Dynamic Effects of Interest Rate and Exchange Rate Changes on Stock Market Returns in Bangladesh

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Abstract

This paper studies the dynamic effects of interest rate and Taka - U.S. Dollar exchange rate changes on Bangladesh stock market (Dhaka Stock Exchange) returns. The well-know cointegration methodology is applied using monthly data from January, 1983 through December, 2006. A long-run equilibrium and causal relationship exists between the dependent variable and two independent variables under consideration. However, the short-run effects of interest rate and exchange rate changes on Bangladesh stock market are virtually non-existent.

JEL Classification: C32, E44

Key Words: Stock Market, Interest Rate, Exchange Rate, Vector Error Correction Model (VECM

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I. Introduction

A number of macroeconomic and financial variables that influence stock market has been documented in the recent empirical literature without a consensus on their appropriateness as regressors (Lanne 2002, Campbell and Yogo 2003, Jansen and Moreira 2004, Donaldson and Maddaloni 2002, Goyal 2004, and Ang and Maddaloni 2005). Frequently cited macroeconomic variables are GDP, price level, industrial production rate, interest rate, exchange rate, current account balance, unemployment rate, fiscal balance, etc. To date, only a very few studies have been conducted examining the direct effects of some of the above variables on the stock market returns of Bangladesh. This empirical paper narrows down its focus on the dynamic effects of interest rate and exchange rate changes on the overall stock market returns in Bangladesh.

The rationales for the relationship between the interest rate and stock market return is that stock prices and interest rates are negatively correlated. Higher interest rate ensuing from contractionary monetary policy usually negatively affects stock market return. This is because higher interest rate reduces the value of equity as stipulated by the dividend discount model, makes fixed income securities more attractive as an alternative to holding stocks, may reduce the propensity of investors to borrow and invest in stocks, and raises the cost of

doing business and hence affects profit margin. On the contrary, lower interest rates resulting from expansionary monetary policy boosts stock market.

There are interactions between stock market returns and exchange rate through changes in foreign investment. Rates of return on foreign investment in stocks are converted from one currency into another currency through changing spot exchange rates. When rates of return in a depreciating currency are translated into a stronger currency, the adjusted rates of return decline. In contrast, when rates of return in an appreciating currency are translated into a depreciating currency, the adjusted rates of return increase. Foreign portfolio investors pay close attention to timing their return conversions based on the anticipated exchange rate movements. Moreover, increasing foreign investments in a country's stock market causes the local currency to appreciate vis-à-vis a related foreign currency through larger foreign currency inflows. Conversely, sales of a country's stocks by foreign investors cause foreign capital outflows. In turn, it makes local currency to depreciate against a related foreign currency. The depictions of such relationships between stock and foreign currency markets have possible flows of bidirectional causality. As currency depreciation and uncertainty adversely affect stock market returns, international fund managers readjust their stock market investment decisions.

This study examines whether stock market returns are influenced by interest rate and exchange rate changes in Bangladesh. This country has been selected

because of its growing importance in Asian economy due to increasing market openness, continuing unfolding strong trade relationship with the outside world, rising foreign investment, expanding GDP growth rate and enduring expansion in export oriented industry and services.

The remainder of the paper proceeds as follows. Section II provides a brief survey of the relevant literature. Section III describes the data and outlines the empirical design. Section IV reports empirical results. Section V offers conclusions.

II. Brief Literature Survey

The expansive empirical literature on the stock market and foreign exchange market linkages relates to both developed and developing countries although their financial markets are not equally developed. They can, however, benefit from each other by sharing their pertinent developments as the foreign currency and stock markets are subject to uncertainties. Frank and Young (1972) examine the relationship between exchange rate and US Multinational firms' stocks and conclude that there exists no definite or uniform pattern of stock price reactions to exchange rate realignments. On the contrary, Ang and Ghallab (1976) study the effect of US Dollar devaluation on 15 US multinational firms' stocks for a period of August 1971 to March 1973 and report that stock market is efficient and stock prices are adjusted rapidly to the exchange rate changes. Similarly, Aggarwal (1981) unearths that the floating value of the US Dollar and US stock prices are positively correlated for the period of 1974-1978. In 1987, Levy

examines the impact of the changes in the external value of the US Dollar on the real amount of gross corporate profits on sectoral basis. He indicates that the US Dollar exchange rate changes can adversely affect firms' gross profits, in general. However, the degree of such impact varies sectorally. He also concludes that the changes in the external value of the US Dollar have largest impact on profits of durable goods manufacturers as compared to certain service industries. Conversely, a very weak relation between the changes in the US Dollar exchange rate and the stock market (industrial stock price indices) is reported by Sonnen and Hennigar in 1998, which they also refer to as negative relation in their study. Bahamani and Payesteh (1993) conclude that there exists a bi-directional causality between stock prices and exchange rate, at least in the short-run, although the cointegration analysis does not depict any long-term relationship between these variables. However, a study conducted by Qiao (1997) reports that a bi-directional relationship exists in the stock prices and exchange rate of the Tokyo stock market.

In Australia, Loudun (1993) studies stock return sensitivity of a sample of Australian companies with respect to changes in the trade weighted index value of the Australian Dollar during the post-float period of January 1984 to December 1989. He finds that resource stocks and industrial stocks respond differently to fluctuations in Australian Dollar. In 2000, Banny and Enlaw investigate the relationship between the exchange rate of Malaysian Ringgit in terms of US Dollar and stock prices in Kuala Lumpur Stock Exchange (KLSE) using the single

index and multi index models. They document a negative relationship between exchange rate and stock prices on the KLSE market.

Regarding the relationship between stock prices and interest rate, a number of empirical studies have been undertaken after 1970s. Fama (1981, 1990), Chen, Roll and Ross (1986) and Chen (1991) tested the relationships between macroeconomic variables and stock prices with US economic data. Fama (1981) documents a strong positive correlation between common stock returns and real economic variables like capital expenditures, industrial production, real GNP, money supply, lagged inflation and interest rates. Chen, Roll and Ross (1986) find that the changes in aggregate production, inflation, the short-term interest rates, the maturity risk-premium and default risk-premium are the economic factors that explain the changes in stock prices. Smirlock and Yawitz (1985) state that interest rate changes can impact equity prices through two conduits: by affecting the rate at which the firm's expected future cash flows will be capitalized, and by altering expectations about future cash flows. In particular, they argue that an increase in interest rates causes stock prices to decline and a decline in interest rates causes stock prices to rise. Further, they argue that if both capitalization rates and expectations about future cash flows are impacted by interest rates, these effects would influence equity prices. Hardouvelis (1987) points out that there exists an inverse relationship between stock prices and changes of interest rate and this can be rationalized in terms of money supply surprises. The negative (positive) reactions of stock prices (interest rates) to

money supply surprises can be explained in terms of the following two hypotheses. The expected real interest rate hypothesis claims that stock prices decline because the real component of nominal interest rates is expected to increase, thereby increasing the discount rate at which future cash flows are capitalized and also because higher interest rates affect real output adversely, thereby reducing future operating cash flows. The expected inflation hypothesis claims that stock prices decline because the inflation premium in nominal interest rates increases, which decreases the after-tax real dividends. Elton and Gruber (1988) applies arbitrage pricing theory (APT) on Japanese stock returns and several macroeconomic variables like industrial production, money supply, crude oil price, short-term interest rates and show that there exists a positive relationship between stock prices and short-term interest rates.

Thorbecke and Alami (1994) and Jensen et al. (1997) have shown that changes in federal funds rate influence equity prices. Thorbecke (1997) studies the effect of actual changes in the federal funds rate targeting on the Dow Jones Industrial and Composite averages over the 24 hours bracketing the news of the target change. He finds that federal funds rate changes are inversely related to stock prices and that's monetary policy exerts large effects on ex ante and ex post-stock returns. Chen et al. (1999) examine the effect of discount rate changes on the volatility of stock prices and on trading volume. They unearth that unexpected discount rate changes contributed to higher, though short-lived, volatility and trading volume. Ying Wu (2001) examines the impact of macroeconomic

variables on the Straits Times Industrial Index (STII) by categorizing the macroeconomic indicators into two groups: money supply and interest rates. He documents that money supply does not register any pattern of influences on the STII but interest rate does play a significant role in determining the STII on the monthly investment horizon. Wing et al. (2005) examine the long- run equilibrium relationships between the major stock indices of Singapore and the United States using selected macroeconomic variables with time series data from January 1982 through December 2002. The results of cointegration test suggest that Singapore's stock prices generally display a long- run equilibrium relationship with interest rate and money supply (M1) but similar relationship does not exist in the United States.

III. Data Description and Empirical Design

(a) Data description

Monthly data are employed in this paper ranging from January, 1983 through December, 2006. The use of monthly data avoids the problems of thin trading and price limits of a stock market (Shen and Wang, 1997). DSE (Dhaka Stock Exchange) all share price indices used as stock market data have been collected from different issues of Economic Trend of Bangladesh Bank. The weighted average interest rate on bank deposit has been used as interest rate since savers of Bangladesh commonly invest their savings in bank deposits for higher interest rate with certainty when investment in shares market does not seem profitable to them. Data on exchange rate between Bangladesh Taka and U.S.

Dollar have been used in view of the dominance of U.S. Dollar in international transactions and evolving strong trade as well as financial relationships of the Bangladesh economy with the U.S. economy.

Both the interest rate and exchange rate data have been collected from several monthly issues of International Financial Statistics published by International Monetary Fund (IMF).

To trace some major interest rate and exchange rate developments, Bangladesh has experimented with interest rate modifications to support its overall development since its independence. Interest rates were fully regulated in Bangladesh till 1988 and afterwards reforms were undertaken in November 1989 and in June 1999, respectively, to make interest rate more flexible. Finally, Bangladesh introduced complete interest rate flexibility in 1997 and banks are now free to set interest rates. But banking system remains oligopolistic and is generally less responsive to market signals. On the other hand, Bangladesh pursued restrictive exchange rate policy to deal with the immediate post independence precarious economic situations during 1971-1975. Since 1976 a series of exchange rate measures have been introduced to convert Bangladesh into a small open economy. In addition to the current account convertibility, Bangladesh also switched to the floating exchanges rate system in May 2003.However, external pressures in adjusting exchange rate sometimes seem as barriers to this openness.

(b) Empirical Design

The base estimating equation in log-linear form is as follows:

$$\ln Y_t = \alpha + \beta \ln IR_{t+} \Psi \ln EX_t + e_t \qquad (1)$$

where, Y =stock market index of Bangladesh, IR = interest rate and EX =exchange rate. There are two reasons why variables are converted into natural logs. First, the coefficients of the cointegrating vector can be interpreted as long-term elasticities if the variables are in logs. Secondly, if the variables are in logs, the first difference can be interpreted as growth rates. The expected signs of the parameters are α>0, β<0 and $\Psi \gtrless 0$. The error-term (e) is assumed to be independently and identically distributed. The additional symbol (t) is used as the time–subscript.

For execution of the empirical design, the nature of the data distribution is examined first by using the standard descriptive statistics (mean, median, standard deviation, skewness and kurtosis). Normality of data distribution is also ascertained by invoking the Jarque –Bera test.

Second, the time series property of each variable is investigated under a univariate analysis by implementing the ADF (Augmented Dickey- Fuller Test) for the unit root (nonstationarity) following (Dickey and Fuller, 1981; Fuller, 1996). Likewise, the PP (Phillips-Perron) test is also implemented following (Phillips, 1986; Phillips and Perron, 1988; Perron, 1989). The KPSS (Kwiatkowski, Philips, Schmidt and Shin) test for no unit root (stationarity) is applied as a counterpart of ADF and PP tests following (Kwiatkowski, et al., 1992). Third, if these tests confirm stationarity in time series data of each variable, equation (1) is estimated appropriately by the Ordinary Least Square (OLS) method. Otherwise, its application leads to misleading inferences in presence of spurious correlation (Granger and Newbold, 1974).

Third, in the event of nonstationarity of each variable, the cointegrating relationship (tendency for variables to move together in the long run) among variables is studied either by the Engle –Granger (1987) procedure or Johansen-Juselius procedure (Johansen 1988; Johansen-Juselius 1992, 1999). For both procedures, all the variables must have the same order of integration. This paper applies the Johansen-Juselius procedure for cointegration by conducting $\lambda_{\max}$ and λ_{trace} tests. Otherwise, Vector of Autoregressive (VAR) approach is applied following Granger (1988).The appropriate lag-length (p) is selected with the aid of the FPE (Final Prediction Error) criterion (Akaike 1969) to ensure that errors are white noise.

Fourth, on the evidence of cointegrating relationship, a vector error-correction model (VECM) needs to be estimated for long-run causality and short-term dynamics. The VECM model may be specified as follows:

$$\mathbf{\Delta lnY_t} = \alpha + \lambda e_{t-1} + \sum_{i=1}^{n} bi \Delta \ln Y_{t-i} + \sum_{i=0}^{m} ci \Delta \ln IR_{t-i} + \sum_{i=0}^{k} di \Delta \ln EX_{t-i} + \mathbf{U_t} \quad \textbf{(2)}$$

In this specification, the variables are cointegrated if the estimate of λ is negative and statistically significant in terms of the associated-t value. **This will indicate long-run causal relationship among variables as well as long term convergence. The short term effects of interest rate and exchange rate on stock market return are inferred by magnitudes and signs of CI's and DI's , respectively.**

Fifth, in the absence of the cointegrating relationship among the variables, the vector auto regressive (VAR) model is to be estimated in first-difference by excluding the error-correction term for Granger causality with short-term interactive feedback relationship (Granger, 1988) as follows:

$$\mathbf{\Delta lnY_t} = \alpha + \sum_{i=1}^{n} bi \Delta \ln Y_{t-i} + \sum_{i=0}^{m} ci \Delta \ln IR_{t-i} + \sum_{i=0}^{k} di \Delta \ln EX_{t-i} + \mathbf{U_t} \quad \textbf{(3)}$$

Additionally, variance decomposition and impulse response analyses are performed in this paper to gain some additional insights.

IV. Results

The nature of the distribution of each variable is examined by using the standard data description as shown below:

[Please insert table 1 here]

A cursory inspection of the descriptive statistics (Table 1) reveals approximate normality in the data distribution of each variable in terms of skewness and kurtosis. The coefficient of skewness of each variable is low and mildly negative. The numeric of Kurtosis of each variable is below its benchmark of 3 for normal distribution confirming near normality. The mean to median ratio of each variable is within the unit proximity. The range of variation between maximum and minimum is reasonable. The standard deviation is also quite low showing small variability. Although above descriptive statistics show near-normality of each

variable, but Jarque-Bera test contradicts it somewhat. However, this does not seem to be a serious issue for executions of the rest of the empirical design.

To examine the time series property of each variable, the ADF and PP tests for unit root as well as their counterpart KPSS test for no unit root are implemented as reported below:

[Please insert table 2 here]

The calculated ADF and PP statistics cannot reject the null hypothesis of unit root at both 1 per cent and 5 per cent significance levels when compared with their respective critical values. The calculated KPSS statistics also clearly reject the null hypothesis of no unit root at both 1 and 5 per cent significance levels when compared with their corresponding critical values. In other words, ADF, PP and KPSS tests decisively confirm nonstationarity of each variable. Table 2 shows further that LnY, LnIR and LnEX possess I(1) behavior. To clarify, each variable restores its stationarity on first differencing of the level data depicting the same order of integration, here I(1) behavior.

Consequently, Johansen-Juselius procedure is implemented to ascertain a possible cointegrating relationship among the variables.

[Please insert table 3 here]

Table 3(a) reveals that trace statistics (λ_{trace}) fails to reject the null hypothesis of no cointegrating relationship. However, maximum eigen value statistics (λ_{max}) finds one cointegrating relationship (Table 3(b)) by rejecting the null hypothesis

of no cointegration. Next, for any conflict between λ_{trace} and $\lambda_{\text{max,,}}$ the $\lambda_{\max}$ test should prevail for inferences (Johansen & Juselius, 1992). As a result, the error correction model (2) is estimated instead of the VAR model. The results are as follows:

[Please insert table 4 here]

Table 4 confirms that a long-run equilibrium relationship exists among the variables and a long term causal flow runs from interest rate and exchange rate changes to stock market returns in Bangladesh. This is revealed by the estimated coefficient ($\hat{\lambda}$) of the error correction term $\hat{e}_{t-1}$ which is negative, as expected, and is statistically significant in terms of its associated t-value. However, the numeric of $\bar{R}^2$ at 0.059654 shows very low explanatory power of the model. The F-statistics at 2.496093 shows also overall modest significance of the model. The DW-value at 2.001895 indicates no problem of autocorrelation.

The coefficients of the subsequent lagged-terms of changes in interest rate are insignificant in terms of the associated t-values. Likewise, the co-efficients of the lagged changes of exchange rate reveal statistical insignificance in terms of the associated t-values.

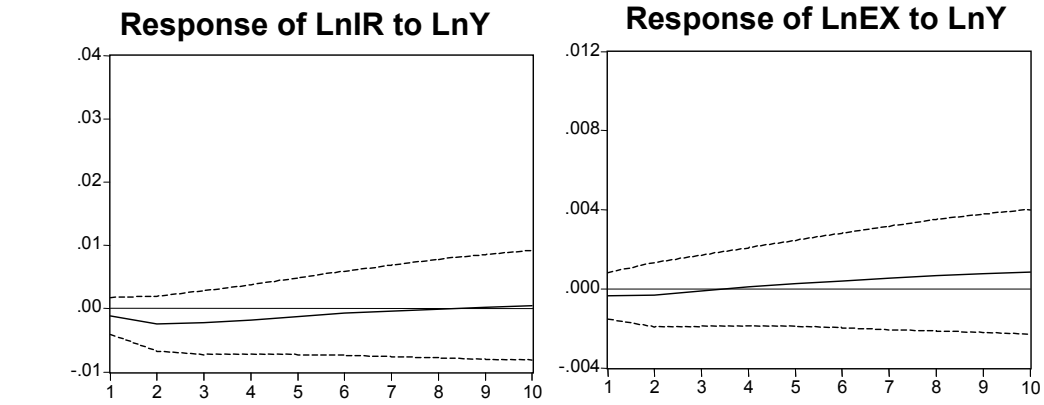
The variance decomposition results are as follows:

[Please insert table 5 here]

Table 5 shows that in the second period, the total variance in stock price is primarily due to the variation of its own price (99.92214), followed by exchange rate (.013979) and interest rate (0.063881), respectively. With the passage of time, the contributions of stock price to the overall volatility decline and those of interest rate and exchange rate rise.

Figure 1 reports impulse responses. It shows that how one-time positive shock of one standard deviation (± 2 S. E. innovations) to interest rate and exchange rate endures on Bangladesh stock market.

Figure 1: Impulse Response Function



(a) (b)

A casual inspection of picture (a) shows that the initial positive shock given to changes of interest rate does not show any visible influence on stock market return. It starts from negative territory, thereafter it merges with the base line somewhere between seventh and eighth months and overlaps it until the tenth

month. Picture (b) shows that changes of exchange rate have relatively more influences on stock market returns in Bangladesh.

V. Conclusions

A long-run equilibrium relationship exists among the variables and flowing from interest rate and exchange rate changes to stock market returns in Bangladesh. However, there is no evidence of discernible short-run interactive feedbacks among the variables.

In closing, the interest rate and exchange rate changes matter for Bangladesh stock market in the long run. At the same time, they seem to have no significant influences on the stock market in the short run, given the history of interest rate and exchange rate regimes in Bangladesh. As for policy implications, Bangladesh should, thus, refrain from frequent interest rate and exchange rate manipulations either to stabilize or to prop up the Bangladesh stock market in the short-run, although they might work in this respect in the long run.

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Table 1: Descriptive Statistics

	LnY	LnIR	LnEX
Mean	6.083328	2.246848	3.720231
Median	6.286017	2.173612	3.695110
Maximum	8.027800	2.484907	4.270341
Minimum	4.681668	1.791759	3.194128
Std. Dev.	0.881473	0.206973	0.292133
Skewness	-0.081806	-0.064872	-0.004209
Kurtosis	1.798174	1.627539	1.989706
Jarque-Bera	17.65386	22.80580	12.24917
Probability	0.000147	0.000011	0.002188

Table 2: ADF, PP and KPSS Tests

	Level			First Difference		
	ADF	PP	KPSS	ADF	PP	KPSS
LnY	-1.514374	-1.392186	1.701732	-15.18931*	-15.42053*	0.047259*
LnIR	-1.331774	-1.390038	1.403140	-10.81950*	-14.82516*	0.2145537 *
LnEX	-.404959	-0.414352	1.994671	-16.87628*	-16.90627*	0.043710*

The Mackinnon (1996) critical values are -3.699871 and -2.976263 at 1 per cent and 5 per cent levels of significance, respectively. The KPSS critical values (Kwiatkowski,et al., 1992, Table 1) are 0.73900 and 0.46300 at 1 per cent and 5 per cent levels of significance, respectively. * indicates stationarity at the first differencing.

Table 3: Johansen-Juselius Multivariate Cointegration Test Result

Panel: 3 (a)

Hypothesized	Trace	5 Percent
No. of CE(s)	Statistic	Critical Value
None	26.22150	29.68
At most 1	2.880258	15.41
At most 2	0.193981	3.76

*(**) denotes rejection of the hypothesis at the 5%(1%)

Trace test indicates no cointegration at both 5% and 1% levels

Panel 3(b)

Hypothesized	Max-Eigen	5 Percent
No. of CE(s)	Statistic	Critical Value
None *	23.34124	20.97
At most 1	2.686277	14.07
At most 2	0.193981	3.76

*(**) denotes rejection of the hypothesis at the 5%(1%) level

Max-eigenvalue test indicates 1 cointegrating equation(s) at the 5% level

Table 4: Estimates of Vector Error –Correction Model

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.014854	0.010331	1.437763	0.1517
RES(-1)	-0.128340	0.027767	-4.622034	0.0000
D(LnY (-1))	0.147917	0.059233	2.497209	0.0131
D(LnY (-2))	0.053287	0.059793	0.891194	0.3736
D(LnY (-3))	-0.023769	0.059939	-0.396556	0.6920
D(LnIR (0))	-0.223852	0.347970	-0.643309	0.5206
D(LnIR (-1))	0.507980	0.346894	1.464367	0.1443
D(LnIR (-2))	0.365725	0.347376	1.052821	0.2934
D(LnIR (-3))	0.045581	0.354752	0.128488	0.8979
D(LnEX (0))	-0.552381	0.852736	-0.647774	0.5177
D(LnEX (-1))	-0.406455	0.850992	-0.477625	0.6333
D(LnEX (-2))	-0.441659	0.854331	-0.516964	0.6056
D(LnEX (-3))	-0.647691	0.856791	-0.755950	0.4503
R-squared	0.099528	Mean dependent var		0.008546
Adjusted R-squared	0.059654	S.D. dependent var		0.143010
S.E. of regression	0.138679	Akaike info criterion		-1.068617
Sum squared resid	5.211830	Schwarz criterion		-0.901586
Log likelihood	164.7436	F-statistic		2.496093
Durbin-Watson stat	2.001895	Prob(F-statistic)		0.004038

Table 5: Variance Decomposition

Period	S.E.	LnY	LnIR	LnEX
1	0.137592	100.0000	0.000000	0.000000
2	0.197993	99.92214	0.063881	0.013979
3	0.234589	99.93930	0.048839	0.011860
4	0.258736	99.79565	0.193190	0.011162
5	0.275751	99.37064	0.608717	0.020648
6	0.288396	98.63268	1.323656	0.043661
7	0.298263	97.58948	2.329277	0.081240
8	0.306334	96.26895	3.597813	0.133233
9	0.313238	94.71071	5.090539	0.198750
10	0.319384	92.96048	6.763093	0.276425