

TECHNICAL ANNEX

INTRODUCTION

The price and cost competitiveness database includes a set of indicators of nominal and real effective exchange rates for the currencies of the European Union Member States, as well as the UK, Japan, the United States, Switzerland, Norway, Turkey, Canada, Australia, New Zealand, Mexico, Russia, China, Brazil, Hong Kong and Korea, spanning the period from 1994 to the current year when source data is available. Aggregate measures for the European Union as a whole (EU27) and the group of countries participating in the euro area (EA19 and EA20) are included as well. Each country (or country group) is compared with the euro area (EA19 and EA20), the EU, (the rest of) 37 industrial countries (the EU countries, the UK, the United States, Japan, Mexico, Canada, Australia, New Zealand, Switzerland, Norway and Turkey) and –data permitting– with the larger group of 42 countries (the 37 industrial countries, Russia, China, Brazil, Hong Kong and Korea).

The nominal effective exchange rate (NEER) (or, equivalently, the “trade-weighted currency index”) describes changes in the average value of a currency with reference to a given base period and a given group of reference countries. It is calculated as a weighted geometric average of the bilateral exchange rates against the currencies of competing countries.

The real effective exchange rate (REER) (or, equivalently, the “relative price and cost indicators”) is calculated taking into account a price or cost deflator. The REER attempts to show the movement in the prices or costs of production of domestically produced goods relative to the prices or costs of goods produced by competitor countries, when expressed in a common currency.

Double export weights are used to calculate NEERs and REERs, reflecting not only competition in the home markets of the various competitors, but also competition in export markets elsewhere.

METHOD

1. Choice of reference period:

The choice of the reference period for assessing developments in nominal and real effective exchange rates is necessarily arbitrary and should not be seen as implying that exchange rates prevailing in this reference period were in equilibrium. The reference year has been chosen as 2015.

2. Calculation of trade weights (used to aggregate the bilateral exchange rates into effective exchange rates) and NEERs:

The nominal effective exchange rates (NEER) of a country are computed using a weighted average of bilateral nominal exchange rates. The process involves averaging the bilateral exchange rates between that country’s currency and the currencies of the trade competitors

considered using trade weights as follows:

$$Neer^t = \prod_{i=1}^N (x_{i,j}^t)^{w_{i,t}}$$

N denotes the competitor countries within the specified partner country group (e.g. 37 industrial countries or 42 countries). The variable $x_{i,j}^t$ is an indicator of the average bilateral exchange rate between the currency of country (j) and the currency of competitor country (i) during a specific time period t . The factor $w_{i,t}$ represents the trade weight of exports associated with the currency of the competitor country (i).

The trade weights used are so-called double export weights. When calculating the geometric average necessary to establish NEERs, the bilateral exchange rates between the currency of a given country and the currencies of its competitor countries are weighted according to:

- (1) the competitors' share in the total supply of competing goods (including the supply by domestic producers) in each market separately; and
- (2) the relative share of each market in the total exports of the given country.

The weight for each partner country (i) for each year (t) is obtained as following:

$$w_{i,t} = w_{i,t}^m \left(\frac{m^{j,t}}{x^{j,t} + m^{j,t}} \right) + w_{i,t}^x \left(\frac{x^{j,t}}{x^{j,t} + m^{j,t}} \right), i = 1, 2, \dots, N; t = 1994, \dots, 2023$$

Where m^j and x^j are, respectively, the total imports and exports of country (j) and w_i^m and w_i^x are respectively the import and export weights of the partner country (i) in a specific year (t), calculated as:

$$w_{i,t}^m = \frac{m_{i,t}^{j,t}}{\sum_{i=1}^N m_{i,t}^{j,t}}, i = 1, 2, \dots, N; t = 1994, \dots, 2023$$

$$w_{i,t}^x = \frac{x_{i,t}^{j,t}}{\sum_{i=1}^N x_{i,t}^{j,t}}, i = 1, 2, \dots, N; t = 1994, \dots, 2023$$

Time-varying weight matrices are used in order to capture the influence of trade patterns over time. The weight matrix of year t are used to calculate the the effective exchange rate of year t . If no weights are available for the year t , the weights of the latest year available are used.

3. The choice of price and cost deflators (to transform the nominal effective exchange rates into real effective rates) and the calculation of the REER:

In line with the calculation method of the nominal effective exchange rates, the real effective exchange rates of a specific country are computed as a weighted average of the bilateral nominal exchange rates adjusted using price or cost deflators:

$$Reer^t = \prod_{i=1}^N \left(\frac{defl_j^t x_{i,j}^t}{defl_i^t} \right)^{w_{i,t}}$$

N denotes the countries within the specified partner country group. The variable $x_{i,j}^t$ is an indicator of the average exchange rate between the currency of country (j) and the currency of competitor country (i) during a specific time period t . $defl_{eur}^t$ and $defl_i^t$ are respectively the deflators for countries j and i. The factor $w_{i,t}$ represents the trade weight of exports associated with the currency of the competitor country (i).

Four real effective exchange rates series (each based on a different deflator) are calculated in order to provide a comprehensive assessment of a country's price and cost competitiveness. The following deflators are currently being used:

- (1) Consumer price indices (CPI and HICP where available);
- (2) the GDP deflator;
- (3) the XPI deflator, i.e. the price deflator of exports of goods and services;
- (4) the ULC deflator, i.e. the unit labour costs in economy as a whole.

Data are taken from DG ECFIN's AMECO database.

For the composite groups such as the EA20 or EU27, that the national exchange rates are aggregated via the following formula:

$$e_{i,agg} = \prod_{k=1}^N (e_{i,k})^{w_k}$$

where $e_{i,agg}$ is the exchange rate of country i against the aggregated group currency (euro), $e_{i,k}$ stands for the country i exchange rate against country k's original (or, for the euro area, former) currency, N is the number of countries within the (aggregated) group. The weight w_k for each constituent country within the aggregate group is its share in the total trade flow of the group.

4. Adjustment in the computation of the euro effective exchange rate indices following the adoption of the euro by new EA member countries:

As from 1 January 2001, following the adoption of the euro by Greece, the euro effective exchange rate (EER) series have been modified to reflect the enlargement of the euro area. The adapted series treat Greece as a euro area country prior to January 2001. The new weights were applied for the whole of the period over which the euro indices are calculated¹. In this context, a "theoretical" euro exchange rate has been computed in which the Greek drachma is treated as an EMU legacy currency. The same methodology was applied when Slovenia entered the euro area on 1 January 2007, when Cyprus and Malta entered the euro area on 1 January 2008, when Slovakia entered the euro area on 1 January 2009, when Estonia entered the euro area on 1 January 2011, when Latvia entered the euro area on 1 January 2014, when Lithuania entered the euro area on 1 January 2015 and when Croatia entered the euro area on 1 January 2023.

¹ Similarly, euro area-wide deflators used for this purpose include Greek cost or price developments, again prior to Greece's adoption of the single currency.

DATA SOURCES

1. Nominal bilateral exchange rates and deflators

Bilateral exchange rate data are taken from the official daily fixings published by the ECB at 16h. Monthly data are calculated as the arithmetic mean of the daily rates. Quarterly and yearly data are calculated as the arithmetic means of these monthly figures. For the periods before euro participation, a weighted average of the currencies of the Member States now participating in the euro area is used as a proxy for the euro.

Regarding the deflators, monthly inflation data (HICP, index number series) published by Eurostat are used. For countries not reported by Eurostat, national CPI data series published by either the IMF (IFS database) or the OECD (MEI database) are used. Annual data for the GDP, XPI (export price index) and ULC (unit labour cost) deflators (including Commission forecasts for the current year) are taken from DG ECFIN's AMECO database. The frequency of updates of GDP, XPI and ULC deflators is biannual, upon release of ECFIN's Spring and Autumn forecasts. HICP-based REER series are updated monthly upon the release of HICP data by Eurostat. The annual data is transformed into quarterly and monthly data by applying a mathematical splining method.

2. Weight matrices

The double export weight matrices are derived from trade matrices with domestic production for the home market on the diagonal.

The source data for bilateral imports and exports (m_i^j and x_i^j) is the DoT (IMF) database, which is the source of data for aggregate imports and exports (m^j and x^j) as well, the domestic production for each individual country is taken from the national accounts' data from AMECO.

3. Missing data

As the calculation of real effective exchange rates requires a full data set, missing deflator data are obtained from national official statistical sources. So far, the only occurrence of missing data pertains to Hong Kong's ULC and XPI deflators, which consequently sourced from the Statistics Department of Hong Kong SAR.

TIME AND COUNTRY COVERAGE

The price and cost competitiveness database contains nominal and real effective exchange rates computed starting from 1994. The nominal and real effective exchange rates cover a broad group of 42 countries and a group of 37 industrial countries (IC37), relative to the European Union as a whole (EU27) and relative to the countries in the euro area (EA19 and EA20). IC37 consists of the 27 EU Member States plus the United Kingdom, United States, Canada, Japan, Switzerland, Norway, Australia, New Zealand, Mexico, and Turkey. The broad group 42 consists of the IC37 countries plus Russia, China, Brazil, Korea and Hong Kong. For the double export weight matrix a group of 66 countries is considered: the broad group of 42 countries plus Albania, Algeria, Argentina, Bosnia and Herzegovina, Chile, Egypt,

Iceland, India, Indonesia, Israel, Malaysia, Montenegro, Morocco, North Macedonia, Philippines, Saudi Arabia, Serbia, Singapore, South Africa, Taiwan Province of China, Thailand, Tunisia, United Arab Emirates, and Venezuela.

Due to data constraints, real effective exchange rates based on unit labour costs and the price deflator of exports of goods and services cannot be calculated for the broad group of 42. In addition, for all the country groups, monthly real effective exchange rates are calculated exclusively for consumer price index, being this the sole deflator updated monthly.