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Real or Nominal Shock- What Drives the Exchange Rate Movements in Bangladesh?

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Abstract

This paper converses a primary element responsible for exchange rate movements of the US dollar against the Bangladeshi Taka. The dynamic effects of real and nominal shocks are scrutinized through conducting a structural vector autoregression (SVAR) model of real and nominal exchange rates with the assumption of the long-run neutrality restriction of nominal shocks on real exchange rate. In order to identify how these factors influence exchange rate variations, this approach allows us to decompose exchange rate movements into two components, real and nominal factors. This empirical analysis demonstrates the effect of a real shock on the real and nominal exchange rate is of a persistent nature, resulting in a long-run real appreciation and the effect of a nominal shock on the nominal exchange rate demonstrates that nominal shock takes around five months to maintain negative direction (depreciation) in the nominal exchange rate in Bangladesh.

Key Words: Exchange Rates, Nominal Shocks, and Real Shocks.

JEL Classification : F31, O24, C32

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I. Introduction

With the onset of flexible exchange rate regime since 31st May, 2003[1], Bangladesh Bank, the central bank of Bangladesh, has liberalized the exchange rates[2] to achieve the goals 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 exchange rate. Dollarization may reduce a 'fear of floating' by partially reducing the adverse impact of exchange rates fluctuations on the economy at the aggregate level. Viaene and Vries (1992) argued that, for the developing countries, exchange 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). There are several causes behind the emergence of such fear, as- the lack of credibility associated with the high volatility in exchange rates, high pass-through from exchange rates to domestic prices, and the sizable foreign currency dominated debt (Ok, Kakinaka, and Miyanamoto, 2010). Thus, exchange rates 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 rates is due to the real shocks, such as resource endowments, technological advancement, preferences; and nominal shocks, such as money supply[3]. In order to identify the real and nominal exchange rates 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 effect on real exchange rates. Lastrapes (1992), Enders and Lee (1997), Chowdhury (2004), and Ok et al. (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 rates regime has been shifting toward nominal exchange rates flexibility, although often managed due to the 'fear of floating' (Calvo and Reinhart, 2002). Moreover, since the real exchange rates are typically considered as measures of international competitiveness, some emerging

[1]Exchange Rate Circular No. 01, Date: 29th May 2003, Bangladesh Bank.

[2]Exchange rate, in this paper, refers to the price of one unit of national currency in terms of foreign currency- US dollar. Following this definition a decline in the exchange rate would represent a depreciation, and vice-versa.

[3]Lastrapes (1992) and Evans and Lothian (1993) among others interpret temporary shocks as nominal disturbances and permanent shocks as real disturbances. Ha et al. (2007) regard real shocks as fundamental disturbances, and nominal shocks as non-fundamental disturbances.

countries seem to pursue the exchange rates 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 model with the long-run neutrality restriction of Blanchard and Quah (1989) in order to investigate sources of exchange rates movements by decomposing the exchange rates series into the real and nominal disturbances. Lastrapes (1992) for six developed countries (United States, Germany, United Kingdom, Japan, Italy and Canada) points out that real shocks dominate nominal shocks for both exchange rates series over short and long frequencies. Kim and Enders (1991) examine real and nominal causes of real exchange rates movements in the Pacific Rim nations and show some evidence of the long-run neutrality of nominal shocks. Clarida and Gali (1994), using data of four developed countries (Germany, Japan, Britain, and Canada) find that demand shocks, to national saving and investment, explain the majority of the variance in real exchange rates fluctuations; while supply shocks explain very little. Chen and Wu (1997) use the data for four Pacific Basin Countries (Japan, Korea, Taiwan and Philippines) 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. The work of Dibooglu and Kutan (2001), using monthly data from January 1990 through March 1999, demonstrates that nominal shocks are a dominant source in determining the real exchange rates movement in Poland, while real shocks are dominant in Hungary. Wang (2004) employs structural decomposition technique in his study and finds that relative real demand and supply shocks account for most of the variation in real exchange rates changes and supply shocks are as important as nominal shocks in accounting for real exchange rates fluctuations for China using yearly data from 1980 to 2002. Chowdhury's (2004) analysis for six emerging countries (Chile, Colombia, Malaysia, Singapore, South Korea and Uruguay) also show that real shocks dominate nominal shocks for the exchange rates series over the sample period of January 1980 to December 1996. Ha, Lee, and Cheong (2007) also find that exchange rates fluctuations are primarily a result of real shocks in Korea. 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 best of our knowledge, there is no study on Bangladesh that examines the sources of movements on real and nominal exchange rates using bivariate SVAR. This paper attempts to decompose real and nominal exchange rates fluctuations into real and

nominal factors through applying a 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), Ha et al. (2007), and Ok et al. (2010). On the other hand, the effect of a nominal shock on the nominal exchange rates demonstrates that nominal shock takes around five months to maintain negative direction (depreciation) in the nominal exchange rates in Bangladesh. This result is consistent with the argument of Dornbusch (1976) that raise in nominal money supply leads a proportionate rise (depreciation) in nominal exchange rates in the long-run.

The remaining of this paper is organized as follows. Section 2 describes recent development of exchange rates, starting from the onset of flexible exchange rates regime, in Bangladesh. Section 3 conducts empirical analysis of exchange rates movements through decomposing the fluctuations of exchange rates into nominal and real components for the Bangladeshi Taka. The last section, Section 4, provides the conclusion along with several policy recommendations.

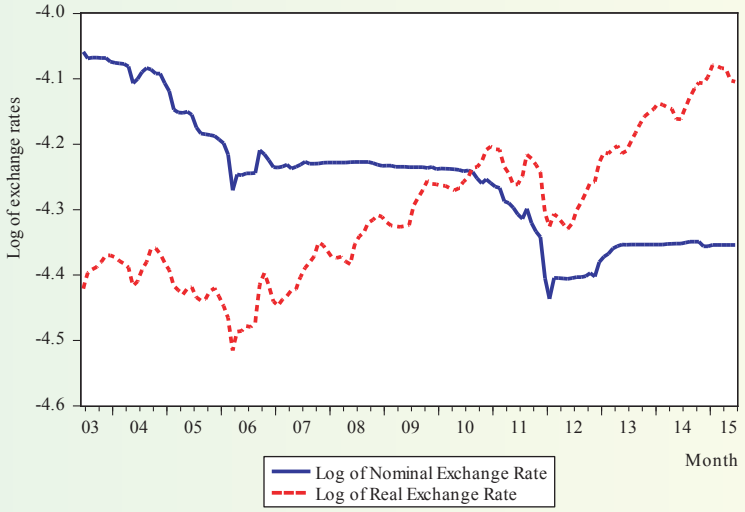
II. Exchange Rates Regime and Developments in Bangladesh- A Historical Overview

The exchange rates system of Bangladesh witnessed different regimes. Primarily in January 1972, just after the liberation, Bangladesh pegged its exchange rates with the British Pound Sterling (Aziz, 2008). However, the sterling started to float against the dollar after the breakdown of the Bretton Woods system and then taka also started to float through its link to the sterling. Secondly, in August 1979, the monetary authority started to peg the exchange rates to a basket of major trading partners' currencies instead of pegging with a single currency. But the sterling still used as the intervening currency (Hossain and Alauddin, 2005). Since 1983, the monetary authority replaced the US Dollar as intervening currency instead of the Pound Sterling. From the independence to 1979, Bangladesh followed a fixed exchange rates system and between 1979 to mid-2003, it followed a managed floating exchange rates regime. The prime goal of these two regimes is to devaluation of the domestic currency, in order to maintain a stable real exchange rates and avoid overvaluation of domestic currency (Aziz, 2012). Finally, from 31 May, 2003 the country has officially introduced a kind of clean floating exchange rates policy by making it fully convertible on the current account, but the controls on capital account are still in place. Regime classification suggests that Bangladesh maintained a de facto managed floating regime by intervening in the foreign exchange

market on a regular basis. IMF also claimed that Bangladesh still maintained a de facto managed floating regime (Hossain and Ahmed, 2009).

Monthly nominal and real exchange rates of USD per Bangladeshi Taka from June 2003 to June 2015 is shown in Figure 1. From the beginning of June 2003 the nominal exchange rates were volatile and depreciating trend had been visible along with some fluctuations till December 2005. After that period, the economy observed the most volatility in the nominal exchange rates during the period of January 2006 to November 2006. Later that period, the nominal exchange rates remained nearly stable for a long period of time from July 2007 to August 2010. It started depreciating from September 2010 till January 2012, and the sharpest depreciation was observed in November 2011 resulting from high import demand and increase in fuel prices (BB Annual Report FY12). The economy again observed an almost stable nominal exchange rate till November 2012. Strong growth in the flow of inward remittances, increase in export earnings and sluggish import payments worked behind the sharp rise in nominal exchange rate during December 2012 to June 2013 (BB Annual Report FY13). Then it was stable up to June 2015 with a little bit of fluctuation.

Figure 1: Nominal and Real Exchange Rates



Source: International Financial Statistics (IFS), IMF.

III. Empirical Analysis

III.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 are mainly due to non-fundamental disturbances, such as nominal money supply shocks and the exchange rates depreciation or appreciation.

To provide some important perceptions on the sources of real and nominal exchange rates 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 rates under certain assumptions (Enders, 1997; Wang, 2004). This restriction could be appropriate since the real exchange rates, as a relative price between domestic and foreign prices, is consistent with conventional economic models of exchange rates movements (Lastrapes, 1992).

The long-run neutrality restriction on SVAR models is applied for various issues, such as the identification of fundamental economic shocks (Blanchard and Quah, 1989; Shapiro and Watson, 1988; King, Plosser, Stock, and Watson, 1991; Lastrapes, 1992; Clarida and Gali, 1994; Wang, 2004; Chen and Wu, 1997; Chowdhury, 2004; Enders and Lee, 1997; Ok et al. 2010). This paper does not statistically test the neutrality restriction in the SVAR model. However, the restriction is simply required to make the structural disturbances just-identified and to examine the dynamic behaviors of these shocks on real and nominal exchange rates.

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:

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

where r_t and n_t are the natural log of real and nominal exchange rates in period t, respectively; e_{rt} the real shock in periodt; $e_{nt}$the nominal shock in period t; $\Delta$the first difference operator; $A_{ij}(L)$ a polynomial in the lag operator . 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 rates, we consider the restriction that the sum of the coefficients in $A_{12}(L)$ is equal to zero, that is:

$$\sum_{k=o}^{00} \alpha_{12}(k) = 0 \qquad (2)$$

where $a_{12}(k)$ is the -th coefficient in $A_{12}(L)$ and represents the effect of the nominal shocks, e_{nt} , on the first-difference of the real exchange rates, 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.

Some literature treats real and nominal shocks in a different, but related way under the assumption of the long-run money neutrality. For example, Chowdhury (2004) interprets the two types of shocks as permanent and temporary disturbances. The main feature of the permanent shock is that its effect on the time series lasts forever and thus never dies out, while the effect of temporary shock is of a transitory nature and dies out over time. Moreover, Ha et al. (2007) call the two types of shocks as fundamental and non-fundamental disturbances. The fundamental shock originates from structural macroeconomic conditions, resulting in permanent changes in real and nominal exchange rates. In contrast, the non-fundamental shock stems from monetary, non-fundamental factors, and has a permanent effect on nominal exchange rates but only a temporary effect on real exchange rates due to the long-run money neutrality.

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 rates 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 rates system. In 1994, the Taka was made convertible for current account transactions (Ahmed and Sattar, 2004). And finally exchange rates became fully flexible in May 2003. Moreover, Chen and Wu (1997) mention some potential problems related to the interpretation of the two structural shocks as real and nominal shocks. First, nominal shocks could have permanent impacts on real exchange rates, as emphasized in the work of Baldwin (1988). Although we admit this issue, the SVAR model with the long-run neutrality restriction would be appropriate for our primary purpose, as long as

this impact is relatively small compared to that of real shocks, as shown in Blanchard and Quah (1989). Second, in reality exchange rates are subject to various types of shocks, so that the model with only two structural shocks may be inappropriate. 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 rates movements as an approximate methodology. Moreover, considering the two shocks is a well-known/celebrated means of generalizing the outcomes of other excluded, and plausible, shocks.

III.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 2015. Nominal exchange rates series considered is average-of-period rates and is expressed as US dollar per national currency units. The real exchange rate is derived by adjusting the nominal exchange rates 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 rates series rt is generally constructed as $r_t = n_t - p_t^* + p_t$, where nt is the log of the nominal exchange rates considered from average-of-period rates, pt and p_t^* are the log of the domestic price level and the log of US price level, respectively. Thus, the real exchange rates 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 rates is greater than that of nominal exchange rates in Bangladesh. The average real appreciation rate is larger than the average nominal depreciation rate in Bangladesh. Table 2 shows the correlations among the first-difference log of nominal exchange rates, real exchange rates and domestic price level for Bangladesh. Nominal exchange rates are positively correlated and statistically significant with real exchange rates in terms of monthly returns. Moreover, statistically significant association can be found between inflation rate and real appreciation as well as inflation rate is also associated with nominal appreciation in Bangladesh.

III.3. Estimation

In order to conduct the basic estimation of the SVAR model, there are several preliminaries needed to do. 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). Since the real exchange rates series is non-stationary, it implies that purchasing power parity (PPP) appears to be violated in the log-run for Bangladesh within the given sample period. This result could be consistent with the argument that the long-run PPP does not hold for most emerging economics, although it is controversial whether the long-run PPP holds for developed economics (Gan, 1994; Taylor, 1995; Calvo and Reinhart 1995; Chowdhury, 2004; Ok et al. 2010).

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.

III.4. Impulse Response Functions

In order to investigate the effect of each type of shocks 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 rates to one standard deviation of real and nominal shocks, while the second panel of Figure 2 shows the dynamic response of nominal exchange rates 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 rates. This effect increases up to 12 months, after that the accumulated response of real exchange rates gradually declines and stabilizes in the long horizon. Thus, the effect of a real shock on the real exchange rates 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 persuades an immediate accumulated positive response in the real exchange rates. This response peaks at 2 months horizon and die out at 8 months horizon. It clearly reflects the identification restriction; the nominal shock has no effect on real exchange rates 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 rates. This effect peaks at 11 months, after these horizons the response of nominal exchange rates gradually declines and stabilizes in the long horizon. Thus, the effect of a real shock on the nominal exchange rates 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 rates to a real shock is very similar to that of the real rate. This suggests that permanent changes in the real exchange rates due to real shocks mainly occur through nominal exchange rates changes. On the other hand, one standard deviation of nominal shock persuades an immediate accumulated positive response in the nominal exchange rates. This response peaks at 2 months and dies out before 5 months horizon. After that it has negative response in the nominal exchange rates 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 rates in Bangladesh. This result is consistent with the argument of Dornbusch (1976) that raise the idea that nominal money supply leads a proportionate rise (depreciation) in nominal exchange rates 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 rates can be discussed in the framework of Harrod-Balassa-Samuelson (Harrod, 1933; Balassa, 1964; Samuelson, 1964) argument- that the real exchange rates 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. This Harrod-Balassa-Samuelson effect has been found consistent with the case of Bangladesh. In addition, accelerated structural reforms and market liberalization, as observed in many emerging market economies since the late

1980s, are found to have led to a significant Harrod-Balassa-Samuelson effect (Ito et al. 1999; Agenor, 1998; Chinn, 2000).

Furthermore, the study has produced evidence that real shock dominates the nominal shocks in both exchange rates series for Bangladesh. Table 6 reports[4] that the magnitude of response of real exchange rates due to real shock (0.0176) has been found to be greater than the response of nominal exchange rates (0.0147). On the other hand, the magnitude of response of nominal exchange rate due to nominal shock is 0.0026 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).

III.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 rates 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 dynamics 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 7. Table 7 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 rates is 68.88 percent at the horizon of one month, 64.87 percent at the horizon of four month, 61.03 percent at eight month and reaches at 53.75 percent at an increased forecasting horizon of 72 months. On the other hand, the relative contribution of a real shock explains about 99.78 percent of the variation of nominal exchange rates at the horizon of one month, 95.57 percent at four month, 92.42 percent at eight month, 91.47 percent at twelve month, and reaches at 89.04 percent increase in forecasting horizon of 72 months. It has clear evidence that real shock dominates nominal shock in both real and nominal exchange rates for Bangladesh. The relative contribution of a real shock in explaining the variation of nominal exchange rates is greater than that of real exchange rates, it might be

[4] Table 6 represents Equation (1) mentioned in the model specification part. Table 6 has been derived from Table 5 which represents the long-run response patterns of the variables included into the Structural VAR model.

the case that real disturbances quickly capture most of the nominal exchange rates 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).

IV. Conclusions

The sources of exchange rates 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 2015. It has been mentioned earlier that our paper assumes two structural shocks: real shock and nominal shock. Furthermore, we assume nominal shock has no long-run effect on real exchange rates. 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 (consistent with among others Lastrapes, 1992; Enders and Lee, 1997; Chowdhury, 2004; Ha et al. 2007; Ok et al. 2010). On the other hand, the effect of a nominal shock on the nominal exchange rates demonstrates that nominal shock takes around five months to maintain negative direction (depreciation) in the nominal exchange rates in Bangladesh. This result is consistent with the argument of Dornbusch (1976) that raise in nominal money supply leads a proportionate rise (depreciation) in nominal exchange rates in the long-run.

A significant impact of real shock on exchange rates could provide some implications from a policy point of view. As Bangladesh now adopts the de facto manage floating exchange rate regime the objective of monetary and exchange rate policies should be to make an effort in offsetting the effect of real shock through sterilization of foreign reserve outflow or raise 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 arise difficulties to capture any possible shock. Notwithstanding, the study believes that the findings of this paper highlight some important policy implications of the exchange rates movement in Bangladesh; and hopes 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

	Δ r	Δ n
Average	0.0022	-0.0021
Standard Deviation	0.0145	0.0106

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

	Δ r	Δ n	Δ p
Δ r	1	-	-
Δ n	0.76	1	-
	(13.83)		
Δ p	0.60	0.02	1
	(8.97)	(0.2 8)	

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	-1.83	-1.80	-10.52*	-10.52*
r	-0.53	-0.40	-8.39*	-7.97*

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 (SBC). * represents statistical significance at 1 percent.

(SBC). * 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	5.54	0.7493	0	H_0: r = 0* H_A: r = 1	5.33	0.7001	0
H_0: r ⩽ 1 H_A: r > 1	0.21	0.6464	0	H_0: r = 1 H_A: r = 2	0.21	0.6464	0

Note: The λ_{trace} and λ_{max} 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: Structural VAR Estimates

Estimation method: method of scoring (analytic derivatives)
Convergence achieved after 6 iterations
Structural VAR is just -identified

Model: Ae = Bu where E[uu']=I
Restriction Type: long -run text form
Long -run response pattern:

C(1)	0
C(2)	C(3)

	Coefficient	Std. Error	z-Statistic	Prob.
C(1)	0.017590	0.001087	16.18641	0.0000
C(2)	0.014711	0.000937	15.69264	0.0000
C(3)	0.002630	0.000162	16.18641	0.0000

Log likelihood 872.3870

Estimated A matrix:

1.000000	0.000000
0.000000	1.000000

Estimated B matrix:

0.010960	0.007366
0.010949	0.000511

Table 6: Real and Nominal exchange rate equations

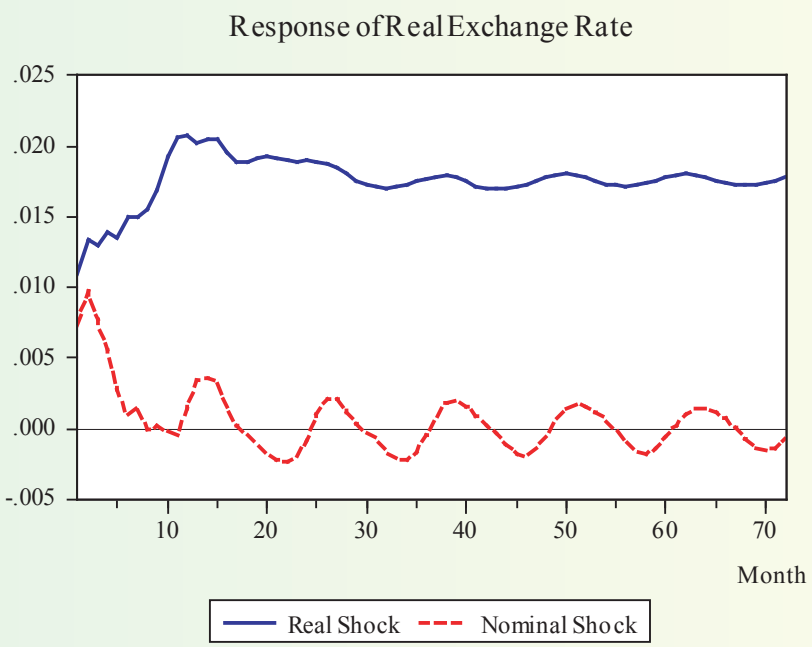
Real exchange rate equation	$\Delta r_t =$	0.0176 e_{rt} (0.0000)	
Nominal exchange rate equation	$\Delta n_t =$	0.0147 e_{rt} (0.0000)	+ 0.0026 e_{nt} (0.0000)

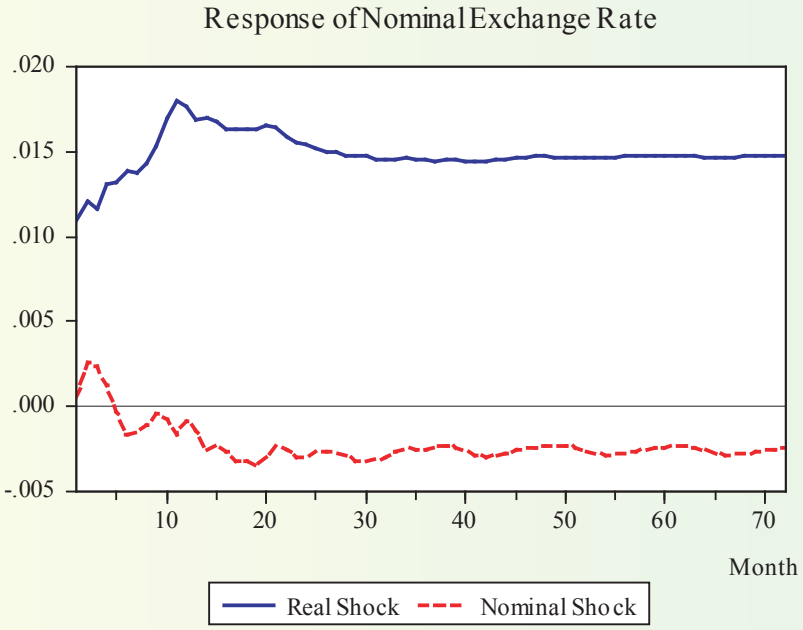
Table 7: Variance Decompositions of Real and Nominal Exchange Rates

Forecast Horizon	Relative Contribution of Real Shock to	
	Δ r	Δ n
1-month	68.88	99.78
4-month	64.87	95.57
8-month	61.03	92.42
12-month	61.70	91.47
24-month	58.94	89.56
36-month	56.77	89.31
48-month	55.43	89.19
60-month	54.47	89.10
72-month	53.75	89.04

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 2: Impulse Response Functions




Response of Nominal Exchange Rate
.020
.015
.010
.005
.000
-.005
10
20
30
40
50
60
70
Month
Real Shock
Nominal Shock