British Journal of Business Design & Education
ISSN (Print): 2222-7426, ISSN (Online): 2222-8412
Vol 09 No 01

Exchange Rates „Overshooting": An Empirical Study of Bangladesh and India

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Abstract
Exchange rates are difficult to forecast because the market is continually reacting to unexpected events or news. Even in the absence of any major news, exchange rates adjust through the day as foreign exchange dealers manage their inventories and respond to trades with others who may be better informed. The role of exchange rate changes in eliminating international trade imbalances suggests that we should expect countries with current trade surpluses to have an appreciating currency, whereas countries with trade deficits should have depreciating currencies. Such exchange rate changes would lead to changes in international relative prices that would work to eliminate the trade imbalance. This paper analyses the movement of the exchange rates of Bangladesh and India over the period 1973-98. From the log-linear model of exchange rate finds that Consumer Price Index for both the country is the main variable causing the exchange rate fluctuations during this period. Exports, Imports, Interest Rates and Forward Rates of these countries do result in the movement of the exchange rates.
Keywords: Exchange Rates, Overshooting, Jump variables, Sticky-price, Exchange rate disconnect puzzle, International trade.

1. Introduction

The exchange rate is one of the most sensitive indicators of any country. There are some factors that affect the exchange rate of any country. This paper analyses movement of the exchange rates of Bangladesh and India over the period 1973-98. The Fluctuation of the exchange rate is a normal phenomenon. The exchange rate changes almost in every moment. But the overshooting of the exchange rate is not so common. Rather it depends in the drastically shift or changes in some factors. The trade balance is the main factor that results in the overshooting of the exchange rate. The exchange rate overshoots sooner the country is in the trade deficit with its trading counterpart. The consumers' price index (CPI) does affect the overshooting of the exchange rate too. Whenever the CPI of any country increases relative to the other country the exchange rate between those countries overshoots. Like CPI, the interest rates differentials cause the exchange rate to overshoot.

Over the period 1973-98, the exchange rate between India and Bangladesh has fluctuated. Both India and Bangladesh had trade deficits, but India had more. Both the purchasing power parity and the interest rate parity showed that the actual exchange rates between India and Bangladesh are not what it should be. And thus, these two had an impact in the overshooting of the exchange rates between India and Bangladesh.

2. Literature Review

2.1 Macroeconomic Determinants of Exchange Rates

The traditional empirical literature on exchange rates is based on a two-country framework where the bilateral exchange rate is viewed as the relative price of the monies of the two countries in question. There are many such models, all of which describe the evolution of the exchange rate as a function of a different set of macroeconomic fundamentals, such as prices, money, interest rates, productivity differentials, government debt, terms of trade, and net foreign assets—typically characterized as inter-country differences.

2.2 Main models of exchange rate determination

The monetary approach to exchange rate determination emerged as an important exchange rate model in the 1970s, just as many industrialized countries began to let their exchange rates float. This approach starts from the definition of the exchange rate as the relative price of two monies and attempts to model that relative price in terms of the relative supply of, and demand for, those monies. This model makes several other key assumptions, including that (i) prices are perfectly flexible; (ii) domestic and foreign assets are perfect substitutes; (iii) absolute purchasing-power-parity (PPP) holds at all times; and (iv) the uncovered-interest-parity (UIP) condition holds at all times.The assumption that PPP holds continuously is relaxed in the sticky-price version of the monetary model that originated with Dornbusch (1976). In this approach, PPP holds only in the long run, and there are "jump variables" (i.e., exchange rates and interest rates) that compensate for stickiness in prices and account for the fact that exchange rates can "overshoot" their long-run equilibrium levels.

The portfolio-balance model is a second approach to modeling exchange rates. Relative to the monetary models of exchange rate determination, the key modification of this model is that domestic and foreign assets are no longer assumed to be perfect substitutes. The result is that a currency risk premium intrudes on the UIP condition, and the exchange rate is now determined by the supply and demand for all foreign and domestic assets and not just by the supply and demand for money.

A third theoretical approach to modelling exchange rates that was initiated in the 1980s, and continued more recently in the context of the development of the New Open-Economy Macroeconomics (NOEM) literature, is to formalize exchange rate determination in the context of dynamic general-equilibrium models with explicit micro-foundations, nominal rigidities, and imperfect competition. Early models of this type were referred to as equilibrium models and were essentially an extension (or a generalization) of the flexible-price monetary model that allowed for multiple traded goods and real shocks across countries.

The more recent NOEM models, based on the seminal work by Obstfeld and Rogoff (1995), offer a more rigorous analytical foundation based on fully specified micro foundations. The main disadvantage of using these later models as a basis for empirical work is that the models are often quite sensitive to the particular specification of the micro-foundations. For instance, a key hypothesis like pricing to market is assumed in some models, but not others, and is an important factor in exchange rate behaviour (by determining whether PPP holds in the short run). As pointed out by Sarno (2001), this is problematic, given that there is not, as of yet, a consensus in the profession as to the "correct" or "preferable" specification of the microfoundations.

A final approach to modeling exchange rates that is worth mentioning is one that accords a central role to productivity differentials in explaining movements in the real exchange rate. The real exchange rate is defined as the nominal bilateral exchange rate for two countries adjusted by the relative prices of goods in those countries. Such models, based on work by Balassa (1964) and Samuelson (1964), relax the assumption of PPP and allow the real exchange rate to depend on the relative price of non-tradable, itself a function of productivity differentials. Empirical evidence supports the view that productivity differentials are an important determinant of real exchange rates, where the link between these variables is typically modelled as a long-run relationship.

Unfortunately, models of exchange rate determination based on macroeconomic fundamentals have not had much success in explaining, let alone forecasting, exchange rate movements. Indeed, as Meese and Rogoff (1983) showed more than 20 years ago in their study comparing the out-of-sample explanatory power of a variety of exchange rate models, no existing structural model can systematically outperform the naïve alternative of a random walk at short and medium-run horizons, even when aided by the actual future values of the repressors. This key result has yet to be convincingly overturned in the literature, although many studies have attempted to do so. As Obstfeld and Rogoff (2000) have noted, there is a very weak relationship between the exchange rate and virtually any macroeconomic variable—a situation they term the "exchange rate disconnect puzzle." Notwithstanding this, researchers at the Bank of Canada have developed an exchange rate equation that has been relatively successful at tracking most of the major movements in the Canadian dollar over the past few decades and has proven to be stable over time (Murray, Zelmer, and Antia 2000).

3. Overshooting Behaviour of Exchange Rates: Theoretical Background

Modern exchange rate models emphasize financial asset markets. Rather than the traditional view of exchange rates adjusting to equilibrate international trade in goods, the exchange rate is viewed as adjusting to equilibrate international trade in financial assets. Since goods prices adjust slowly relative to financial asset prices and financial assets are traded continuously each business day, the shift in emphasis from goods market to asset markets has important implications. The exchange rate will change every day or even every minute as suppliers and demands for financial assets of different change.

Current spot exchange rates are affected by the change in expectation concerning future trade flows. Short run effect of some new event determining the balance of trade can differ from the long run result. If we are initially in equilibrium and then experience a disturbance (Recession in world economy), in the short run we expect large balance of trade deficit, but in the long run as all prices and quantities adjust to the situation, we return to the long-run equilibrium of balance of trade. The new long run equilibrium rate will be higher than the old rate since foreigners will have a larger stock of domestic currency while domestic residence hold less foreign currency as a result

British Journal of Business Design & Education
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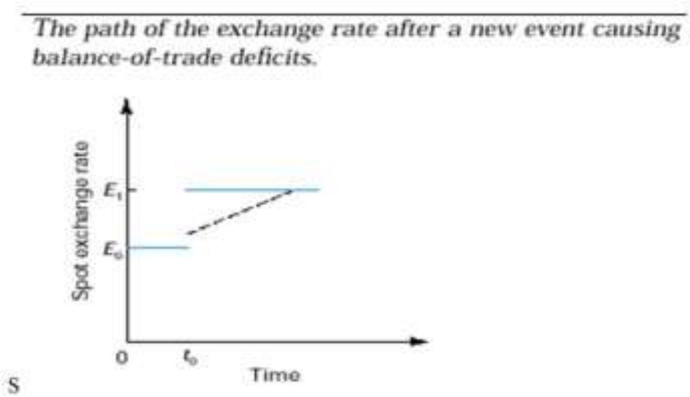
Vol 09 No 01
of the period of trade deficit. The exchange rate need not move to the new equilibrium immediately.

In the short run during which trade deficits are experienced, the exchange rate will tend to be below the new equilibrium rate. Thus, as the outflow of money from the domestic economy proceeds with the deficits, there is a steady depreciation of the domestic currency to maintain the short run equilibrium where quantities demanded and supplied of monies are equal.



Some unexpected event occurs at time **T_0** that causes a balance of trade deficit. The initial exchange rate is **E_0**. With the deficit, and consequent outflow of money from home to abroad, domestic currency will depreciate eventually, as price and quantities adjust to the changes in the structure of trade, a new long run equilibrium is reached at **E_1** where trade balance is restored. This movie to the new long-run exchange rate **E_1** does not have to come instantaneously because the deficit persists for some time. However, the forward rate could jump to **E_1** at time **T_0** as the market now expect **E_1** to be the long-run equilibrium exchange rate. The dash line represents the path taken by the spot exchange rate in the short run. At **To** there is an instantaneous jump in the exchange rate even before any trade deficits are realized, because individuals try to exchange domestic money for foreign in anticipation of the domestic currency depreciation. Over time as the trade deficit occur, there is a steady depreciation of the domestic currency with the exchange rate approaching its new long-run steady state value **E_1** as the trade deficit approaches zero.

In the short run, following some disturbance to equilibrium, prices will adjust slowly to the new equilibrium level whereas exchange rates and interest rates adjust quickly. Thus, different speed of adjustment to equilibrium allows for some interesting behaviour regarding exchange rates and prices. Again if country ―A‖ has a higher inflation rate than country ―B‖, ―A‖s currencies appreciates relative to —B‖. These anomalies can be explained in the context of an **"Overshooting" exchange rate model.**

For equilibrium in the money market, money demand must equal money supply. If the money supply increases, some things must happen to increase money demand. We assume money demand is a function of income and interest rate:

$$M^d = aY + bi \qquad \text{--} \quad (1)$$

Here is the real stock of money demanded, **Y** is income and **i** is the interest rate. Money demand is positively related to income so, **a** exceeds to Zero since interest rate is the opportunity cost of holding money, there is an inverse relation between money demand and **i** or b is negative. It is commonly believed that in short run following an increase in the money supply both income and the price levels are relatively constant.

Interest rate parity relation for country —I‖ and —B‖ may be written as:

$$i_A = i_B + \frac{F - E}{E} \qquad \text{--} \quad (2)$$

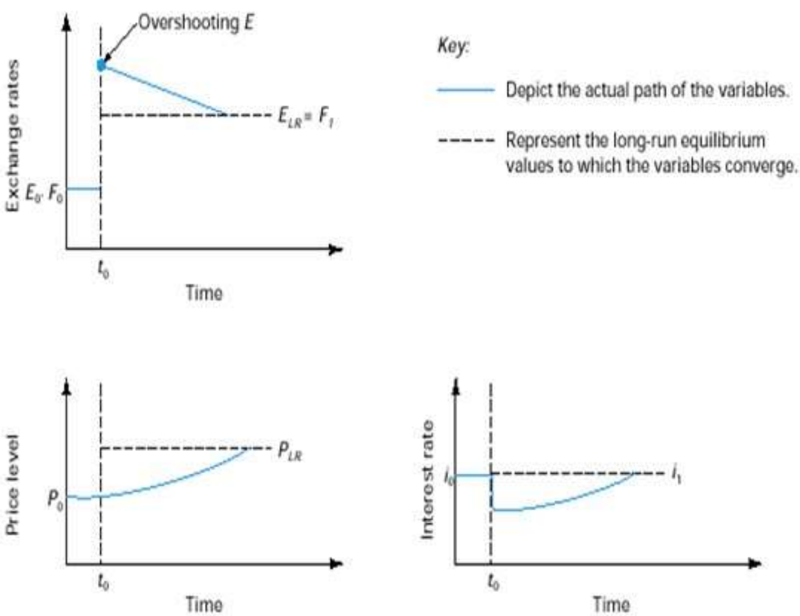
If i_A falls, given the foreign interest rate i_B, $\frac{F-E}{E}$ or the expected depreciation of the country **A** must fall. When money supply in the country **A** increases, we expect that eventually prices will rise. Higher future price in **A** will imply a higher future exchange rate to achieve purchasing power parity:

$$E = \frac{P_A}{P_B} \qquad \text{--} \quad (3)$$

Since P_A is expected to rise over time, given P_B, E will also rise. This higher expected future spot rate will be reflected in a higher forward rate now. But if F rises, while at the same time **(F-E)** must fall to maintain interest rate parity, **E** will have to increase more than more than f. Then once price start rising, real money balances fall so that the domestic interest rate rises. Over time, as the interest rate increases, **E** will fall to maintain interest rate parity. Therefore, the initial rise in E will be in excess of the long-run **E**, or **E** will overshoot its long-run value.

British Journal of Business Design & Education
ISSN (Print): 2222-7426, ISSN (Online): 2222-8412
Vol 09 No 01

The time path of the forward and spot exchange rate, interest rate, and price level after an increase in the domestic money supply at time t_0.



4. Methodology

The purpose of this paper is to analyse the movement in the exchange rate of Bangladesh and India. Before that it is necessary to know and measure the impacts of the economic variables on the exchange rates. For this, a log-linear model is formulated explaining the variables of the exchange rates. Then 2SLS regression of the explanatory variables was run on the Exchange Rate to get the extent of the impact on the dependent variable. On the second phase, crosssectional time series analysis was done from different aspects between Bangladesh and India.

4.1 Data

This paper is based on the secondary data estimate for the period 1973-98. Most of the data are taken from the publication of the World Bank Economic Review, World Development Indicators (WDI) of the World Bank. The data on Interest Rates, Foreign Currency Reserve and Consumer Price Index for Bangladesh have been taken from publications of Bangladesh Bank and Bangladesh Bureau of Statistics (BBS).

British Journal of Business Design & Education
ISSN (Print): 2222-7426, ISSN (Online): 2222-8412
Vol 09 No 01

4.2 Empirical Model

For the purpose of tracing out the overshooting behaviour of the exchange rate, we need to find the economic factors that cause this shooting and then constructed a model and to trace out the magnitudes of their effects. The exchange rate can be taken as a function of these determinant or the variables. Like,

Exchange Rate = f (Import, Export, Interest Rate, Forward Rate, Foreign Currency Reserve, CPI)

In the above function, Exchange rate is a function of a number of explanatory variables. All these explanatory variables have its own impact on the exchange rate. This paper, by constructing a log-linear model and then through 2SLS regression tried to find out the impact of these variables and tried to trace out the overshooting behaviour of the exchange rate.

$$\ln ER = C_0 + \beta_1 \ln IMP + \beta_2 \ln Exp + \beta_3 \ln IR + \beta_4 \ln FCR + \beta_5 \ln FR + \beta_6 \ln CPI \text{ --- } (4)$$

Where, ER = Exchange rates, Imp = Imports, Exp = Exports, IR = Interest Rates, FR = Forward Rates(LIBOR), FCR = Foreign Currency Reserves, CPI= Consumers' Price Index.

For Bangladesh:

$$\ln ER_B = C_B + \beta_1 \ln IMP_B + \beta_2 \ln Exp_B + \beta_3 \ln IR_B + \beta_4 \ln FCR_B + \beta_5 \ln FR_B + \beta_6 \ln CPI_B \text{ - } (5)$$

Where, ER = Exchange rates of Bangladesh, Imp = Imports of Bangladesh, Exp = Exports of Bangladesh, IR = Interest Rates of Bangladesh, FR = Forward Rates (LIBOR), FCR = Foreign Currency Reserves of Bangladesh, CPI= Consumers' Price Index of Bangladesh.

For India:

$$\ln ER_I = C_I + \beta_1 \ln IMP_I + \beta_2 \ln Exp_I + \beta_3 \ln IR_I + \beta_4 \ln FCR_I + \beta_5 \ln FR_I + \beta_6 \ln CPI_I \text{ - } (6)$$

Where, ER = Exchange rates of India, Imp = Imports of India, Exp = Exports of India, IR = Interest Rates of India, FR = Forward Rates (LIBOR), FCR = Foreign Currency Reserves of India, CPI= Consumers' Price Index of India.

5. Description of the Model Dependent Variable:

Exchange Rate (ER) In the model Exchange rate (ER) is the taken as the dependent variable. This is because for the purpose of this paper we need to find out the affect of the factors of the exchange rate on it. Cause only then we will be able to determine and actual cause of exchange rate overshooting. We assumed that the equilibrium value of exchange rate is determined by the interactions of the independent variables in the model.

Explanatory Variables:

Import (Imp) Import of a country is the factor that affects the exchange rate of a country most. The higher the volume of the import higher will be the demand for the foreign currency. Thus this excess demand for foreign currency will bid up the price of that currency means the exchange rate will depreciate.

Export (Exp) Like import export does affects the exchange rates of a country. But acts in the opposite direction of the import's affects. Whereas the demand for foreign currency at the of import increases the exchange rates, the excess export appreciates the exchange rates of that country.

Interest Rates (IR) Interest rates may have its effect in two ways. The higher the saving interest of a country the higher will be the deposit in the bank. This high-interest rate may attract foreigners to transfer their money in those countries. This will increase the foreign currency reserve of that country and will decrease the exchange rate of that country. On the other hand, when the interest rate increases the investment declines. Then the capital may fly away from home country resulting foreign currency shortage. This will increase the demand for foreign currency; as a result exchange rate will depreciate.

Table 1: The expected signs of the variables:

Variables	Expected signs
Import (Imp)	**+ ve**
Export (Exp)	**- ve**
Interest Rate (IR)	**+/- ve**
Foreign Currency Reserve (FCR)	**- ve**

British Journal of Business Design & Education
ISSN (Print): 2222-7426, ISSN (Online): 2222-8412
Vol 09 No 01

Forward Rate (FR)	**+ ve**
Consumer Price Index (CPI)	**+ ve**

Foreign Currency Reserve (FCR) Higher the foreign currency reserves the stable the exchange rate will be. So the demand for foreign currency will be low. On the other hand when the reserve declines the demand for foreign currency will increase leading to exchange rate depreciation.

Forward rate (FR) In this model we took one year LIBOR rate as forward rate. As the forward rate increases, it is assumed that exchange rate will depreciate.

Consumer Price Index (CPI) Consumer price index has an effect on the exchange rate of any country. When the CPI of a country changes, the exchange rate also changes. If the CPI increases the exchange rate of that country depreciates and vice versa.

6. Empirical Findings

The effects of different economic variables on exchange rates of Bangladesh and India, for the period 1973-98, are estimated using equations (2) and (3). The fits are good, and the DurbinWatson (DW) statistics provide no evidence of autocorrelation.

The dependent variable is defined in such a way that associates downward movements in the exchange rate with appreciations and upward movements with depreciation. Surprisingly, not all the variables are showing the expected sign, i.e.; in reality the variables are affecting the exchange rates such a way that is unexplained by the theory. Besides different variables are significant at different levels of significance.

For both the countries Consumer Price Indices (CPI) is the prime variable affecting the exchange rate of the corresponding country most. Both the variables are statistically significant at 0.05 level and are showing the expected sign. The results suggest that with every unit increase in the CPI will result in a depreciation of the currency of 1.351 and 1.176 for Bangladesh and India respectively.

Export (ER) variable is statistically significant at 0.10 level for both the countries. Though for Bangladesh, the sign of the variable is as expected but for India it is showing the opposite side suggesting that with every unit of export the Indian currency would depreciate by 0.326.

For Bangladesh, Interest rate (IR) is the other variable statistically significant at 0.10 level and showing the expected sign. Both Import (Imp) and Forward Rates (FR) variables are statistically significant at 0.05 level for India but are not showing the expected sign. With the increase in these two variables, the exchange rate is supposed to depreciate whereas in reality the exchange rate is appreciating. This suggests that there are other variables that are appreciating the exchange more to offset the depreciation caused by the increased importation.

Table 2: Two-Stage Least Squares Estimates of The Models

Explanatory Variable	Equation	
	ER_B	ER_I
Constant	-0.191	-0.106
	(0.353)	(0.198)
Imp	0.002353	-0.609 *
	(0.226)	(0.3205)
Exp	-0.370 **	0.326 **
	(0.263)	(0.169)
IR	0.284 **	-0.119
	(0.169)	(0.141)
FCR	0.004575	0.00005308
	(0.086)	(0.027)
FR	-0.113	-0.200 *
	(0.154)	(0.075)
CPI	1.351 *	1.176 *
	(0.336)	(0.090)
R^2	0.9569	0.9915
D.W.	1.982	2.006

- Definition of Variables: ER = Exchange rates, Imp = Imports, Exp = Exports, IR = Interest Rates, FR = Forward Rates (LIBOR), FCR = Foreign Currency Reserves, CPI= Consumers' Price Index
- Figures in parentheses are standard errors
- Significance at 10% level is indicated by ** and at 5% by *

7. Cross-sectional Analyses between Bangladesh and India

Relationship of exchange rate with the exports and imports of Bangladesh

The graph below shows the relationship of exchange rate with regard to import and export of Bangladesh. Exchange rate tends to shot up after certain time periods. But it didn't seem like to be affected by the export-import behaviour of Bangladesh. In 1975, the export decreased by 28.71% and the import increased by only 1.42% but the exchange rate increased by 83.54%.

Again in 1981 and 1982 both the export and import decreased but the exchange rate had increased by 22.09% and 21.32% respectively. Again in 1985, the import decreased by 17.07% whereas exchange rate had increased by 19.23%. And in 1990, export increased by 23.95% but exchange rate had increased by 10.91%. In 1992, the import increased by 15.14% and export increased by 30.68% and in 1995, import increased by 39.74% and export increased by 17.94% but the exchange rate increased by only 1.09% and 1.24% respectively. So from this analysis we can say that the export and import do not have that much impact on the exchange rate what it should have been.

Relationship of exchange rate with the exports and imports of India

Up to 1978, the exchange rate of India with respect to the US$ had remained almost the same as a result of the import and export offsetting each others[1]. But in 1979-81, the exchange rate decreased even though there was a sharp increase in the import. Unti 1989, the exchange rate of rupees to US$ increased steadily even though there was volatility in the importation. Then the exchange rate of India had showed overshooting behaviour a few times during 1989-

[1] The Left axis shows the volume of export and import of India and the right axis shows the exchange rates of Rupee to US$

98.

Again, during 1989-91 and in 1993 the exchange rate increased even though India had experienced a sharp decline in the import. Thus the exchange rate overshoots due to some other factors other than the import. But in 1994 and 1996 the exchange rate overshot with the increase in the import.

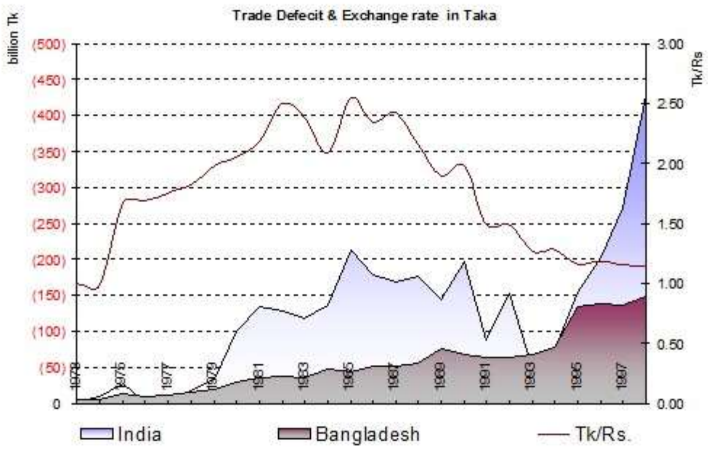
Trade deficit of Bangladesh and India in terms of Taka

In this section, we tried to find out the exchange rate between with respect to their respective trade deficits[2]. Over the years, India had much higher trade deficits than Bangladesh. Exchange rates between these two countries moved with the movement of Indian trade deficits.

Every time India's trade deficit increased during 1984-95 the exchange rate between these two countries overshot. Surprisingly, these overshoots resulted in strengthen the rupees against the Taka. It is not consistent with the theory. And it implies that some other variable have a stronger effect than the import of these two countries.

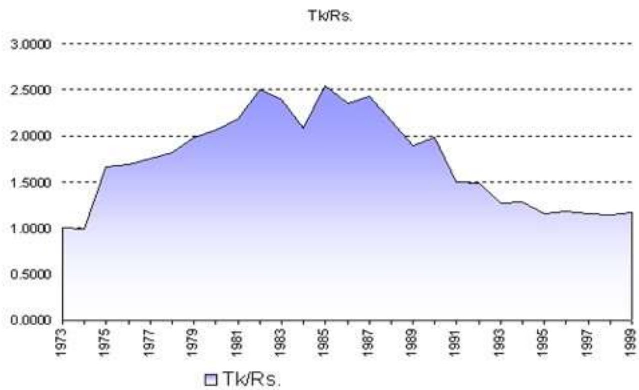
[2] The Left axis shows the Trade deficits of India and Bangladesh and the right axis shows the exchange rates of Taka to Rupee

British Journal of Business Design & Education
ISSN (Print): 2222-7426, ISSN (Online): 2222-8412
Vol 09 No 01



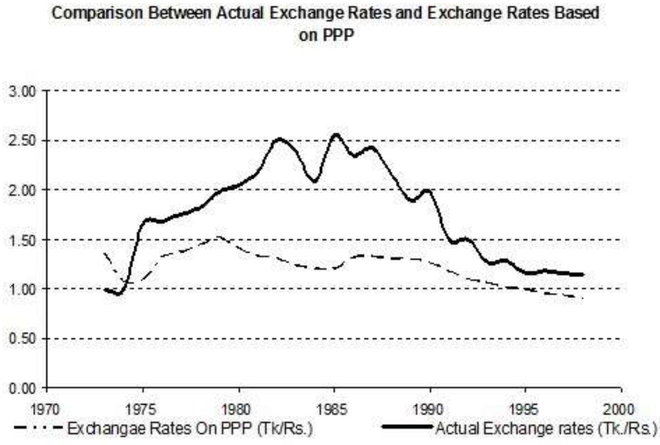
Exchange Rates between India and Bangladesh

The direct quote for Bangladesh shows that Rupee was always stronger than Taka. The rupee was strengthening till 1985, but it has weakened after that.



Exchange Rates on Purchasing Power Parity

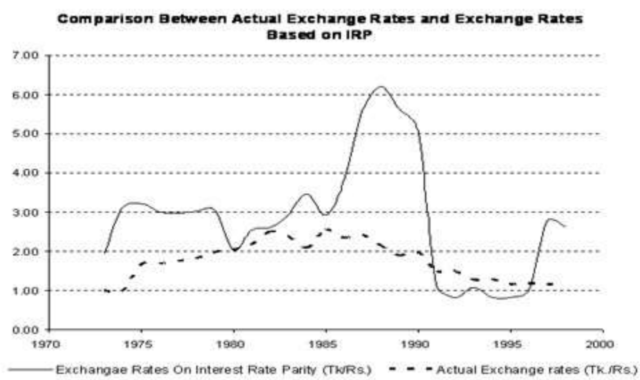
India and Bangladesh lack Purchasing Power Parity between them. The exchange rate what should be based on purchasing power parity is much lower than the actual exchange rate between these two countries.



Thus, we can say that there are some inconsistencies between these two countries. This means that purchasing power of these two countries r not the only thing that determines the exchange rate between. Rather it is affected by other parameters too. And we can say that from 1974 rupee is always overvalued.

Exchange Rates on Interest Rate Parity

From the graph, we can see that the exchange rate based on the interest rate parity is slightly consistent with the actual exchange rate except for the period 1985 to 1991. But all the while up to 1991 the Indian rupee was undervalued relative to the Bangladeshi taka. During 1991-1996, the Indian rupee was overvalued, and again the Bangladeshi Taka became overvalued after that.

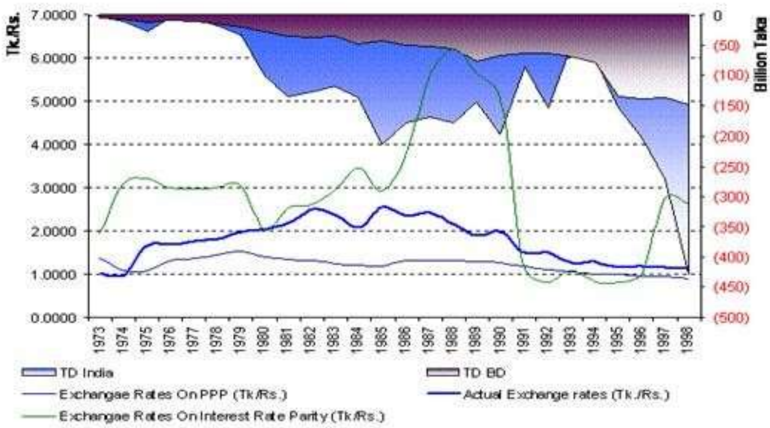


Combined effect on Exchange Rate Overshooting

British Journal of Business Design & Education
ISSN (Print): 2222-7426, ISSN (Online): 2222-8412
Vol 09 No 01

In the following graph, we brought all the elements factors of the exchange rate that has been discussed so far in this paper[3]. We can see that the exchange rate between Bangladeshi Taka and Indian rupee overshot a numbers of times during the period 1973-1998. But from our analysis we found that no single factor had caused these overshooting. Rather it fluctuated for different reasons in different times.

During this period the first overshooting occurred during 1974-1975. This can be taken as the impact of both the Indian trade deficits and the shift in the interest rate parity between these two countries. After 1976, the exchange rate between Indian rupee and Bangladeshi taka had slowly increased till 1981. Then the second overshooting occurred in 1981. This overshooting seemed mysterious to us because that interest rate parity between India and Bangladesh remained almost constant till the last part of 1982, and the trade deficit of India was declining. Again the next overshooting occurred in 1984-1986. This time it happened fully due to the higher trade deficit in India.



This was the last time the exchange rate between India and Bangladesh overshot drastically. Every time the exchange rate between India and Bangladesh overshot the reason behind almost was the higher trade deficit of India than Bangladesh. One thing to observe here that, the exchange rate between these two countries remained constant even though the trade deficit reached the highest point between1973-1998. The exchange rate should have overshot but did not

[3] The left axis is the exchange rates of Taka to Rupees and the right axis is the trade deficits in Billions of Taka

because some other factor(s) might offset the movement of the exchange rate between India and Bangladesh.

5 Conclusion

The paper found that exchange rates in both the countries have fluctuated over time. But the extents in the variations were different. Both the countries lack Purchasing Power Parity (PPP) and Interest Rates Parity (IRP). This lack of parity found to be the factor causing the exchange rate overshooting. For the individual country, CPI has been found to be the prime factor affecting the Exchange rates most. Besides exports, imports, interest rates, and forward rates also have been found to be significant in different measures.

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