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Real or Nominal Shocks : What Drives the Exchange Rate Movements in Bangladesh?

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Abstract

This paper searches for a primary element responsible for exchange rate movements in Bangladesh. The dynamic effects of real and nominal shocks are scrutinized through conducting a structural vector autoregression model of real and nominal exchange rates with the assumption of the long-run neutrality restriction of nominal shocks on the real exchange rate. In order to identify how these factors influence exchange rate variations in Bangladesh, this approach allows us to decompose exchange rate movements into two components: real and nominal factors. This empirical analysis demonstrates that the effect of a real shock on the real and nominal exchange rates is of a persistent nature, resulting in a long-run real appreciation. In Bangladesh, it takes around 5 months before the nominal exchange rate beginning depreciating in response to a positive nominal shock such as an increase in money supply.

JEL Codes: F31, E52, E24
Keywords: Exchange rates, nominal shocks, and real shocks.

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1. Introduction

With the onset of the flexible exchange rate regime since 31st May, 2003, Bangladesh Bank, the central bank of Bangladesh, has liberalized the exchange rates (price of one unit of national currency in terms of the US dollar) to achieve the goal of a vibrant market mechanism through the interaction of demand for and supply of currencies. Under this regime the international capital mobility has intensified the level of dollarization which in turn induces instability of the exchange rate. Dollarization may reduce a *'fear of floating'* by partially reducing the adverse impact of exchange rate fluctuations on the economy at the aggregate level. Viaene and Vries (1992) argued that, for the developing countries, exchange rate volatility has an adverse effect on international trade. Many emerging countries, on the other hand, appeared to be reluctant to allow exchange rates to move freely due to a '*fear of floating*' psychology—as argued by Calvo and Reinhart (2002). Thus, exchange rate management has always been an important measure in mitigating external and internal imbalances as a nominal anchor in most of the developing countries, and Bangladesh is no exception.

The objective of this paper is to investigate the sources of movements in real and nominal exchange rates in Bangladesh. We assume that any shock to either type of exchange rate is due to the real shocks, such as resource endowments, technological advancement, preferences, and nominal shocks, such as money supply. In order to identify the real and nominal exchange rate movements by the dynamic effects of real and nominal shocks, this paper conducts a structural vector autoregression (SVAR) model with the long-run neutrality restriction; that is, nominal shocks have only a short-run effect but no long-run effects on real exchange rates. Lastrapes (1992), Enders and Lee (1997), Chowdhury (2004), and Ok, Kakinaka and Miyamoto (2010) conducted similar empirical studies which were based on the technique developed by Blanchard and Quah (1989).

The recent trend in emerging economies is that the exchange rate regime has been shifting towards nominal exchange rate flexibility, although often managed due to the *'fear of floating'* (Calvo and Reinhart, 2002). Moreover, since the real exchange rate is typically considered as measures of international competitiveness, some emerging countries seem to pursue exchange rate policies that try to set the real exchange rates at some target level through adjusting the nominal exchange rates (Silva, 1999).

A number of studies incorporated structural VAR models with the long-run neutrality restriction of Blanchard and Quah (1989) in order to investigate sources of exchange rate movements by decomposing the exchange rate series into the real and nominal disturbances. Lastrapes (1992) points out that real shocks dominate nominal shocks for both exchange rate series over short and long frequencies. Kim and Enders (1991) examine real and nominal causes of real exchange rate movements in the Pacific Rim nations and show some evidence of the long-run neutrality of nominal shocks. Clarida and Gali (1994) find that demand shocks, to national saving and investment, explain the majority of the variance in real exchange rate, while supply shocks explain very little.

Chen and Wu (1997) use the data for four Pacific basin countries and show that real shocks have a significant impact on the variability of real exchange rates and real shocks were more important during the 1990s than during the 1980s, especially for Japan, Taiwan and Philippines. Enders and Lee (1997) show that nominal shocks have a minor effect on the real and nominal exchange rates for Canada, Germany, and Japan over the sample period of January 1973 to April 1992.

Chowdhury's (2004) analysis for six emerging countries: Chile, Colombia, Malaysia, Singapore, South Korea and Uruguay also shows that real shocks dominate nominal shocks for the exchange rates over the sample period of January 1980 to December 1996. Moreover, Ok et al. (2010) point out that real shocks in the direction of depreciation lead to real and nominal depreciation, while nominal shocks induce long-run nominal depreciation but real appreciation in short-run for Cambodia and Lao PDR.

To the best of our knowledge, there is no study on Bangladesh that examines the sources of movements in real and nominal exchange rates using bivariate SVAR. This paper attempts to decompose real and nominal exchange rate fluctuations into real and nominal factors through applying an SVAR model with the long-run neutrality restriction in which nominal shocks have only a short-run effect but no long-run effect on real exchange rates.

Our empirical finding from the SVAR analysis demonstrates that the effect of a real shock on the real and nominal exchange rates is of a persistent nature, resulting in a long-run real appreciation. This finding is consistent with, among others, Lastrapes (1992), Enders and Lee (1997), Chowdhury (2004), and Ok et al. (2010). On the other hand, the effect of a nominal shock on nominal exchange rates demonstrates that nominal shock takes few months to maintain negative direction, i.e. depreciation in the nominal exchange rates in Bangladesh. This result is consistent with the argument of Dornbusch (1976) that raising nominal money supply leads depreciation in nominal exchange rates in the long run.

The remainder of this paper is organized as follows. Section 2 conducts empirical analysis of exchange rate movements through decomposing the fluctuations of exchange rates into nominal and real components for the Bangladeshi taka. The last section, Section 3, provides conclusion along with several policy recommendations.

2. Empirical Analysis

2.1. Model Specification

In order to specify our model, it has been assumed that observed real and nominal exchange rates are subject to two types of orthogonal shocks. The first shock is a “real shock,” which mainly comes from the fundamental disturbances related to various structural macroeconomic conditions including resource endowments, technological advancement, productivity, and preference. The terms of trade and international competitiveness are generally affected by the real shocks (Lastrapes, 1992; Enders and Lee, 1997; Chowdhury, 2004). The second shock is the nominal shock, which is mainly due to non-fundamental disturbances, such as nominal money supply shocks and the exchange rates depreciation or appreciation.

To provide some important insights on the sources of real and nominal exchange rate movements, we apply a bivariate SVAR analysis of real and nominal exchange rates through decomposing the variables into real and nominal shocks. Although the two shocks: real and nominal shocks, are not directly observable, they could be inferred from the examination of their joint behavior by imposing the long-run neutrality restriction that a nominal shock has no long-run or permanent impact on real exchange rate under certain assumptions (Enders, 1997; Wang, 2004). This restriction could be appropriate since the real exchange rate, as a relative price between domestic and foreign prices, is consistent with conventional economic models of exchange rate movements (Lastrapes, 1992).

In order to identify the sequence of real and nominal shocks to exchange rates, we consider the infinite moving average representation in the structural shocks, following Lastrapes (1992), Enders and Lee (1997) and Ok et al. (2010), among others, as follows:

$$\begin{bmatrix} \Delta r_t \\ \Delta n_t \end{bmatrix} = \begin{bmatrix} A_{11}(L) & A_{12}(L) \\ A_{21}(L) & A_{22}(L) \end{bmatrix} \begin{bmatrix} e_{rt} \\ e_{nt} \end{bmatrix} \tag{1}$$

where r_t and n_t are the natural log of real and nominal exchange rate in period *t*, respectively; e_{rt} the real shock in period *t*; e_{nt} the nominal shock in period *t*; Δ the first difference operator; $A_{ij}(L)$ a polynomial in the lag operator L. By construction, we assume that the innovations are normalized with $var(e_t) = I$, that real and nominal exchange rates are non-stationary and non-cointegrated, and that the first-differences of real and nominal exchange rates are stationary.

To impose the long-run neutrality restriction that nominal shocks have only a short-run effect but no long-run effect on real exchange rate, we consider the restriction that the sum of the coefficients in $A_{12}(L)$ is equal to zero, that is:

$$\sum_{k=0}^{\infty} a_{12}(k) = 0 \qquad (2)$$

where $a_{12}(k)$ is the k-th coefficient in $A_{12}(L)$ and represents the effect of the nominal shocks, e_{nt}, on the first-difference of the real exchange rate, Δr_t, after k periods. Thus, the restriction (2) simply implies that the cumulative effect of e_{nt} on Δr_t is zero, i.e., nominal shocks have no long-run effects on real exchange rates.

Questions may arise as to whether this type of model is applicable to a developing economy such as Bangladesh. For example, the model assumes an open economy with a flexible exchange rate and capital mobility, and full employment in the long run. Bangladesh may not fully satisfy these assumptions. Fundamental changes in the economy over the past two decades have made the model increasingly more relevant. Bangladesh has opened up its trade and become more market oriented. The major progress in the trade policy reform started in 1991 with a substantial scaling down and rationalization of tariffs, removal of trade related quantitative restrictions and elimination of import licensing, unification of exchange rates and the move to a more flexible exchange rate system. In 1994, the taka was made convertible for current account transactions (Ahmed and Sattar, 2004). And finally exchange rate became fully flexible in May 2003.

However, since it is difficult to identify and test multiple shocks, the discussion under the assumption of the two structural shocks would be helpful to access the sources of exchange rate movements as an approximate methodology.

2.2. Data and Preliminary Results

The data are taken from the International Monetary Fund's (IMF) *International Financial Statistics (IFS)*. In order to carry out the empirical analysis, we use the monthly observations on bilateral exchange rates from June 2003, since the flexible exchange rate regime started from 31 May, 2003, to June 2014 (Figure 1). Nominal exchange rate series considered is average-of-period rate and is expressed as US dollar per national currency units. The real exchange rate is derived by adjusting the nominal exchange rate with the ratio of the domestic price level to US price level. Consumer price index is used as a measure of price level in this case. The log-level real exchange rate series r_t is generally constructed as $r_t = n_t - p_t^* + p_t$, where n_t is the log of the nominal exchange rate considered from average-of-period rate, p_t and p_t^* are the log of the domestic price level and the log of US price level, respectively. Thus, the real exchange rate measure the relative price of Bangladeshi goods in terms of US goods.

The descriptive statistics of the differenced log of nominal and real exchange rates against the Bangladeshi taka are represents in Table 1. The volatility of real exchange rate is greater than that of nominal exchange rate in Bangladesh. The average nominal depreciation rate is larger than the average real appreciation rate in Bangladesh, which implies that Bangladesh has experienced relatively higher inflation compared to the US. Table 2 shows the correlations among the first-differenced log of nominal exchange rate, real exchange rate and domestic price level for Bangladesh. Nominal exchange rate is positively correlated and statistically significant with real exchange rate in terms of monthly returns. Moreover, statistically significant association can be found between inflation rate and real appreciation; inflation rate is also associated with nominal appreciation in Bangladesh.

2.3. Estimation

In order to conduct the basic estimation of the SVAR model, there are several preliminaries that have to be completed. The first preliminary exercise is to investigate the presence of a unit root in the univariate representations of the real and nominal exchange rates. Augmented Dickey-Fuller (Dickey and Fuller, 1979) and Phillips-Perron (Phillips and Perron, 1988) tests are carried out for all exchange rates series in log level and first difference. For all real and nominal log-level exchange rates the null hypothesis of the series having a unit root could not be rejected, which implies that the log-level of real and nominal exchange rates are non-stationary. On the other hand, the first-differences of real and nominal exchange rates are stationary in both tests (see Table 3).

Given the non-stationary results, we now test the long-run relationship between real and nominal exchange rates through examining whether the two non-stationary series are cointegrated for Bangladesh. The result of Johansen cointegration test (Johansen, 1992) suggests that for Bangladesh real and nominal exchange rates are not cointegrated. It implies that no long-run equilibrium between nominal and real exchange rates in Bangladesh over the considering period (see Table 4).

Given that real and nominal exchange rates are non-stationary at the level but stationary at the first-difference, and that they are not cointegrated, the SVAR specification can be appropriate to examine the dynamic effects of real and nominal shocks on real and nominal exchange rates.

2.4. Impulse Response Functions

In order to investigate the effect of each type of shock on real and nominal exchange rates, this paper estimates the SVAR model and derives impulse response functions (IRFs) for Bangladesh. The first panel of Figure 2 represents the dynamic response of real exchange rate to one standard deviation of real and nominal shocks, while the second panel of figure 2 shows the dynamic response of real exchange rate to one standard deviation of real and nominal shocks over a horizon up to 72 months. Each panel is shown in terms of cumulative sums of the difference dynamics.

The first panel of figure 2 shows that one standard deviation of real shock induces an immediate accumulated positive response in the real exchange rate. This effect increases up to 10 to 11 months, after that the accumulated response of real exchange rate gradually declines and stabilizes in the long horizon. Thus, the effect of a real shock on the real exchange rate is of a persistent nature, resulting in a long-run real appreciation. Similar findings were derived by Lastrapes (1992), Enders and Lee (1997), Chowdhury (2004), Ha et al. (2007), and Ok et al. (2010). On the other hand, one standard deviation of nominal shock induces an immediate accumulated positive response in the real exchange rate. This response peaks between 1 to 2 months horizon and dies out at 7 months horizon. It clearly reflects the identification restriction; the nominal shock has no effect on real exchange rate in the long-run. However, it does appear to be a non-trivial impact in the short run.

The second panel of Figure 2 illustrates that one standard deviation of real shock tempts an instantaneous accumulated positive response in the nominal exchange rate. This effect peaks at 11 months, after these horizons the response of nominal exchange rate gradually declines and stabilizes in the long horizon. Thus, the effect of a real shock on the nominal exchange rate is of a persistent nature, resulting in a long-run nominal appreciation [similar findings were derived by Lastrapes (1992), Enders and Lee (1997), Chowdhury (2004), Ha et al. (2007), and Ok et al. (2010)]. The dynamic response of the nominal exchange rate to a real shock is very similar to that of the real rate. This suggests that permanent changes in the real exchange rate due to real shocks mainly occur through nominal exchange rate changes.

On the other hand, one standard deviation of nominal shock persuades an immediate accumulated positive response in the nominal exchange rate. This response peaks at between 2 to 3 months and dies out before 5 months horizon. After that it has negative response in the nominal exchange rate and below the zero-line for the rest of the forecasting horizons. Thus, nominal shock takes near about 5 months to maintain negative direction (depreciation) in the nominal exchange rate in Bangladesh. This result is consistent with the argument of Dornbusch (1976) that raise the idea that nominal money supply leads to a proportionate rise (depreciation) in nominal exchange rate in the long-run.

If technology shock is considered as one type of real shock, which is of particular interest to the economy of Bangladesh, the impact of a real shock on real exchange rate can be discussed in the framework of Harrod-Balassa-Samuelson (Harrod, 1933; Balassa, 1964; Samuelson, 1964) argument—that the real exchange rate movements in the long-run could be explained by the productivity growth in tradable sectors. Higher productivity growth in tradable sectors tends to increase local input costs and therefore prices of non-tradable sectors (Berka, Devereux, and Engel, 2012). Since traded-goods prices tend to be equalized across countries, this raises the local price level, which is a real exchange rate appreciation (Berka et al., 2012). Thus, a positive technology shock should induce real appreciation of the home currency.

Furthermore, the study has produced evidence that real shock dominates the nominal shocks in both exchange rates series for Bangladesh. Table 5 reports that the magnitude of response of real exchange rate due to real shock (0.0179) has been found to be greater than the response of nominal exchange rate (0.0149). On the other hand, the magnitude of response of nominal exchange rate due to nominal shock is 0.0029 which implies that real shock dominates over nominal shock in the long-run (this findings also consistent with Lastrapes, 1992; Enders and Lee, 1997; Chowdhury, 2004; Ha et al. 2007; Chen and Wu, 1997; Ok et al. 2010).

2.5. Variance Decompositions

In order to summarize the information contained in the moving average representation the variance decompositions (VDCs) are conducted in this paper and in which the exchange rate series can be decomposed into real and nominal shocks. The VDC measures the average, relative contribution to forecast error variance of each shock in terms of forecast horizon. On the other hand, impulse response function reveals the dynamic effect of a one-time shock. The VDC is a convenient measure of the relative importance of such shock into the system. The summarized results of the VDC for the first-difference of log real and nominal exchange rates for the periods up to 72 months are shown in then Table 6. Table 6 contains only the relative contribution of forecasted error variance in percent of the real shocks, the remaining variance is attributed to the nominal shocks for Bangladesh.

The relative contribution of a real shock in explaining the variation of real exchange rate is 68 percent at the horizon of one month, which increases to 70 percent at the horizon of the second month, after that it steadily declines to 65 percent at eight months and stays roughly the same and reaches at 64.7 percent at an increased forecasting horizon of 20 months. On the other hand, the relative contribution of a real shock explains about 99.8 percent of the variation of nominal exchange rate at the horizon of one month, after that it gradually declines to around 92 percent with an increase in forecasting horizon. The relative contribution of a real shock in explaining the variation of nominal exchange rate is greater than that of real exchange rate, it might be the case that real disturbances quickly capture most of the nominal exchange rate fluctuation in Bangladesh (this finding is consistence with the work of Lastrapes, 1992 for Japan).

In sum, real shock plays more important roles in explaining the variation of real and nominal exchange rates for Bangladesh. This result would be consistent with the high importance of real shock in most developed and emerging countries (Lastrapes, 1992; Enders and Lee, 1997; Chowdhury, 2004), but is in contrast to the high importance of nominal shock for Korea (Ha et al. 2007).

3. Conclusion

The sources of exchange rate movements of real and nominal exchange rates in Bangladesh are investigated in this paper by conducting a structural VAR model over the sample period June 2003 to June 2014. It has been mentioned earlier that our paper assumes two structural shocks: real and nominal.

Furthermore, we assume nominal shock has no long-run effect on real exchange rate. Based on these assumptions, we find that the effect of a real shock on the real and nominal exchange rates is of a persistent nature, resulting in a long-run real appreciation. On the other hand, the effect of a nominal shock on the nominal exchange rates demonstrates that a nominal shock takes few months to maintain negative direction (depreciation) in the nominal exchange rates in Bangladesh. This result is consistent with the argument of Dornbusch (1976) that a rise in nominal money supply leads depreciation in nominal exchange rates in the long run.

A significant impact of the real shock on exchange rates could provide some implications from a policy point of view. As Bangladesh now adopts the managed floating exchange rate regime, the objective of monetary and exchange rate policies should be to make an effort in offsetting the effect of real shocks through sterilization of foreign reserve outflows or raising the interest rate for the purpose of economic stabilization.

The model specification illustrated in this paper might be too simple since decomposition of the shock in only two types: nominal and real, might create difficulties to capture any possible shocks. In practice, an existing, managed floating exchange rate policy is complicated because of the fact that policymakers cannot easily distinguish between the observed real and nominal shocks. Although we have addressed these issues in our paper, we believe that the findings of this paper highlight some important policy implications of the exchange rate movements in Bangladesh, and we hope that more in-depth research would be conducted in this area in the near future.

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Table 1. Descriptive Statistics of Real and Nominal Exchange Rate

	Δr	Δn
Average	0.0019	-0.0022
Standard Deviation	0.0142	0.0096

Note: Δr is the first difference of logarithm of the real exchange rate and Δn is the first difference of logarithm of the nominal exchange rate.

Table 2. Summary Statistic: Correlations Matrix

	Δr	Δn	Δp
Δr	1	-	-
Δn	0.75	1	-
	(12.96)		
Δp	0.65	0.08	1
	(9.73)	(0.92)	

Note: Δr is the first difference of logarithm of the real exchange rate, Δn is the first difference of logarithm of the nominal exchange rate, Δp is the first difference of logarithm of the consumer price index and numbers in parentheses are t-statistic.

Table 3. Stationary Test

Variable	Level		First-Difference	
	ADF Test	PP Test	ADF Test	PP Test
n	-1.58	-1.61	-8.61*	-8.56*
r	-0.74	-0.66	-7.94*	-7.83*

Note: n is the logarithm of the nominal exchange rate, and r is the logarithm of the real exchange rate. The lag length was selected basing on Schwarz's Bayesian Information Criterion. * represents statistical significance at 1 percent.

Table 4. Johansen-Juselius cointegration Tests

λ_{trace} test					λ_{max} test				
		λ_{trace}	Prob	CE			λ_{max}	Prob	CE
$H_0: r=0$*	$H_A: r>0$	5.58	0.7441	0	$H_0: r = 0$*	$H_A: r = 1$	5.23	0.7124	0
$H_0: r \leq 1$	$H_A: r > 1$	0.35	0.5526	0	$H_0: r = 1$	$H_A: r = 2$	0.35	0.5526	0

Note: The λtrace and λmax are calculated as per Johansen (1988) and Johansen and Juselius (1990). p-values are calculated as per MacKinnon et al. (1999). r stands for the rank of the matrix, which denotes the number of the conintegrating equation between the variables. CE stands for conintegrating equation. *Denotes rejection of the hypothesis at the 0.05 level.

Table 5. Real and Nominal exchange rate equations

Real exchange rate equation	$\Delta r_t =$	$0.0179\ e_{rt}$	
		(0.0000)	
Nominal exchange rate equation	$\Delta n_t =$	$0.0149\ e_{rt}$	$+\ 0.0029\ e_{nt}$
		(0.0000)	(0.0000)

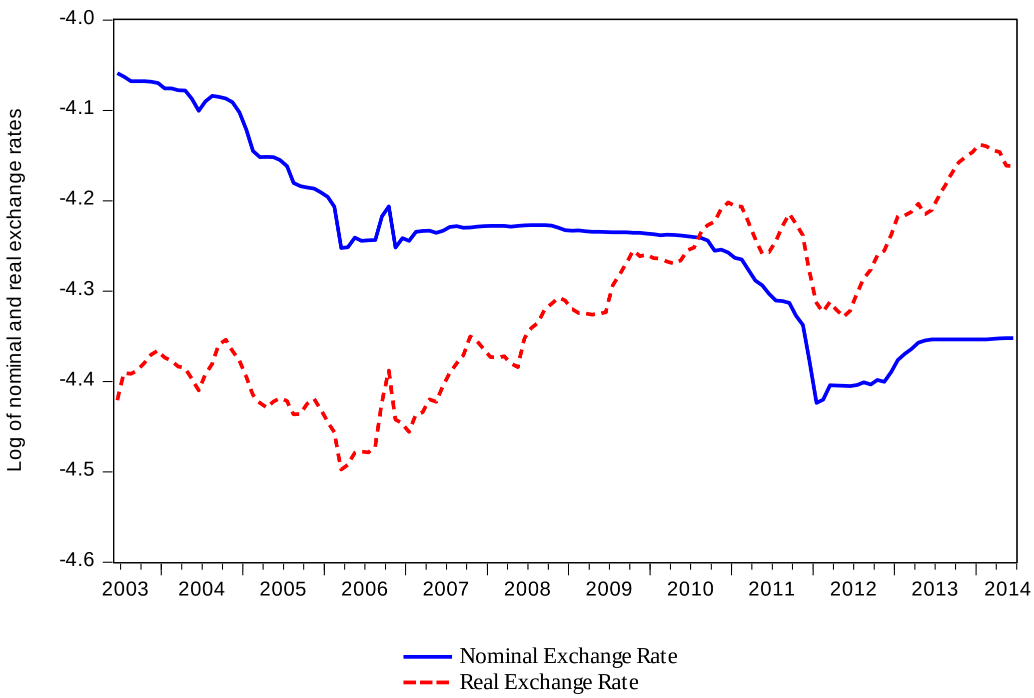
Note: p-values are reported in parenthesis.

Table 6. Variance Decompositions of Real and Nominal Exchange Rates

	Relative Contribution of Real Shock to	
Forecast Horizon	Δr	Δn
1-month	68.26718	99.85730
3-month	69.66850	99.29004
6-month	66.07162	95.28452
9-month	67.08711	95.02557
12-month	67.11495	94.72434
24-month	64.19685	92.26897
36-month	61.60677	91.85531
48-month	59.92267	91.69216
60-month	58.61236	91.55210
72-month	57.60458	91.44462

Note: Δr is the first difference of logarithm of the real exchange rate, and Δn is the first difference of logarithm of the nominal exchange rate. Contribution of a nominal shock is 100 minus the contribution of a real shock.

Figure 1. Nominal and Real Exchange Rates



Source: International Financial Statistics (IFS), IMF, 2015.

Figure 2. Impulse Response Functions