

## **Nominal and Real Effective Exchange Rates Indices for Bangladesh: 2000:M1 -2021:M7**

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### **Abstract**

*A country's purchasing power is measured by the bilateral real exchange rate, which is the price of domestic goods in terms of foreign goods. The concept of real effective exchange rate illustrates the inflation-adjusted value of a currency compared to the weighted average value of a basket of its trading partner currencies. Methods used to construct both nominal effective exchange rate and real effective exchange rate depend on how the nominal exchange rate is quoted (direct or indirect), which trading partners are selected, the averaging methods used (geometric or arithmetic), and how the trade weights are calculated. This study uses geometric mean as averaging technique, and export and import for calculating trade weight. This study calculates three types of trade weight: import weight, export weight and trade weight for constructing effective exchange rate indices. The findings of this study is that Bangladeshi Taka depreciates both nominally and in real terms over the 2000s, but thereafter it shows an appreciating trend, which lasts until the year 2021.*

**Keywords:** Bilateral real exchange rate, NEER, REER, trade weight, Bangladesh

### **1. Introduction**

Nominal effective exchange rate (NEER) is unadjusted weighted average rate at which one unit of home currency is exchanged for a basket of multiple foreign currencies. As an economic indicator, the NEER measures a country's international

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competitiveness in the foreign exchange market. The nominal exchange rate is the rate at which one unit of home currency is exchanged for one unit of foreign currency. When NEER is adjusted for inflation then it is called real effective exchange rate (REER). Although NEER measures a country's international competitiveness in nominal terms, REER measures this in real terms.

Calculation methodology of effective exchange rates consists of three steps, they are as follows; (i) calculation of exchange rate index, (ii) calculation of weight, and (iii) calculation of relative price index. Two types of averaging techniques – arithmetic and geometric means are used in calculation process, and we employ geometric mean for averaging our weighted exchange rate. At the same time, weight can be calculated in different ways such as import-based weight, export-based weight, and finally the traditional trade weight (export plus import), and we have calculated these three types of weights for NEER and REER calculation. Additionally, we have calculated fixed and variable weights. Fixed weight is calculated using the average of the last three fiscal years (2017-18, 2018-19 and 2019-20) data as base period. The variable trade weights, however, are calculated by reevaluating the trade data in each period. The price indexes used for constructing the real effective exchange rate may come from either consumer price indexes (CPI), producers' price indices (PPI), or GDP deflators. We use CPI to construct price indexes that are used for calculating REER.

A number of studies have attempted to calculate the effective exchange rate indices (EERI) for developing countries (Bahmani-Oskooee, 1995; Bahmani-Oskooee & Mirzai, 2000; Bahmani-Oskooee, 2001; Bahmani-Oskooee & Gelan, 2007; Bahmani-Oskooee & Kandil, 2007; Bahmani-Oskooee & Harvey, 2007). But none of these studies included Bangladesh to calculate EERI. Goswami et. al. (2011) take a pioneering step to calculate the EERI for Bangladesh using data from 1973:M07 to 2008:M12. After this novel work no studies has attempted to calculate the EERI of Bangladesh.

In the field of international trade and commerce, researchers and policymakers have to face difficulties in getting an authentic database of effective exchange rate for Bangladesh. This database is very crucial for policy modelling, and there is a growing demand for it. Considering the above situations, we endeavored to calculate the EERI of Bangladesh using the daily and monthly data from 2000:M01 to 2021:M07. We use the average of three fiscal years (FY2018-FY2020) as the base year. The significance of this study is that it would meet the growing demand for effective exchange rate database for Bangladesh.

Bangladesh Bank calculates the effective exchange rate indices of Bangladesh to assess the external competitiveness of Bangladeshi Taka against its trading partners. From January 1986, Bangladesh Bank started to calculate the effective exchange rate index to measure the appreciation or depreciation of Taka against its partner countries. The bilateral nominal exchange rate used to calculate the appreciation or depreciation of Taka under the adjustment process before 1986. Initially, Bangladesh Bank used only its six major trading partners (Germany, Japan, the United Kingdom, India,

Pakistan, and the United States) currency to calculate NEER and REER. In December 2001, the number of trading partners increased to fifteen. After introduced Euro by twelve member states of the European Union as their single currency in February 2002, Bangladesh Bank has reduced its trading partners to eleven. At that time, it used FY 1994-95 as the base year for calculating effective exchange rate indices. In January 2008, Bangladesh Bank further reduced its trading partners to eight currencies as a currency basket, and FY 2000-01 has been using as the base year.

## 2. Review of Related Literature

Goswami et. al., (2011) construct both nominal and real effective exchange rates for Bangladesh from 1973:07 to 2008:12. In this study, they found that effective exchange rate indices of Bangladesh have shown a downward trend over the period 1973 to 2008, indicating that the Bangladeshi Taka has depreciated both in nominal and real terms.

Adam, (2014) calculates NEER and REER for Maldives both monthly and annually from 1990 to 2012. The study concluded that the exchange rate indices in Maldives were relatively stable, even though there were short periods of large appreciations and long periods of moderate depreciation. Despite the differences in magnitudes, all indices constructed using different trade weights demonstrated similar trends.

Bhowmik (2020) examined the determinants of NEER and REER of Chinese Renminbi (RMB). According to this study, the nonlinear trend of NEER of the Chinese RMB between 1990 and 2019 is cubical, which initially increases then declines and finally declines again. During 1990-2019, the REER of the Chinese RMB revealed a nonlinear quadratic trend, where downswings are insignificant, but upswings are significant.

Santoya and Soutar (2011) calculated the REER for Belize from 2000-2009. They calculated three types of REER: traditional approached REER, which is based on total trade; commodity-based REER; and tourism-oriented REER. This study found that all the three REER have a declining trend, meaning that the exchange rate depreciate.

Nakorji et. al. (2019) re-estimated the REER index for Nigeria using the Bank for International Settlement (BIS) methodology. The results of this study conferred that BIS methodology imitates the methodology of International Monetary Fund (IMF). The only difference of these two methodologies is that IMF uses direct quotation, while Nigeria uses indirect quotation, in defining exchange rates. According to IMF methodology, an increase/decrease in the REER would lead to an appreciation/depreciation of the domestic currency. While an increase/decrease of REER calculated by BIC methodology, using indirect quotation, lead to a depreciation/appreciation of the domestic currency.

Bahmani-Oskooee (2001) estimated nominal and real effective exchange rates of Middle Eastern countries and their trade performance. The main purpose of this study is to construct and report annual indexes of real and nominal effective

exchange rates for 11 Middle Eastern countries based on quarter by quarter data from 1971(I) to 1994(IV).

Bahmani-Oskooee (1995) calculated real and nominal effective exchange rates for 22 LDCs using quarterly data from 1971-1990. This study used literature-based methods to construct and calculate the nominal and real effective exchange rate. It also investigated the empirical validity of Purchasing Power Parity Theory (PPP) by determining the stationarity of real effective exchange rates. It concluded that PPP does not hold for most of the countries.

### **3. A Systematic Method for Calculating Effective Exchange Rates**

Economists follow several steps in order to construct nominal and real effective exchange rates. In general, the steps are: selection of trading partners, selection of base period, computation of trade weights, computation of bilateral nominal exchange rates and indices, and computation of bilateral real exchange rates and indices.

#### ***3.1 Selection of Trading Partners***

To select major trading partners, we use the average of the last three fiscal years (i) value of exports, (ii) value of imports, and (iii) the value of total trade (exports plus imports). A country that has more than 0.50% of the total trade share of Bangladesh is selected as a trading partner of Bangladesh. On the basis of these criteria, we select 24 trading partners which cover 88.64% of Bangladesh's total trade. Nineteen countries in Europe are using Euro as their currency and we consider them as the EU. Other 23 countries are China, India, the USA, the UK, Japan, Indonesia, Malaysia, Singapore, Canada, Brazil, Saudi Arabia, Korea, Qatar, Australia, Russia, the UAE, Taiwan, Thailand, Turkey Vietnam, Pakistan, Hong Kong and Switzerland.

#### ***3.2 Selection of Base Year***

The current exchange rate unit is made free unit by using the value of base year exchange rate. By definition, the value of the base year index is 100. Generally, base year is selected on the basis of the safe and sound economic as well as social condition of a country. Bangladesh Bureau of Statistics (BBS) uses 2005-06 as the base year for explaining most of the macroeconomic data at constant price while, IMF uses 2010 as the base year for calculating NEER as well as REER. Bangladesh Bank uses 2015-16 as the base year for calculating both NEER and REER. We use an average of three years' total trade share to calculate trade weight, which is used by the IMF, State Bank of Pakistan, and Reserve Bank of India. For exchange rate index and CPI, we use 2015-16 as base year.

#### ***3.3 Trade Weight Calculation***

Trade weight is used to calculate the effective exchange rate (EER) index, which shows the competitiveness of the currency of the home country in terms of its trading partner countries. The most common method of calculating trade weight is to use (i)

the value of imports, (ii) the value of exports, and (iii) the value of total trade (exports plus imports). In this study, we use all these three methods to calculate bilateral trade weight. Whichever weights are used, the averaging technique (arithmetic or geometric) and exchange rate quotation (direct or indirect) are the key to calculating EER. This study uses the geometric mean averaging technique and direct exchange rate quotation for calculating the EER index. We use the following three methods for trade weight calculation:

$$\text{For export weight; } W^{iX} = \frac{X_b^i}{X_b}$$

$$\text{For import weight; } W^{iM} = \frac{M_b^i}{M_b}$$

$$\text{For Trade weight; } W^{iT} = \frac{X_b^i + M_b^i}{X_b + M_b}$$

Where,  $W^{iX}$  = fixed export weight of Bangladesh for its partner country i.

$W^{iM}$  = fixed import weight of Bangladesh for its partner country i.

$W^{iT}$  = fixed trade weight of Bangladesh for its partner country i.

$X_b^i$  = exports of Bangladesh with its partner country i at base period.

$X_b$  = total value of exports to all trading partners of Bangladesh at base period.

$M_b^i$  = imports of Bangladesh with its partner country i at base period.

$M_b$  = total value of imports to all trading partners of Bangladesh at base period.

Table 1 depicts that in terms of imports, China, India and the EU are the first, second, and third largest trading partners of Bangladesh, respectively while, Turkey is the smallest trading partner. In terms of exports, the EU, the USA and the UK are the first, second, and third largest trading partners of Bangladesh, and Thailand is the smallest trading partner. Finally, in terms of total trade, the EU, China and India are the first, second, and third largest trading partners of Bangladesh while, Switzerland is the smallest. One of the most important issue is that the EU covers 46.09% of Bangladesh's total exports. This is because under the EU we take 19 countries that use Euro as common currency.

**Table 1: Partner-wise fixed trade weights of Bangladesh for average of three FY (2017-18 to 2019-20)**

Country	Three FY Average Trade Weight	Three FY Average Export Weight	Three FY Average Import Weight
Australia	1.95%	2.46%	1.59%
Brazil	2.43%	0.58%	3.24%
Canada	2.70%	3.50%	1.56%
China	18.88%	2.29%	27.99%
EU	20.11%	46.09%	6.27%
Hong Kong	0.64%	0.70%	1.11%
India	10.48%	3.45%	16.73%
Indonesia	3.07%	0.19%	4.27%
Japan	3.90%	3.19%	4.13%
Korea	1.97%	0.82%	2.75%

Country	Three FY Average Trade Weight	Three FY Average Export Weight	Three FY Average Import Weight
Malaysia	2.94%	0.81%	3.48%
Pakistan	0.92%	0.22%	1.26%
Qatar	1.96%	0.12%	1.89%
Russia	1.89%	1.69%	1.57%
Saudi Arabia	2.03%	0.79%	2.20%
Singapore	2.83%	0.40%	5.70%
Switzerland	0.56%	0.35%	0.66%
Taiwan	1.40%	0.18%	2.00%
Thailand	1.30%	0.12%	2.24%
Turkey	1.01%	1.66%	0.61%
UAE	1.57%	1.18%	2.16%
UK	4.88%	11.74%	0.97%
USA	9.62%	17.27%	4.26%
Vietnam	0.94%	0.18%	1.36%
Total	100.00%	100.00%	100.00%

Source: Author's own calculation based on Annual Exports Receipts FY 2019-20 and Annual Import Payments FY 2019-20 of Bangladesh Bank

Table 2 depicts that India, Japan and Singapore were the first, second, and third largest sources of imports for Bangladesh in FY 2000-01. However, in FY 2019-20 India is not in the first place but in the second place, and China occupied the first position. In FY 2019-20, Singapore lost its previous position, and the EU grabbed third position though the percentage share of imports from Singapore declined. The import share of China has increased substantially from 9.44% in FY 2000-01 to 28.28% in FY 2019-20. The USA, the EU, and the UK were the first, second, and third largest export partners of Bangladesh in FY 2000-01. However, in FY 2019-20 the EU secured the first position, Russia holds the second position, and the USA moves on to the third place as Bangladesh's export partners.

**Table 2: Partner-wise variable trade weights of Bangladesh for FY 2000-01 and FY 2019-20**

Country	Import Weight		Export Weight		Trade Weight	
	FY 2000-01	FY 2019-20	FY 2000-01	FY 2019-20	FY 2000-01	FY 2019-20
Australia	2.91%	1.60%	0.32%	2.59%	0.32%	1.95%
Brazil	0.45%	3.52%	0.06%	0.50%	0.06%	2.43%
Canada	1.30%	2.32%	2.10%	3.37%	2.10%	2.70%
China	9.44%	28.28%	0.16%	2.18%	0.16%	18.88%
EU	7.18%	5.93%	37.82%	45.34%	37.82%	20.11%
Hong Kong	6.36%	0.69%	2.12%	0.54%	2.12%	0.64%
India	15.76%	14.25%	1.19%	3.79%	1.19%	10.48%
Indonesia	2.52%	4.68%	0.11%	0.22%	0.11%	3.07%
Japan	11.26%	4.24%	1.51%	3.30%	1.51%	3.90%
Korea	5.48%	2.54%	0.28%	0.96%	0.28%	1.97%
Malaysia	1.96%	4.11%	0.13%	0.85%	0.13%	2.94%

Country	Import Weight		Export Weight		Trade Weight	
	FY 2000-01	FY 2019-20	FY 2000-01	FY 2019-20	FY 2000-01	FY 2019-20
Pakistan	1.27%	1.34%	0.72%	0.19%	0.72%	0.92%
Qatar	0.05%	3.00%	0.03%	0.13%	0.03%	1.96%
Saudi Arabia	3.17%	1.92%	0.23%	1.82%	0.23%	1.89%
Singapore	10.96%	2.68%	0.64%	0.87%	0.64%	2.03%
Switzerland	1.56%	4.22%	0.42%	0.35%	0.42%	2.83%
Taiwan	5.48%	0.68%	0.28%	0.35%	0.29%	0.56%
Thailand	2.66%	2.09%	0.47%	0.19%	0.47%	1.40%
Turkey	0.22%	1.97%	0.45%	0.11%	0.45%	1.30%
UAE	2.30%	0.57%	1.59%	1.79%	1.59%	1.01%
UK	3.63%	1.77%	10.10%	1.22%	10.10%	1.57%
USA	3.30%	1.01%	38.86%	11.76%	38.85%	4.88%
Russia	0.66%	5.23%	0.21%	17.42%	0.21%	9.62%
Vietnam	0.10%	1.37%	0.20%	0.17%	0.20%	0.94%
Total	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

Source: Author's own calculation based on Annual Exports Receipts FY 2009-10 and FY 2019-20; Annual Import Payments FY 2000-01 and FY 2019-20 of Bangladesh Bank.

The export share of Russia has increased from 0.21% in FY 2000-01 to 17.42% in FY 2019-20. At the same time, export share of the EU has increased from 37.82% to 45.34%. In terms of total trade weight, it observed that the USA, the EU, and the UK were the first, second, and third largest trading partners of Bangladesh in FY 2000-01, respectively. However, in FY 2019-20, the EU remained in the first place but its share of total trade decreased from 37.82% in FY 2000-01 to 20.11% in FY 2019-20. It is remarkable that China and India have occupied second and third places in terms of total trade and their share have increased significantly from 0.16% and 1.19% in FY 2000-01 to 18.88% and 10.48% in FY 2019-20, respectively.

#### 4. Construction of Effective Exchange Rate

Now, we construct two different types of effective exchange rates, namely the nominal effective exchange rate (NEER) and the real effective exchange rate (REER). Based on the calculation of trade weight and averaging technique, we can calculate different types of nominal effective exchange rate (NEER) and real effective exchange rate (REER) indices. Three types of trade weights are calculated in this paper and geometric mean is used as an averaging technique.

##### 4.1 Calculation of Exchange Rate Index (ERI)

ERI has calculated using the following formulae

$$ERI_t^i = \frac{ER_t^i}{ER_b^i} \times 100 \quad (1)$$

Where,  $ERI_t^i$  = exchange rate index of country i's currency at period t.

$ER_t^i$  = exchange rate of country i's currency at period t.

$ER_b^i$  = exchange rate of country i's currency at base period.

#### 4.2 Calculation of Nominal Effective Exchange Rate (NEER)

NEER has calculated by using the following formulae

$$NEER_t = \frac{ERI_{BD}}{\prod_{i=1}^{24}(ERI_{TP})^{w_i}} \times 100 \quad (2)$$

Where,  $NEER_t$  = nominal effective exchange rate of Bangladesh at period t.

$ERI_{BD}$  = exchange rate index of Bangladesh.

$\prod_{i=1}^{24} ERI_{TP}$  = geometric average of 24 trading partners exchange rate index and  $i=1, 2, \dots, 24$ .

$W^i$  = Trade weight of partner country i. Here we use six different ways to calculate the trade weight: (i) uses of fixed and variable weights (ii) uses of trade weight, import weight, and export weight. This study uses a geometric mean for averaging technique. Using the formula (2) and geometric mean as an averaging technique, we can calculate six different kinds of NEER. At the same time, using the formula (3) and the same technique we also can calculate six different kinds of REER.

#### 4.3 Calculation of Real Effective Exchange Rate (REER)

REER has calculated by using the following formulae

$$REER_t = NEER \times \frac{CPI_{BD}}{\prod_{i=1}^{24}(CPI_{TP})^{w_i}} \quad (3)$$

Where;  $REER_t$  = real effective exchange rate index of Bangladesh at period t.

$CPI_{BD}$  = consumer price index of Bangladesh.

$\prod_{i=1}^{24} (CPI_{TP})^{w_i}$  = geometric average of 24 trading partner's consumer price index and  $i=1, 2, \dots, 24$ .

#### 4.4 Construction of Nominal and Real Effective Exchange Rate for Bangladesh

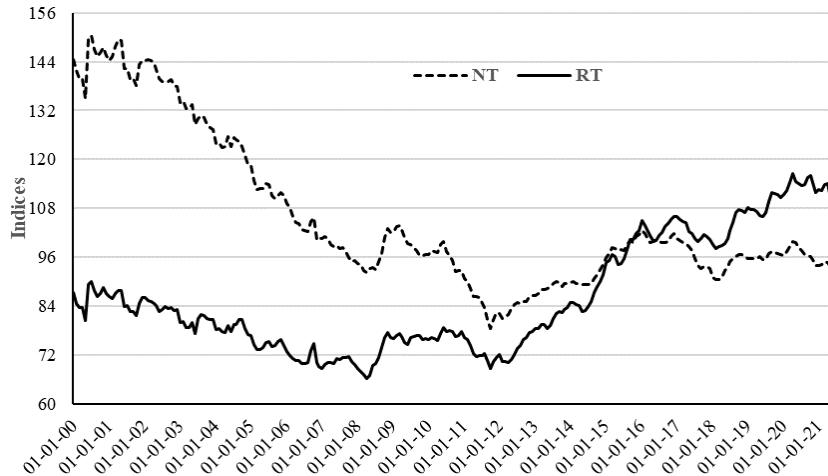
By using the above formulae, we have calculated twelve different kinds of effective exchange rate for Bangladesh for the period of 2000:M1 to 2021:M7. For brevity, we have calculated six different types of effective exchange rate indices, three for NEER (NT, NM and NX) and three for REER (RT, RM and RX) using fixed trade weight (average of last three FY's i.e. 2017-18, 2018-19 and 2019-20 export plus import) and geometric mean for averaging technique. We have calculated a series of nominal exchange rates of Taka against US\$ and consumer price index of Bangladesh using FY 2015-16 as the base year. We also calculate the weighted average of CPI of 24 trading partner countries and relative price index (RPI) also known as purchasing power parity index (PPPI)

#### 4.5 Trends of Nominal Effective Exchange Rate (NEER) Index of Bangladesh

Figure 1 depicts that both NEER and REER indices were in a declining trend from 2000 to 2008 and then both indices show an increasing trend. But, up to August 2015 NEER remains above REER, which means that inflation in Bangladesh was lower than its trading partners' inflation. After that, REER started to increase more than NEER and the gap between REER and NEER becomes wider day by day up to July 2021. This means that after August 2015 inflation in Bangladesh was much higher than its trading partners' inflation. This implies that Bangladesh Taka has depreciated up to 2008 and then showed an appreciating trend up to July 2021, both in nominal and real terms.



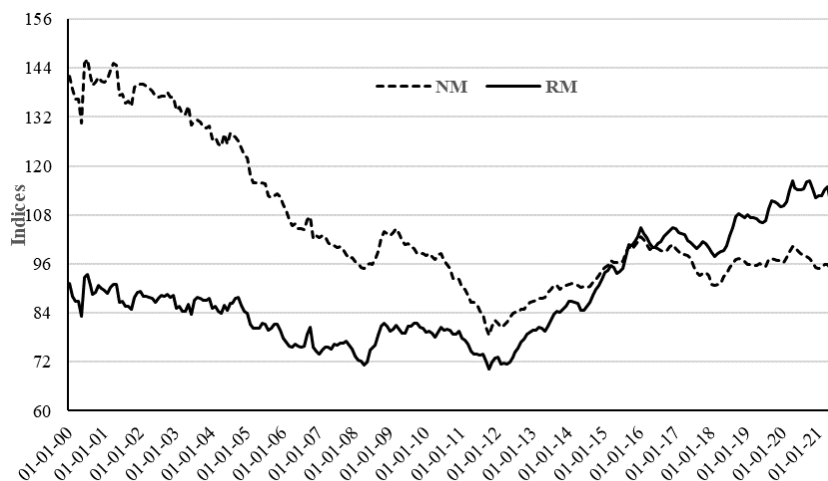
**Figure 1: Trends of trade weighted NEER and REER**



Source: Author's own calculation

Import weighted NEER and REER are presented in Figure 2. This figure shows a similar trend as in Figure 1. Export weighted NEER and REER are shown in Figure 3. This figure also shows a similar trend as Figures 1 and 2. A similar trend of NEER and REER is observed from these three figures. All these three figures show that initially, both indices were in a declining trend then started to increase slowly and exists till 2021. Meaning that Bangladesh Taka has depreciated in nominal terms up to 2011 and in real terms up to 2008 then started to appreciate and this appreciating trend survive till recent time.

**Figure 2: Trends of import weighted NEER and REER**



Source: Author's own calculation

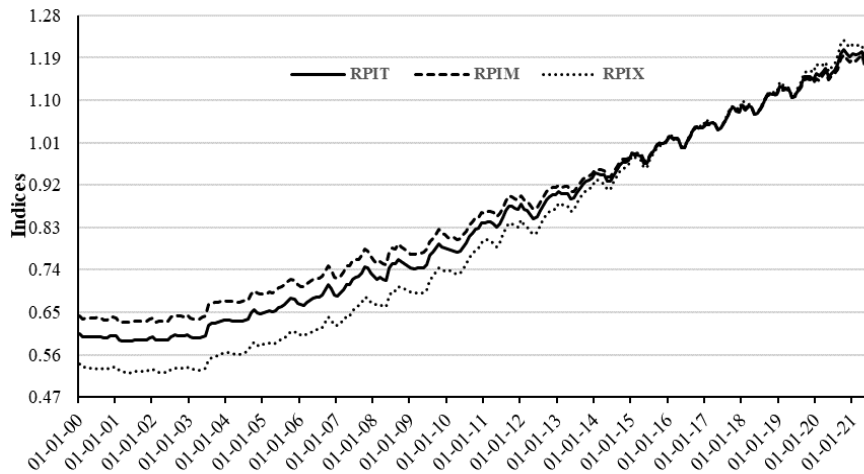
**Figure 3: Trends of export weighted NEER and REER**



Source: Author's own calculation

Figure 4 depicts trade, import and export weighted relative price index (RPI) of Bangladesh. This figure shows that till 2003 these three types of RPI remained steady, and after that they started to increase which continued till 2021. From this figure, it is observed that up to 2016 RPI was below one meaning that the inflation rate of Bangladesh was lower than its trading partners' inflation rate in this period.

**Figure 4: Trends of trade, import and export weighted relative price index**



Source: Author's own calculation

After 2016, RPI index became more than one and remained around 1.20 in 2021. This means that after 2016 inflation rate of Bangladesh was well above its trading

partners' inflation rate. The value of RPI tells us how many units of Bangladesh's products need to buy its trading partners one unit of product. Value of RPI is 1.20 means that 1.2 units of Bangladeshi products need to buy one unit of its trading partners' product.

## 5. Conclusion

To examine the overall competitiveness of a country's currency against its trading partners, the concept of the nominal and real effective exchange rate is highly important. In terms of aggregate export, import, and trade balance modeling particularly in the 80s policymakers and researchers gave great attention to these concepts. Following this trend, IMF started to calculate its database of nominal and real effective exchange rates for developed countries, and this data is available in International Financial Statistics (IFS). However, the demand for calculation of these indices for developing countries gained importance. To bridge the gap some researchers made an endeavor to prepare the nominal and real effective exchange rate indices for some developing countries (Bahmani-Oskooee, 1995; Bahmani-Oskooee & Mirzai, 2000; Bahmani-Oskooee, 2001; Bahmani-Oskooee & Gelan, 2007; Bahmani-Oskooee & Kandil, 2007; Bahmani-Oskooee & Harvey, 2007).

Unfortunately, the name of Bangladesh was not included here although it gained importance in international trade in the recent past. In 2011, a study had done to calculate the nominal and real effective exchange rate indices for Bangladesh (Goswami et. al., 2011). This study used FY 2001 as the base year, and 21 countries as trading partners of Bangladesh. Bangladesh bank took the pioneering initiative to calculate the indices for Bangladesh. At first, it considered only six countries as her trading partners. After that, the number of trading partners has been gradually increasing. At present, Bangladesh Bank uses 15 currency basket and FY 2016 as the base year to calculate the indices for Bangladesh. The more we can increase the trade coverage of our total, the more accurate picture will show by these indices. In this regard, we felt the necessity to calculate the indices for Bangladesh by using such type of currency basket that covers more of total trade.

This study uses 24 partner countries including the EU, which covers 89% of the total trade of Bangladesh and an average of three FYs (2017-18, 2018-19, and 2019-20) as weight and FY 2016 as the base year for calculating NEER and REER. In this study, we have calculated three types of NEER and three types of REER namely export, import, and trade-weighted. This study finds that all these three types of NEER and REER show a declining trend from 2000 to 2011 and then started to show an increasing trend. This means that in the 2000s, Bangladesh Taka depreciated both in nominal and real terms but in the 2010s, BDT has shown an appreciating trend and till 2021 this increasing trend continues. The significance of this result is that the export of Bangladesh becomes costlier for its trading partners and Bangladesh losing competitiveness in the international market.

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## **Annex**

### **Data Sources:**

- 1) International Financial Statistics (IFS): Consumer price indices (CPI) data are collected from this source on a monthly basis.
- 2) IMF Exchange Rate Wizard: Bilateral nominal exchange rate data are collected from this source on daily basis.
- 3) We have collected bilateral nominal exchange rate from the central bank website of respective countries that are not listed in IMF exchange rate wizard.
- 4) Annual Export Receipts, 2019-20 Bangladesh Bank: Monthly export receipts data of FYs 2018, 2019 and 2020 are collected from this source.
- 5) Annual Import Payments, 2019-20 Bangladesh Bank: Monthly import payments data of FYs 2018, 2019 and 2020 are collected from this source.