reject $H_0 : \varphi_{11} = \varphi_{12} = ... = \varphi_{1r} = 0$ implies that stock prices do not Granger cause exchange rates.

If cointegration exists between *SP* and *ER*, the VECM is required in testing Granger causality as shown below:

$$\Delta SP_t = \beta_0 + \sum_{i=1}^{q} \beta_{1i} \Delta SP_{t-i} + \sum_{i=1}^{q} \beta_{2i} \Delta ER_{t-i} + \alpha_1 Z_{t-1} + \varepsilon_{1t} \tag{6}$$

$$\Delta ER_t = \varphi_0 + \sum_{i=1}^{r} \varphi i_{1i}\, \Delta ER_{t-i} + \sum_{i=1}^{r} \varphi_{2i}\, \Delta SP_{t-i} + \lambda_1 Z_{t-1} + \varepsilon_{2t} \tag{7}$$

where Z_{t-1} is the error correction term obtained from the cointegrating equation (3), so that changes in the variables SP_t and ER_t are partly driven by the past values of Z_t The first difference operator is marked by Δ. The error correction coefficients, α_1 and λ_1, are expected to capture the adjustments of SP_t and ER_t towards long-run equilibrium, whereas the coefficients on SP_{t-i} and ER_{t-i} are expected to capture the short-run dynamics of the model. Thus, in using equations (6) and (7) to test for the Granger-causal relationship between SP_t and ER_t, we included the error-correction terms in order to introduce additional channels through which causality could emerge and equilibrium could be re-established. Failing to reject H_0: $\beta_{21} = \beta_{22} = ... = \beta_{2q} = 0$ and $\alpha_1 = 0$ implies that exchange rates do not Granger cause stock prices while failing to reject H_0: $\varphi_{11} = \varphi_{12} = ... = \varphi_{1r} = 0$ and $\lambda_1 = 0$ indicates stock prices do not Granger cause exchange rates.

4. Empirical Results

At first, we tested for the presence of unit roots and order of integration in all the exchange rates and stock market index in the level and in the first difference. We used ADF test and PP test with constant and constant and linear trend as suggested by Eangle and Granger (1987). The lag length and bandwith in the unit root tests were allowed to vary across the exchange rates and stock index to correct any serial correlation in the residuals. The results of the tests are given in table – 1. Considering the results, it is clearly evident that null hypothesis of a unit root in the level is accepted in all cases as test statistics are lower than the critical values. So, we can say that exchange rates and stock prices are non-stationary data series and integrated of order one, I (1). Results also indicate that null hypothesis of a unit root is rejected in all cases when the data series are first differenced. So the first difference of the data series of the variables is stationary. After determining stationarity of the data series and order of integration, we progress to cointegration test to find the presence of any cointegrating relationship between stock prices and exchange rates. The results of cointegration test are given in table-2. Results clearly reveal that both trace test and maximum eigenvalue test accept the null hypothesis of no cointegration in all the cases. Thus there is no long-term co-movement between stock prices and exchange rates and none of the variables is predictable on the basis of past values of other variable.

In the absence of any co-integrating relationship between the variables we move to standard Granger causality test to find out any causal relationship between stock prices and exchange rates. To find out the causal relationship between the variables which are non-stationary, the data series should be transformed into stationary (Oxley and Greasley, 1998). Because it has been confirmed that Granger causality test is well specified if they are applied in a standard vector autoregressive form to differenced data for non-cointegrated variables (MacDonald and Kearney, 1987; Miller and Russek, 1990; Lyons and Murinde 1994). Otherwise the inference from the F-statistics might be spurious because the test statistics will have nonstandard distributions. So we have transformed the level data series into the first difference data series and used them for causality test. The results show that there is no way causal relationship between stock prices and exchange rates. So we can say that stock prices do not influence exchange rates and past values of stock prices can not be used to improve the forecast of future exchange rates.

5. Conclusion

In this paper we have explored the association between two important component of an economy named as stock prices and exchange rates. First of all, we applied unit root test to find the stationarity of data series. The results show that all the data series of the variables are non stationary and integrated of order one. Then we applied Johansen procedure to test for the possibility of a cointegrating relationship. Result shows that there is no cointegrating relationship between stock prices and exchange rates. That means there is no long-term co-movement between the variables and none of the variables is predictable on the basis of past values of other variable. In the absence of any co-integrating relationship between the variables we move to standard Granger causality test to find out any causal relationship between stock prices and exchange rates. Results shows that stock prices does not Granger cause exchange rates and exchange rates does not Granger cause stock prices, so there is no way causal relationship between stock prices and exchange rates.

There is a common belief among the investors that there is an association between exchange rates and stock prices and they are predictable on the basis of the values of other variables. But our result of no cointegration counters this belief and states that the variables are not predictable on the basis of the past values of other variables. The result of non-stationarity of the data series reveals that there is no chance of profitable speculation in the stock market or foreign exchange market. As there is no way causal relationship between stock prices and exchange rates, market participants can not use information of one market to improve the forecast of other market.

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Table 1. Unit root test results

Variables	ADF				PP			
	Level		First Difference		Level		First Difference	
	Constant	Constant & Linear trend	Constant	Constant & Linear trend	Constant	Constant & Linear trend	Constant	Constant & Linear trend
	Test Statistics							
BD_{ER}	-1.55289	-0.881478	-7.90467*	-8.037783*	1.552888	-0.0881478	-7.904674*	-8.05583*
BD_{SP}	-0.99841	-1.442939	-6.88695*	-6.853409*	-1.07793	-1.710894	-6.965766*	-6.928318*
IN_{ER}	-1.93154	-2.274069	-5.15931*	-5.172079*	-1.74561	-1.983285	-5.159306*	-5.171351*
IN_{SP}	-2.30473	-1.629852	-7.03695*	-7.373607*	2.304726	1.720471	-7.034003*	-7.373607*
PK_{ER}	-2.22514	-1.951736	-7.45895*	-7.154865*	-2.41447	-0.223346	-6.93276*	-7.406076*
PK_{SP}	.2.278715	-1.949943	-6.89027*	-7.295443*	-2.63945	-1.864992	-6.839351*	-7.385457*
	Critical Values							
1 percent	-3.53659	-4.107947	-3.53659	-4.107947	-3.53487	-4.105534	-3.536587	-4.107947
5 percent	-2.90766	-3.481595	-2.90766	-3.481595	-2.90692	-3.480463	-2.90766	-3.481595
10 percent	-2.5914	-3.168695	-2.5914	-3.168695	-2.59101	-3.168039	-2.591369	-3.168695

Notes:

1. Using critical values by Mackinnon, 1996.
2. Maximum lag length chosen using Schwarz Information Criterion (SIC)
3. * indicates stationarity at 1% level, ** indicates stationarity at 5% level,*** indicates stationarity at 10% level
4. Selection of bandwidth in case of PP unit root test according to Newey-West,1994

Table 2. Co-integration test results

Null hypothesis	Alternate hypothesis	Variables	Trace	5% Critical Values	Prob.	Max-Eigen Statistic	5% Critical Values	Prob.
r = 0	r = 1	$\mathbf{BD_{ER}/BD_{SP}}$	13.63272	25.87211	0.6878	7.176378	19.38704	0.8884
r ≤1	r = 2		6.456342	12.51798	0.4046	6.456342	12.51798	0.4046
r = 0	r = 1	$\mathbf{IN_{ER}/IN_{SP}}$	13.23201	25.87211	0.7199	8.9674	19.38704	0.7278
r ≤1	r = 2		4.264071	12.51798	0.7036	4.264071	12.51798	0.7036
r = 0	r = 1	$\mathbf{PK_{ER}/PK_{SP}}$	15.74962	25.87211	0.5128	11.55947	19.38704	0.4572
r ≤1	r = 2		4.19015	12.51798	0.7145	4.19015	12.51798	0.7145

Notes:

1. Critical values based on MacKinnon-Haug-Michelis (1999)

2. Considered lag length 2 according to LR (likelihood ratio) test

Table 3. Granger causality test results

Null Hypothesis	F- Statistic	Probability
$\mathbf{BD_{SP}}$ does not Granger Cause $\mathbf{BD_{ER}}$	2.2054	0.12004
$\mathbf{BD_{ER}}$ does not Granger Cause $\mathbf{BD_{SP}}$	0.94258	0.39594
$\mathbf{IN_{SP}}$ does not Granger Cause $\mathbf{IN_{ER}}$	0.81079	0.4494
$\mathbf{IN_{ER}}$ does not Granger Cause $\mathbf{IN_{SP}}$	0.96028	0.38869
$\mathbf{PK_{SP}}$ does not Granger Cause $\mathbf{PK_{ER}}$	0.09294	0.91138
$\mathbf{PK_{ER}}$ does not Granger Cause $\mathbf{PK_{SP}}$	1.17355	0.31638

Notes:

1.* indicates significant causal relationship at 5%

2. Appropriate lag length was determined by Akaike information criterion