Relationship between Stock Prices and Exchange Rates: Evidence from Bangladesh

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Abstract

In this paper we have investigated the interactions between stock prices and exchange rates in the emerging economy of Bangladesh. We have considered monthly nominal exchange rates of US dollar, euro, Japanese yen, pound sterling and monthly values of Dhaka Stock Exchange General Index for period of June 2003 to March 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 Granger causality test shows that stock prices Granger cause exchange rates of US dollar and Japanese yen but there is no way causal relationship between stock prices and exchange rates of euro and pound sterling.

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

1. Introduction

The recent liberalization of foreign capital controls and adoption of floating exchange rate regime in Bangladesh 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.

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 country like Bangladesh where the economy is still emerging and capital market is still in a vulnerable condition, according to our knowledge no study has been made so far to investigate the relationship between stock prices and exchange rates which encourages us to conduct the study to detect the relationship between the variables.

2. Data and Methodology

Data used in this study include monthly nominal exchange rates of US dollar (EX_{us}), nominal exchange rates of Euro (EX_{eu}), nominal exchange rates of Japanese Yen (EX_{jp}), nominal exchange rates of UK Pound Sterling (EX_{uk}) and monthly closing values of Dhaka Stock Exchange General Index (DSEGI) for a period of June 2003 to March 2008. All the exchange rates are expressed in terms of local currency Taka. Then we transform all the data series into natural log form.

The data series we have used 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 have used both unit root tests 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

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

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:

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

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 two data series are integrated of the same order, it is useful to test for cointegrating relationship between the integrated variables. For this purpose we have employed 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):

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

where Y_t is a vector of non-stationary variables and C is the constant term.

In the absence of any cointegrating relationship between the variables, the standard Granger causality test base on Granger (1988) method can be applied. The Granger method involves the estimation of the following equations:

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

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

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.

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

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

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

where Z_{t-1} is the error correction term obtained from the cointegrating equation , 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.

3. Empirical Results

At first, we have run unit root tests on all the exchange rates and stock market index to test stationarity and order of integration in the level and in the first difference. We have 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 with the exception of exchange rates of euro and Japanese yen null hypothesis of a unit root in the level is accepted in all other cases as test statistics are lower than the critical values. The data series of exchange rates of euro is stationary at 10% level while considering constant and linear trend in case of both ADF test and PP test. The data series of exchange rates of Japanese yen is stationary at 10% level while considering constant in case of both ADF and PP test. As other alternative tests accept null hypothesis of a unit root, we can say that exchange rates and stock prices are non-stationary data series and integrated of order one, I (1) (Note 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 are stationary.

After determining stationarity of the data series and order of integration we made the use of 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 eigen value 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 have used 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 and non-cointegrated, the data series should be transformed into stationary (Oxley and Greasley, 1998). Because it has been confirmed that Granger causality test are 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 a unidirectional causality from stock prices to exchange rates of US dollar and Japanese yen as F-statistic is significant at 5% level. But there is no way causal relationship between stock prices and exchange rates of euro and pound sterling. So we can say that stock prices influence exchange rates of US dollar and Japanese yen and past values of stock prices can be used to improve the forecast of future exchange rates of said currencies.

4. 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 Granger cause exchange rates of US dollar and Japanese yen but there is no way causal relationship between stock prices and exchange rates of euro and pound sterling.

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 stock prices Granger cause the exchange rates of US dollar and Japanese yen, participants in the foreign exchange market can use information of stock prices to improve the forecast of exchange rates of said currencies.

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Notes

Note 1. According to Eangle and Granger (1987), identical results of all alternative tests are needed to conclude about sationarity of any time series. If even one test shows non-stationarity, the time series is treated as non-stationary.

Table 1. Unit root test results

Variables	ADF Test results				PP test results			
	Level		First Difference		Level		First Difference	
	Constant	Constant& linear trend	Constant	Constant& linear trend	Constant	Constant& linear trend	Constant	Constant& linear trend
	Test Statistics							
EX_{us}	-1.030686	-1.609128	-7.142503*	-7.105665*	0.921113	-1.647252	-7.196486*	-7.169096*
EX_{eu}	-0.972108	-3.27611***	-6.90167*	-6.832279*	-0.714095	-3.402264***	-8.014109*	-8.266159*
EX_{jp}	-2.743498***	-2.954585	-8.096094*	-8.255091*	-2.7404***	-2.954585	-8.096094*	-8.500896*
EX_{uk}	1.098908	-2.96831	-7.08755*	-7.049017*	-0.987302	-3.034151	-7.335153*	-7.513587*
DSEGI	-0.754434	-1.253349	-6.227357*	-6.162166*	-0.921113	-1.526717	-6.305345*	-6.242291*
	Critical Values							
1 percent	-3.568308	-4.152511	-3.57131	-4.156734	-3.568308	-4.152511	-3.57131	-4.156734
5 percent	-2.921175	-3.502373	-2.922449	-3.50433	-2.921175	-3.502373	-2.922449	-3.50433
10 percent	-2.598551	-3.180699	-2.599224	-3.181826	-2.598551	-3.180699	-2.599224	-3.181826

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 Statistic	5% Critical Values	Prob.	Max-Eigen Statistic	5% Critical Values	Prob.
r = 0	r = 1	***EX_{us} / DSEGI***	21.43688	25.87211	0.1617	16.45662	19.38704	0.1268
r ?1	r = 2		4.980266	12.51798	0.5992	16.45662	12.51798	0.5992
r = 0	r = 1	***EX_{eu} / DSEGI***	16.15248	25.87211	0.4804	13.63411	19.38704	0.2796
r ?1	r = 2		2.518371	12.51798	0.9282	2.518371	12.51798	0.9282
r = 0	r = 1	***EX_{jp} / DSEGI***	19.06167	25.87211	0.2771	16.30101	19.38704	0.1328
r ?1	r = 2		2.760662	12.51798	0.9037	2.760662	12.51798	0.9037
r = 0	r = 1	***EX_{uk} / DSEGI***	14.39175	25.87211	0.6252	11.49482	19.38704	0.4635
r ?1	r = 2		2.896937	12.51798	0.8886	2.896937	12.51798	0.8886

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
LN_DSEGI does not Granger Cause LN_DOLLAR	3.85696*	0.02862
LN_DOLLAR does not Granger Cause LN_DSEGI	0.3902	0.67924
LN_EURO does not Granger Cause LN_DSEGI	0.40003	0.67271
LN_DSEGI does not Granger Cause LN_EURO	0.80768	0.45239
LN_POUND does not Granger Cause LN_DSEGI	0.94014	0.39828
LN_DSEGI does not Granger Cause LN_POUND	0.59523	0.55581
LN_YEN does not Granger Cause LN_DSEGI	0.67351	0.51509
LN_DSEGI does not Granger Cause LN_YEN	4.76857*	0.01335

Notes: 1.* indicates significant causal relationship at 5%
2. Appropriate lag length was determined by Akaike information criterion