# METHODOLOGY FOR CALCULATING THE EFFECTIVE EXCHANGE RATES

Nominal effective exchange rate (hereinafter: NEER) is a weighted average of bilateral exchange rates of Bosnia and Herzegovina’s convertible mark (hereinafter: KM) to its relevant trading partners’ currencies.

Real effective exchange rate (hereinafter: REER) is defined as nominal effective exchange rate deflated by relative prices (measured in CPI (consumer prices) and PPI (industrial producers’ prices), in domestic economy and trading partners economies denominated in single currency.

## Nominal effective exchange rate (NEER)

### Calculation method

$$NEER^{t}=\prod\_{i=1}^{N}(e\_{KM,i}^{t})^{w\_{i}}$$

where *N* stands for the number of countries in the reference group of trading partners, $e\_{KM, i}^{t}$ is an index of the average exchange rate of the currency of KM vis–à–vis the partner country *i* in period *t* (expressed in terms of the domestic currency unit per unit of a foreign currency), and $w\_{i}$ is the trade weight assigned to the currency of trading partner *i*.

Two elements are important for ensuring the proper construction and interpretation of the nominal effective exchange rate, those being:

* calculation of weights, which needs to include:
	+ trading partners selection
	+ updating of trade weights
	+ weighting method
	+ double export weights in practice
* choice of currencies

### Calculation of weights – double export weights

The approach used for calculating the effective exchange rates of KM follows the Bank for International Settlements (BIS) methodology presented in BIS economic papers No.39 “Measuring international price and cost competitiveness” by Philip Turner, P and Jozef Van’t Dack ( 1993).

According to the methodology, weights for calculating effective exchange rates of KM are based on the structure of imports and exports of manufacturing industry goods. Weights reflect direct import competition, direct export competition and export competition on third markets. Calculation of the total weights is therefore based on the matrix of very detailed import and export data.

While import weights are simple share of total BH imports for each trading partner, export weights are a combination of simple share and double export weights taking into account third market competition. They capture the effect of competition faced by BH exporters from both domestic producers in domestic markets and exporters on third markets.

The weights are based on the structure of imports and exports of manufacturing industry goods– consisting of four commodity groups according to Standard International Trade Classification: chemicals and related products, n.e.s. (SITC group 5), manufactured goods classified chiefly by material (group 6), machinery and transport equipment (group 7) and miscellaneous manufactured articles (group 8). Source data are obtained from the UN Commodity Trade Statistics Database – UNCTAD.

Link: <http://unctadstat.unctad.org/wds/ReportFolders/reportFolders.aspx?sCS_ChosenLang=en>

In order to more closely and easily explain the method for calculating the double–weighted export weights and how the simple export weights are adjusted for competition in third markets, a simplified example in Figure 1 is shown.

Figure 1 Illustration of direct competition and competition in third markets



Note: Illustration shows the real value of trade in products of manufacturing industry obtained as the average value in the period 2002 – 2004; Values are expressed in millions of dollars. This illustration is motivated by a similar one displayed in Turner and Van't Dack, 1993, p. 18 – 19

In this illustration the first two steps are to determine the extent of competition between BH exporters and manufacturers from Germany on the German market (direct competition), and the extent of competition between exporters from BH and exporters from Germany in third markets (indirect competition).

The first step is to determine the importance of manufacturers from Germany on their domestic market (⸗283.165), as well as the importance that exporters in Germany have in the third markets (⸗695.920). From this it can be determined that in the total supply of products that is available in the German market (excluding supply from BH), German manufactures account for 49% (⸗283.165/(283.165+293.995)), while exporters from third markets account for 51% (⸗293.995/(283.165+293.995)). Likewise, share of German exporters in the total export in third markets (excluding export from BH) accounted for 16% (⸗695.920/(695.920+3.570.265)), while the remaining part is related to other manufactures/exporters in third markets, 84% (⸗3.570.265/(695.920+3.570.265)). The second step is to determine the importance the German market and third markets have to BH exporters, so the extent to which BH exporters compete on the German market (direct competition) and on the third markets (indirect competition) can be determined. This is achieved by calculating Simple export weights, which shows the shares of these two markets in total BH exports. German market, in total BH exports, participates with 21% (⸗183/(183+708)), and third markets participate with 79%.

Combining both steps would result in assigning a double–weighted export weight for Germany (the importance of Germany in direct and indirect competition).

Overall trade weights are derived by combining the bilateral import weights with the double export weights.

Simple import weights are calculated by using imports from Germany (⸗500), so simple import weight assigned to Germany is 17% (⸗500/(500+2.442)).

### Trading partners selection

The selection of countries is based on evaluation of individual trading partners’ shares in overall BH foreign trade of manufacturing industry (in sections 5–8 SITC Standard International Trade Classification).

According to mentioned criteria, the group for calculation of effective exchange rate index includes the 24 most important countries. The group includes Austria, Belgium, China, Croatia, Czech Republic, France, Germany, Hungary, India, Italy, Montenegro, Netherlands, North Macedonia, Poland, Romania, Russian Federation[[1]](#footnote-1), Serbia, Slovakia, Slovenia, Spain, Switzerland, Turkey, United Kingdom, and United States, with a total significance share for the group approximately 90%. In case that one of the countries has become a significant trading partner, it should be included in the calculation.[[2]](#footnote-2)

Figure 2 Market shares in total BH trade (5–8 SITC)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Economy** | **Average for2004-2006** | **Average for2007-2009** | **Average for2010-2012** | **Average for2013-2015** | **Average for2016-2018** | **Average for2019-2021** |
| Austria | 4.5% | 4.5% | 4.8% | 5.2% | 5.2% | 5.9% |
| Belgium | 0.6% | 0.6% | 0.6% | 0.6% | 0.7% | 0.8% |
| China | 2.3% | 3.1% | 3.4% | 4.7% | 4.3% | 0.8% |
| Croatia | 17.9% | 16.9% | 14.7% | 11.7% | 10.6% | 2.2% |
| Czech Republic | 1.9% | 1.8% | 1.7% | 1.6% | 1.7% | 1.7% |
| France | 1.9% | 2.0% | 1.8% | 1.8% | 2.0% | 10.7% |
| Germany | 12.6% | 12.4% | 12.3% | 13.0% | 13.0% | 0.5% |
| Hungary | 3.5% | 3.5% | 2.4% | 2.5% | 2.4% | 11.5% |
| India | 0.2% | 0.3% | 0.4% | 0.4% | 0.5% | 4.9% |
| Italy | 10.5% | 10.4% | 10.0% | 11.3% | 11.4% | 2.4% |
| Montenegro | 0.0% | 1.2% | 1.5% | 1.4% | 1.4% | 13.2% |
| Netherlands | 1.0% | 1.1% | 1.1% | 1.4% | 1.7% | 2.4% |
| North Macedonia | 0.8% | 1.0% | 1.1% | 1.0% | 1.0% | 1.2% |
| Poland | 1.6% | 1.3% | 1.8% | 2.1% | 2.3% | 0.0% |
| Romania | 1.8% | 0.9% | 1.1% | 1.3% | 1.2% | 2.0% |
| Russian Federation | 1.9% | 2.5% | 6.6% | 5.4% | 3.4% | 1.0% |
| Serbia | 0.0% | 11.0% | 10.3% | 9.8% | 10.6% | 1.0% |
| Serbia and Montenegro | 11.3% | 0.3% | 0.0% | 0.0% | 0.0% | 6.3% |
| Slovakia | 0.6% | 0.8% | 0.8% | 1.0% | 1.0% | 11.3% |
| Slovenia | 8.3% | 7.1% | 6.5% | 6.0% | 6.4% | 0.0% |
| Spain | 0.7% | 0.8% | 1.1% | 1.1% | 1.2% | 4.3% |
| Switzerland | 2.0% | 1.7% | 1.0% | 0.9% | 1.0% | 1.3% |
| Turkey | 2.0% | 3.5% | 2.5% | 3.4% | 4.1% | 1.5% |
| United Kingdom | 0.8% | 0.7% | 0.6% | 0.8% | 0.8% | 1.3% |
| United States of America | 2.1% | 2.4% | 2.3% | 2.0% | 2.0% | 0.9% |
| **Share in total trade** | **90.7%** | **91.8%** | **90.5%** | **90.3%** | **90.0%** | **89.2%** |

### Updating of trade weights

The trade weights are time–varying as they are calculated over non–overlapping three–year periods, where weights are fixed in the sense that the same weights are used for the entire period until the next set of weights (three–year trade data[[3]](#footnote-3)) become available. An advantage of using three–year averages, as opposed to trade weights that are updated more frequently, is the smoothing out of potentially large short–term fluctuations in trade flows. Moreover, more frequent updating also entails additional data revisions, which could complicate the analysis of competitiveness developments.

As a result, six sets of weights are currently available, based on trade data for the periods 2004–2006, 2007–2009, 2010–2012, 2013–2015, 2016–2018 and 2019-2021, selected periods are identical as used by the European Central Bank (ECB) and some other institutions, what enables direct comparability and harmonization.

### Weighting method

In accordance with approach used by the BIS and ECB, CBBH needs to assume that the BH exporters are faced with the total number of export markets “H” (whereby H = N + R; “N” being the trading partners, while, “R” the group of countries referred to as the “rest of the world”). It is assumed that the countries included in the reference group for calculation of effective exchange rate are the only suppliers in H foreign markets and that exports of manufacturing products and domestic production of manufacturing industries of the countries not included in the reference group (i.e. the rest of the world) are not competing with products of the countries in the reference group.

The share of each market in total BH exports is calculated as:

$$x\_{j}=\frac{x\_{j}^{a}}{\sum\_{j=1}^{H}x\_{j}^{a}}, j=1,2,…,H$$

where $x\_{j}^{a}$ denotes the BH export flows in the reference period (average total BH exports in the three–year period) to market *j* (all markets, not only those against which KM external value is measured).

The subsequent adjustment of export shares to capture third market effects yields the double export weights of each partner country *i*:

$$w\_{i}^{x}=\sum\_{j=1}^{H}(S\_{i,j}x\_{j}), i=1,2,…,N$$

where $S\_{i,j}$ is the share of country *i*’s supply (competitors entering into the reference group of countries against which to measure external value of KM) in market *j*, which is obtained as:

$$S\_{i,j}=\frac{S\_{i,j}^{a}}{\sum\_{i=1}^{N}S\_{i,i}^{a}}, i\ne j, i=1,2,…,N, j=1,2,…,H$$

where $S\_{i,j}^{a}$ denotes the export flows from country *i* to market *j*, and $S\_{i,i}^{a}$ represents the gross manufacturing output of country *i* that is sold in its domestic market in the reference period and serves as a proxy for the gross value of the domestically produced supply of manufactured goods.

Then the share of manufacturing products produced in each competitors’ markets that make reference group$ S\_{i,i}$, is obtained as:

$$S\_{i,i}=\frac{S\_{i,i}^{a}}{S\_{i,i}^{a}+\sum\_{i=1}^{N}x\_{i,i}^{a}}$$

where $x\_{i,i}^{a}$ denotes countries exports of country *i* on the reference group market N.

Imported weight of the country *i* does not undergo any adjustments, and is equal to the simple share of country *i* in the total BH imports from N competitor economies that compose the reference group, and is obtained as:

$$w\_{i}^{m}=m\_{i}=\frac{m\_{i}^{a}}{\sum\_{i=1}^{N}m\_{i}^{a}}, i=1,2,…,N$$

where $m^{a}$ is the total import in BH from country *i* in the reference period.

The overall weight of each partner country *i* in the group of trading partners is obtained as the weighted average of the export and import weights, that is:

$$w\_{i}=\left(\frac{m^{a}}{x^{a}+m^{a}}\right)w\_{i}^{m}+\left(\frac{x^{a}}{x^{a}+m^{a}}\right)w\_{i}^{x}, i=1,2,…,N$$

where$ x^{a}$= $\sum\_{j=1}^{H}x\_{j}^{a}$ denotes BH export towards H foreign markets, and $m^{a}=\sum\_{i=1}^{N}m\_{i}^{a}$ denotes BH imports from N competitor economies.

### Double export weights in practice

Domestic production of manufacturing sector represents a value–added product of manufacturing industry increased by imports of these products and reduced for export. The purpose of the aforementioned adjustment was to get the total amount of products that is offered in the domestic market.

Table 1, Part 1. provides simple export weights reflecting shares of BH exports (5–8 SITC) destined for each of the 24 partner countries plus the aggregate for the rest of the world. For example, 6.85% of such BH exports goes to Austria, 11.50% to Croatia, 13.26% to Germany, etc.

Part 2. provides the supply structure matrix of the partner countries, with all percentages in the columns totalling to 100%.

$S\_{i,j} $Each element in this part of the table (excluding those on the main diagonal) – represents the percentage of manufactured goods produced in one of the N competitor countries (across the rows), that is exported abroad to one of the H foreign markets (across the columns). For example, in the first column it is noticeable that 1.93% is accounted for by imports from China, 28.07% imports from Germany, etc.

$S\_{i,i}$ The elements on the main diagonal of the supply structure matrix stand for the percentage of total manufactured goods produced in each of the competitor countries making the reference group, intended for domestic markets of these countries. For example, in Austria 38.49% of the total supply of manufactured goods is from domestic production (first column), in China 93.88% (third column), etc.

Part 3. provides the double export weights – to obtain them CBBH uses the formula presented above $w\_{i}^{x}$ where each row in part 2 is multiplied by the row in part 1. For example, the double export weight of 5.24% is assigned to Austria.

Part 4. provides the impact of foreign competition on the domestic market and therefore it represents a set of bilateral import weights ($w\_{i}^{m}$), and is equal to the simple share of country *i* in the total BH imports from N competitor economies.

Part 5. provides an overall set of weights. In order to obtain an overall set of weights the double–weighted export weights $(w\_{i}^{x})$ and the bilateral import weights $(w\_{i}^{m}) $must be weighted together. For example, using the above-mentioned mathematical formula, the overall weight for Austria is 9.08%, for Croatia 6.48%, etc.

Table 1 Calculation of weights, in %

 

### Choice of currencies

Choice of currencies is based on choice of trading partners, whereas euro is used for members of the euro area and Montenegro. The bilateral exchange rates of domestic currency to the currencies of relevant trading partners are needed for the compilation of both the nominal and real effective exchange rates, where the base period is 2015 (i.e. 2015=100).

In terms of the interpretation of the index, an increase is regarded as an appreciation, whilst a decrease is regarded as a depreciation. Therefore, all the bilateral exchange rates are presented through the value of the domestic currency unit per unit of a foreign currency (for example 1 KM=0,511 EUR).

The CBBH is the source of monthly bilateral exchange rates data, where monthly data on exchange rates were aggregated using geometric average of daily exchange rates.

### Interpretation of the index

An increase in NEER indicates an appreciation of the local currency (KM) against the weighted basket of currencies of its trading partners. Likewise, a decrease in NEER indicates a depreciation of KM.

## Real effective exchange rate (REER)

The real effective exchange rate serves as an indicator of international price and cost competitiveness. Changes in cost and price competitiveness depend not only on exchange rate movements but also on cost and price trends. It is well known that a real effective exchange rate (REER), not bilateral nominal exchange rates, is a better measurement to consider the export firms’ competitiveness in the global market.

REER is calculated as the geometric weighted average of bilateral nominal exchange rates which are deflated using relative prices, where the relative prices trend is based on CPI (Consumer Price Index) and PPI (Producer Price Index).

### Calculation method

$$REER^{t}= \prod\_{i=1}^{N}\left(\frac{d\_{KM}^{t}e\_{i, KM}^{t}}{d\_{i}^{t}}\right)^{w\_{i}}$$

where N stands for the number of competitor countries in the reference group of trading partners, $e\_{i, KM}^{t}$ is an index of the average exchange rate of the currency of partner country *i* vis–à–vis KM in period *t*, $d\_{KM}^{t}$ and $d\_{i}^{t}$ are the deflators with partner country *i*, and $w\_{i}$ is the trade weight assigned to the currency of trading partner *i*.

### Choice of deflators

#### Consumer price index – CPI

Consumer price index is one of two deflators used in REER calculation. The advantage is that it is fairly comparable across countries (as it is calculated on the basis of a basket of goods), it is reasonably rapidly available for a number of countries. The disadvantage is that it also includes goods and services that are internationally tradable, and excludes capital goods.

CPI data are used from various sources on monthly basis since 2005; Data for Austria, Belgium, Croatia, Czech Republic, France, Germany, Hungary, Italy, Montenegro, Netherlands, North Macedonia, Poland, Romania, Serbia, Slovakia, Slovenia, Spain, Switzerland, Turkey and United States of America are published by EUROSTAT; data for China, India, and United Kingdom are published by OECD and data are published by national statistical office for Russian Federation (see the footnote 1).

Data for Bosnia and Herzegovina are published by Agency for Statistics of Bosnia and Herzegovina.

#### Industrial producer price index – PPI

Producer price index (PPI) measures the gross monthly change in the trading price of industrial products. It includes a larger number of products traded internationally, and is a rather good replacement for prices of products traded internationally. The PPI measures price changes from the point of view of the producers/manufacturers of a product.

PPI monthly data for all countries are used since 2007. The data on total markets – for Austria, Belgium, Croatia, Czech Republic, France, Germany, Hungary, Italy, Netherlands, North Macedonia Poland, Romania, Serbia, Slovakia, Slovenia, Spain and Switzerland are published by EUROSTAT; data for domestic market for Montenegro and Turkey are also published by EUROSTAT, and data for domestic markets for China, Russian Federation, United Kingdom and United States of America are published by national statistics offices or other relevant agencies.

Industrial producer prices data of the domestic market for Bosnia and Herzegovina are published by Agency for Statistics of Bosnia and Herzegovina.

## Interpretation of the index

An appreciation in the REER index means that the domestic currency is appreciating and this can occur either through an increase in the domestic price level or a fall in the foreign price level and its likely to translate into a worsening of a country’s trade balance, as it is expected that consumption of its exports will be discouraged as they become more expensive while the country’s import should rise because these will now be relatively cheaper, therefore, an increase indicates a loss in trade competitiveness.

A depreciation in the index signifies currency depreciation due to a lowering in the domestic price level and an increase in the foreign price level.

# Chain–Linking

As mentioned above, weights are updated over non–overlapping three–year periods. The reason for using time–varying weights is that trade patterns change over time and a fixed–weight index does not capture this effect and its weights become gradually outdated (using fixed weights would lead either to an overestimation of a specific country, or an underestimation of its importance).

Therefore, one way to eliminate the problems inherent in the construction of index by using a base period is to use chain-linking approach. A chain index links together the exchange rates and trade weights from period–to–period.

For the effective exchange rates of KM, three-year periods (currently 2007–2009, 2010–2012, 2013–2015, 2016–2018 and 2019-2021) are used. This means that the indices are chain–linked at the end of each period and the chain index gives a correct picture of period–to–period changes.

# Data frequency

With regard to the data frequency of the series, the NEER (2015=100) and chain–linked NEER, REER – CPI deflator (2015=100) and chain–linked REER CPI deflator are available since January 2005, while REER – PPI deflator (2015=100) and chain–linked REER PPI deflator are available since January 2007.

1. In the category of significant trading partners observed up to the three-year weighting period 2019-2022. [↑](#footnote-ref-1)
2. For example. India, Slovakia and Spain became important trade partners in 2023, so they were added to the calculation scheme. [↑](#footnote-ref-2)
3. According to updated UNCTAD data [↑](#footnote-ref-3)