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Exchange Rate Pass-Through in Bangladesh

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Exchange Rate Pass-Through in Bangladesh

Mainul Islam Chowdhury and Syed Fahad Siddique[1]

April 2006

Abstract

This paper estimates the extent of exchange rate pass through to domestic inflation in Bangladesh based on McCarthy's (1999) approach of a recursive VAR model using data from July 1997 to March 2005. The Impulse Response Functions and Variance Decompositions show that exchange rate fluctuation does not have any significant effect on WPI or CPI and the forecast error variances of WPI and CPI are mostly influenced by quantum index of industrial production which is used as a proxy for demand shocks. In case of WPI none of the other variables in the model has any significant impact and over 12 percent of CPI error variance is attributed to WPI inflation.

Keywords: Pass-through, Exchange rate, and Vector Autoregression (VAR).

JEL Classification: E31, F31

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Exchange Rate Pass-Through in Bangladesh

1. Introduction

The Bangladesh Bank is responsible for formulation and implementation of monetary policy in Bangladesh. According to the Bangladesh Bank Order of 1972, major functions of monetary policy in Bangladesh are: (1) to maintain reasonable price stability, (2) to ensure a stable balance of payment position and maintain an external competitiveness of the Bangladesh Taka, and (3) obtain sustained economic growth through increased production and employment. Therefore, two major mandates of the Bangladesh Bank are to maintain the par value of the currency (Bangladesh Taka, BOT or taka for short) and stabilizing the domestic price level. It is generally argued that any devaluation of the currency creates an upward pressure on inflation. It has long been an interest for researchers to find the degree to which exchange rate movements are reflected in prices. The change in domestic prices that results from a change in the exchange rate is referred to as the exchange rate pass through. Traditionally this phenomenon was defined as the percentage change in the domestic-currency price of an imported good resulting from a one per cent change in the nominal exchange rate between the exporting and importing countries. This definition has changed over time to include other types of prices such as consumer prices. Textbook models normally assume a one-for-one response of import prices to exchange rates, which is known as complete exchange rate pass through, however, in reality exchange rate pass through are rarely complete. It is important for a country to assess the extent of exchange rate pass-through to understand, design and conduct monetary policy better.

This paper estimates the extent of exchange rate pass through to domestic inflation in Bangladesh based on McCarthy's (1999) approach of a recursive VAR model. We generate impulse-response functions (IRF) to quantify the effect of an exchange rate shock on Wholesale Price Index (WPI) and Consumer Price Index (CPI). We also use variance decomposition (VDC) to see the proportion of the movements in a sequence due to its own shock versus shocks to the other variables.

The IRFs and VDCs show that exchange rate fluctuation does not have any significant effect on WPI or CPI inflation and the forecast error variances of WPI and CPI inflation are mostly influenced by quantum index of industrial production which is used as a proxy for demand shocks. In case of WPI none of the other variables in the model has any significant impact and over 12 percent of CPI error variance is attributed to WPI inflation.

The paper is organized as follows. Section 2 will survey the literature on the inflationary effect of exchange rate changes. Section 3 describes the methodology followed by the sources and features of data in section 4. Results of the impulse response function and variance decomposition are presented in section 5 while section 6 concludes.

2. Literature Review

We came across a number of theoretical and empirical papers on exchange rate pass through. However, very little was learned of exchange rate pass through to domestic prices in case of Bangladesh from the literature.

David Hendry (2001) proposed a model for inflation in UK and it treated the exchange rate as one of the variables that can cause domestic inflation. In his study he found that there was no evidence that excess money causes inflation. In the context of UK, Hendry found that the main proximate inflation determinants were the excess demand for goods and services, world price inflation and the short-long interest-rate spread. Excess money or exchange rate change do not affect inflation rate that much. Thus in case of UK, Hendry did not find any effect of exchange rate change on inflation.

Ashok Bhundia (2002) analyzed the degree to which fluctuations in the nominal exchange rate pass-through to consumer prices in South Africa. He found that the inflationary impact of exchange rate depreciations in South Africa has been absorbed at intermediate stages of production. But the shocks to producer prices have had a

considerable impact on inflation. The author concluded that nominal shocks on exchange rate follow standard exchange rate pass-through dynamics but when real shocks cause exchange rate to depreciate, inflation effect is much smaller.

Michael Devereux (2000) showed that nominal movements in exchange rates typically feed quickly into price levels in emerging-market economies, or at least do so a lot more quickly than in OECD economies. The reason behind this is the presence of credible monetary policy in the OECD countries. For example, since 1991, Canada has been following a strict inflation targeting policy. As a result Canada experienced 1 to 3 percent inflation over the last decade. The response of domestic prices to the large currency depreciations experienced by Canada in the 1990s was much smaller than expected. The paper also showed the results using monthly consumer price index (CPI) inflation rates on lagged exchange rate changes vis-à-vis the U.S. dollar for countries like United Kingdom, Canada, Mexico, and Korea. From the result it is apparent that for Canada and the United Kingdom, the lagged exchange rate change has no explanatory power, at the monthly frequency, for CPI inflation. For Mexico and Korea, the coefficient on lagged exchange rate changes is highly significant. So he hypothesized that exchange rate pass-through is very rapid for emerging markets, but slow for advanced economies. He also mentioned that most literature on monetary policy on open economies has been based on the premise that the rate of CPI inflation is instantaneously affected by movements in exchange rates. But this hypothesis is not wholly accurate, except for emerging-market economies. There might be lagged inflationary effect of exchange rates even in an advanced economy.

Bailliu and Fujii (2004) in their paper investigated the question of whether a transition to a low-inflation environment, induced by a shift in monetary policy, results in a decline in the degree of pass-through of exchange rate movements to consumer prices. They used panel-data approach. The empirical research from a panel-data set of 11 industrialized countries over the period from 1977 to 2001, supported the hypothesis that exchange rate pass-through declines with a shift to a low-inflation environment brought about by a change in the monetary policy regime. The result suggests that the pass-

through to consumer price inflation declined following the inflation stabilization that occurred in many industrialized countries in the early 1990s. This conclusion also matches with the one by Devereux as both suggest that countries with strong monetary policy can actually lessen the pressure of exchange rate changes on consumer prices.

Jonathan McCarthy (1999) analyzed the impact of exchange rate and import prices on domestic Producer Price Index (PPI) and CPI in six industrialized OECD countries using data from 1976:1 to 1998:4. He used a recursive VAR framework in his analysis. From the impulse response function and variance decomposition he found that the exchange rate has a modest effect on domestic price over the post-Bretton Woods era. Another finding of his paper is that the pass through is stronger in countries with a large import share.

Leigh and Rossi (2002) followed McCarthy's (1999) VAR framework to analyze the exchange rate pass through in Turkish economy. They found that the pass through to wholesale prices is more pronounced than CPI and that the impact of the exchange rate on prices is mostly felt in the first four months and is over after about a year. Hyder and Shah (2004) followed McCarthy and Leigh and Rossi in analyzing exchange rate pass through in Pakistan. They found similar results in line with Leigh and Rossi. They also found that pass-through to domestic prices are much stronger in higher inflationary environment relative to lower inflationary environment.

Therefore from the above discussion it is evident that the experience is mixed. Exchange rate pass through is more pronounced in emerging market economies in the absence of credible monetary policy. But a stable monetary policy with a low inflationary environment seems to lessen the pressure of exchange rate changes on consumer prices.

3. Methodology

We use a five variable recursive Vector Autoregressive (VAR) approach following McCarthy (1999) and Leigh and Rossi (2002) to examine the pass through of exchange rate to domestic prices. To recover the structural shocks from the VAR residuals we have to use the Cholesky decomposition where the variables are to be ordered in a particular sequence so that variables placed higher in the ordering have contemporaneous impact on the variables than those lower in the ordering, and not vice-versa. The ordering of the endogenous variables is as follows: oil price (π^{oil}) representing international supply shock, Quantum Index of Industrial Production *(y)* representing the demand shock, nominal exchange rate *(e)* representing nominal exchange rate shock, wholesale price index (π^{WPI}) and consumer price index (π^{CPI}).[2] The system can be represented as follows.

$$\pi_t^{oil} = E_{t-1}[\pi_t^{oil}] + \varepsilon_t^{oil}$$
$$y_t = E_{t-1}[y_t] + \alpha_1 \varepsilon_t^{oil} + \varepsilon_t^{y}$$
$$e_t = E_{t-1}[e_t] + \beta_1 \varepsilon_t^{oil} + \beta_2 \varepsilon_t^{y} + \varepsilon_t^{e}$$
$$\pi_t^{WPI} = E_{t-1}[\pi_t^{WPI}] + \gamma_1 \varepsilon_t^{oil} + \gamma_2 \varepsilon_t^{y} + \gamma_3 \varepsilon_t^{e} + \varepsilon_t^{WPI}$$
$$\pi_t^{CPI} = E_{t-1}[\pi_t^{CPI}] + \delta_1 \varepsilon_t^{oil} + \delta_2 \varepsilon_t^{\Delta y} + \delta_3 \varepsilon_t^{e} + \delta_4 \varepsilon_t^{WPI} + \varepsilon_t^{CPI}$$

The system incorporates the dynamic effect of an exchange rate shock on prices along the supply chain. Inflation at any particular stage is assumed to be comprised of several different components. The first is the expected inflation at that stage; the second and third components are the supply and demand shocks, fourth is the exchange rate shock and finally there are shocks due to changes in WPI and CPI index. Therefore, there is no contemporaneous feedback in the model. The time period *t* corresponds to one month. $E_{t-1}[\ ]$ refers to the expectation of a variable conditional on information available at period *t-1*.

[2] We include oil price in our model as petroleum constitutes about 12 percent of Bangladesh's import and is used in different industries as an input apart from being consumed directly by households and the transport sector. Therefore any change in the international oil price will have a considerable impact on our import price index and subsequently transmit to the consumer price level via different channels.

McCarthy (1999) and Hyder and Shah (2004) also incorporated money supply (M2) as a policy variable in the VAR model. But in our case inclusion of M2 destabilizes the model which would in turn make the impulse response standard errors invalid. Therefore we did not include M2 in our model. We also used different VAR models using seasonally adjusted series of the chosen variables but our original VAR model seems robust to these changes.

4. Description of Data

Oil Price Inflation: For calculating oil price inflation we took the average of U.K. Brent and Dubai Fateh and converted the average into taka by multiplying by the prevailing Tk/USD exchange rate at the time. The data is taken from the *Economic Trends*.

Quantum Index of Industrial Production (1988-89 = 100): This variable is used as a proxy of real GDP to represent the demand factors as monthly GDP data is not available. The data is taken from the *Monthly Statistical Bulletin*.

Nominal Exchange Rate: We used nominal Tk/USD exchange rate. The data is taken from the *Economic Trends*.

Wholesale Price Index (1969-70 = 100): Wholesale prices are the prices ruling at the wholesale market of the country. The monthly wholesale price index is intended to measure price changes over time at the wholesale markets which are not due to change in the quality of goods, terms of delivery etc. The commodities are selected on the basis of pre-determined specifications and these include imported items sold at domestic market, export items up to the custom frontiers and domestic products of both agricultural and industrial origin by their types and stages of processing. The data is taken from the *Monthly Statistical Bulletin*.

Consumer Price Index (1985-86 = 100): CPI reflects the average change over time in the prices of a specified set of final commodities and services representing the market

basket of a given group off consumers. The data is taken from the *Monthly Statistical Bulletin*.

Bangladesh's national accounts are compiled on an annual basis, so that only a few, mostly monetary variables, are available at high frequency. In order to have a reasonably large sample size, we used monthly data from July 1997 to March 2005 (93 observations), which limits our choice of variables to monetary variables, and the quantum index that serves as a proxy for activity. It may be noted that as of January 1972, the exchange rate of Bangladesh's currency 'Taka' was fixed with the British Pound Sterling. As the Pound Sterling was floated with dollar later in 1972, Taka was also floated with dollar via Pound Sterling. In 1979 Taka was pegged with to a basket of currencies of Bangladesh's major trading partners with Pound Sterling as the intervention currency which was later replaced by US Dollar in 1983. This exchange rate arrangement continued till May 2003. Bangladesh adopted the floating exchange rate system since end May 2003.[3] Therefore we should have used only post May 2003 data for our analysis but we could not do so as the number of observations would have been insufficient. We selected the sample period depending on the availability of all the series.

4.1 Preliminary Data Analysis

In figure 1 we plot the log of exchange rate and log of CPI. From the figure we can see that though both exchange rate and CPI have upward trends, exchange rate does not seem to affect CPI much except for the recent floating exchange rate regime starting from June 2003. We also used pair wise Granger causality test to see whether exchange rate Granger causes CPI for different sample periods. Table 1 presents the results of the Granger causality test which shows that exchange rate does not Granger cause CPI not even in the floating exchange rate regime. On the other hand we can not reject the null of

[3] See Habib and Kabir (2003) for details.

'CPI does not Granger cause exchange rate' at 10 percent and 2 percent level for the full sample period and the floating exchange rate period respectively.[4]

Figure-1

Log of Exchange Rate and Log of CPI

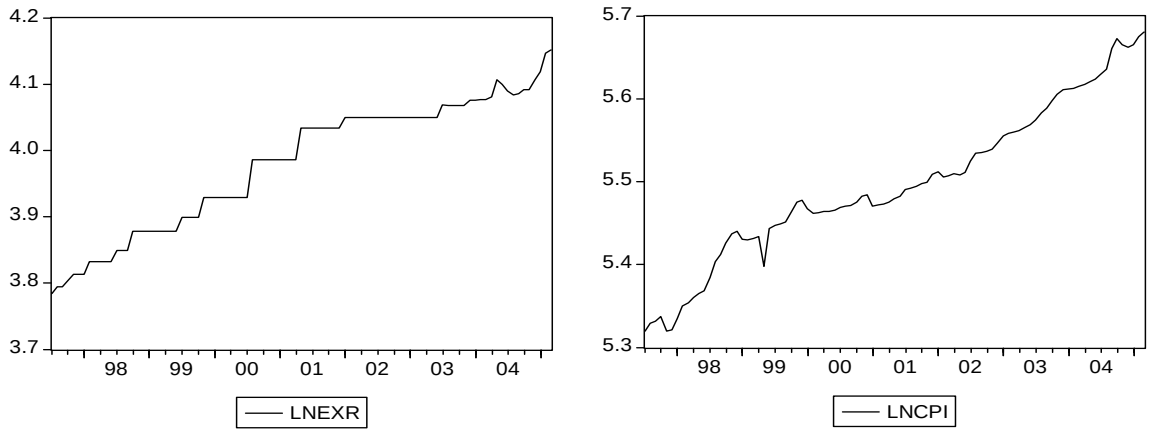


Table 1

Pairwise Granger Causality Tests

Sample: 1997:07 2005:03
Lags: 12

Null Hypothesis:	Obs	F-Statistic	Probability
LNCPI does not Granger Cause LNEXR	93	1.66647	0.09420
LNEXR does not Granger Cause LNCPI		0.96263	0.49241

Sample: 1997:07 2003:05
Lags: 12

Null Hypothesis:	Obs	F-Statistic	Probability
LNCPI does not Granger Cause LNEXR	71	1.24695	0.28209
LNEXR does not Granger Cause LNCPI		1.21290	0.30345

Sample: 2003:02 2005:03
Lags: 12

Null Hypothesis:	Obs	F-Statistic	Probability
LNCPI does not Granger Cause LNEXR	26	2165.71	0.01679
LNEXR does not Granger Cause LNCPI		0.79434	0.71619

[4] To run the Granger causality test for the floating exchange rate regime we used sample period from February 2003 (instead of June 2003) to March 2005 to allow for 12 lags. We also run pair wise Granger causality test for exchange rate and WPI but failed to find any causality in either direction.

Before using the data in the estimation of VAR, we need to know the order of integration of all the variables. Several unit root tests[5], such as Augmented Dickey-Fuller (ADF), Phillips-Perron (PP), and Kwiatkowski-Phillips-Schmidt-Shin (KPSS) are used on the log level of all the variables to determine the order of integration for each series. The results of unit root tests are shown in the following table.

Table-2
Results of Unit-Root Tests

Variables (in log levels)	Without Trend			With Trend			Decision
	ADF	PP	KPSS	ADF	PP	KPSS	
Oil Price	I(1)	I(1)	I(1)	I(1)	I(1)	I(0)	I(1)
Quantum Index	I(1)	I(1)	I(1)	I(1)	I(0)	I(0)	I(1)
Nominal Exchange Rate	I(1)	I(1)	I(1)	I(1)	I(1)	I(1)	I(1)
WPI	I(1)	I(1)	I(1)	I(1)	I(1)	I(1)	I(1)
CPI	I(1)	I(1)	I(1)	I(1)	I(1)	I(1)	I(1)

Notes:
1. Lag length for ADF tests are decided based on Akaike's information criterion (AIC).
2. Maximum Bandwidth for PP and KPSS test are decided based on Newey-West (1994).
3. All the tests are performed on the basis of 5 percent significance level.

From table 1 we can conclude that all the variables are I(1) at the logarithm level and the VAR is estimated in log level with 12 lags based on Akaike's Information Criterion (AIC).

5. Empirical Results

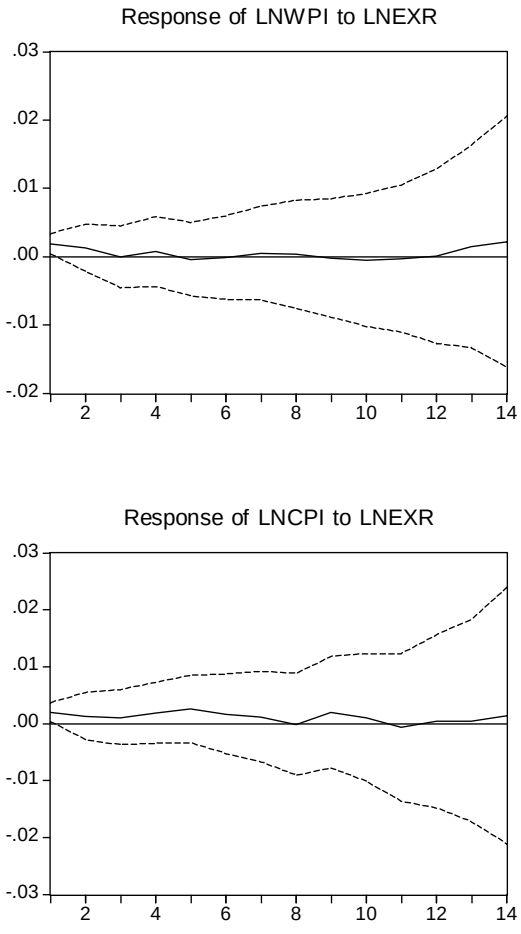
To examine the impact of an exchange rate shock on domestic prices the Impulse Response Functions (IRF) and Variance Decompositions (VDC) are generated using EViews. The IRFs show the response of each variable in the system to shock from system variables. The VDCs show the portion of the variance in the forecast error for each variable due to innovations to all variables in the system. Figure 1 shows the impulse response functions of WPI and CPI to a one standard deviation innovation in the nominal exchange rate. It is evident from the figure that inflationary effect of exchange rate changes is rather moderate. Both WPI and CPI increase immediately as a result of an

[5] ADF and PP tests are based on the null of unit-roots while KPSS test assumes the null of stationarity.

exchange rate shock though the response is minimal. But the responses are statistically insignificant as the band of standard errors contain the zero line indicating no significant exchange rate pass through.

Figure 2

Impulse Responses to a One Standard Deviation Innovation in the Exchange Rate ± 2 Standard Errors[6]



[6] The dashed lines show two standard error bands.

The forecast error variance decomposition shows the proportion of the movements in a sequence due to its own shocks versus shocks to the other variables in the model. Thus, the variance decomposition provides information about the relative importance of each random innovation in affecting the variables in the VAR. The variance decompositions of WPI inflation are reported in Table 3. Exchange rate shocks explain only about 7 percent of the WPI variance in the first month and about 4 percent in the longer horizon. A little more than 14 percent of the error variance of WPI is explained by its own shocks during longer time horizons. In the very first month the WPI explains about 84 percent of its own forecast error variance. Quantum index explains more than 66 percent of the error variance of WPI in the longer horizon. Therefore exchange rate has very little impact on WPI and demand shocks seem to have most significant impact on WPI error variance.

Table-3

Variance Decomposition of WPI Inflation

Forecast Horizon	Oil Price	Quantum Index	Exchange Rate	WPI	CPI
1	6.20	3.14	6.89	83.74	0.00
2	6.98	9.56	5.50	77.17	0.77
3	9.23	12.86	4.07	71.74	2.08
4	8.21	20.85	3.99	65.07	1.85
5	7.37	27.75	3.57	59.65	1.63
6	6.76	32.83	3.16	54.15	3.07
9	5.66	39.06	2.52	44.82	7.93
12	4.17	51.63	1.80	31.78	10.59
18	4.47	67.94	4.09	14.67	8.80
22	4.40	66.51	4.15	14.35	10.56

The variance decompositions of CPI inflation are reported in Table 4. Like WPI most of the error variance of CPI inflation is explained by demand shocks (over 60 percent). WPI inflation explains a little over 12 percent of the CPI inflation and about 15 percent of the forecast error variance of CPI inflation is explained its own innovations in the long run whereas in the first month it explains 42 percent of the error variance of CPI. Exchange rate does not contain much information about the movement of CPI.

Table-4

Variance Decomposition of CPI Inflation

Forecast Horizon	Oil Price	Quantum Index	Exchange Rate	WPI	CPI
1	24.08	5.93	4.76	23.36	41.85
2	24.36	11.10	4.80	26.72	32.99
3	24.42	14.63	5.13	25.70	30.10
4	23.10	24.16	6.02	23.52	23.18
5	18.98	36.35	7.52	18.67	18.45
6	17.11	40.05	7.71	16.53	18.58
9	13.53	44.13	7.65	17.51	17.16
12	13.49	44.19	7.39	18.62	16.28
18	9.15	57.50	5.77	14.44	13.12
22	7.20	60.22	5.40	12.24	14.92

We should note that our sample period comprises mostly of the pegged exchange rate regime when there was considerable intervention by the central bank to maintain the stability of the foreign exchange market. In Bangladesh the oil prices are also administered. Therefore it may not be unexpected to find a modest and limited exchange rate pass through to domestic prices in Bangladesh. Furthermore the basket contents of WPI and CPI are such that they are not very much affected by any change in exchange rate or fuel prices. In case of WPI the highest weight is given to Agriculture (67.87) within which food group contains a weight of 41.08, raw materials 25.94 and fuel and lighting contains a weight of only 0.85. Under the all industry group, fuel and lighting has a weight of 6.16. Therefore in WPI fuel and lighting has a total weight of 7.01. In case of CPI, food beverage and tobacco contains a weight of 64.47. Weight to non-food items is 35.53 of which gross rent, fuel and lighting contains a weight of 14.98 and transport and communications has a weight of 3.32. Therefore by construction of these indices movements in exchange rate or oil price shocks may not directly pass through to domestic prices in any significant way. Again, during the sample period Bangladesh experienced a low inflationary environment when the average inflation rate was around 5 percent which might have lessened the pressure of exchange rate changes to consumer prices.

6. Conclusion

This paper attempted to measure the nominal exchange rate pass through to wholesale and consumer prices using Mccarthy's (1999) recursive VAR model. We used monthly data from July 1997 to March 2005. For Cholesky decomposition we used the following ordering of the variables: oil price (representing supply shock), quantum index of industrial production (representing demand shock), nominal Tk/USD exchange rate, Wholesale Price Index and Consumer Price Index. To measure the impact of the exchange rate shock on domestic prices impulse response functions and variance decompositions are generated. From the IRFs it is found that an exchange rate shock does not have any significant impact on either WPI or CPI inflation in Bangladesh. This may be an outcome of the managed float regime of the sample period (from July 1997 to May 2003) and of the administered oil prices in Bangladesh. The variance decompositions show that most of the error variance of both WPI (67 percent) and CPI (60 percent) inflation are explained by quantum index. In case of WPI inflation none of the other variables in the model contain any significant information about its future path. On the other hand, WPI inflation can explain 12 percent of the forecast error variance of CPI inflation in the long run. Therefore it appears that demand shock is the major determinant factor for WPI and CPI inflation.

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