EUROPEAN CENTRAL BANK
EUROSYSTEM

Technical notes

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ECB/Eurosystem policy and exchange rates

Official interest rates

Calculation of interest rates on indexed longer-term refinancing operations

The interest rate on an indexed longer-term refinancing operation (LTRO) is equal to the average of the minimum bid rates on the main refinancing operations (MROs) over the life of that LTRO. According to this definition, if an LTRO is outstanding for D number of days and the minimum bid rates prevailing in MROs are $R_{1,MRO}$ (over D_1 days), $R_{2,MRO}$ (over D_2 days), etc., until $R_{n,MRO}$ (over D_n days) the applicable annualised rate (R_{LTRO}) is calculated as:

(1.1) $$R_{LTRO} = \frac{\sum_i^n D_i R_{i,MRO}}{\sum_i^n D_i}$$

Effective exchange rates[1]

The effective exchange rates (EERs) of the euro are weighted geometric averages of the bilateral exchange rates of the euro against the currencies of the euro area's main trading partners. A positive change in the index denotes a strengthening of the EER of the euro. The weights assigned to each trading partner combine information on imports and exports of manufactured goods between it and the euro area.
The nominal EER of the euro is defined as:

(1.2) $$NEER^t = \prod_{i=1}^{N} \left(e_{i,euro}^t\right)^{w_i}$$

where N stands for the number of trading partners in the reference group, $e_{i,euro}^t$ is an index of the average exchange rate of the currency of trading partner i vis-à-vis the euro in period t, and w_i is the trade weight assigned to the currency of trading partner i.

Real EERs of the euro are calculated as weighted geometric averages of nominal bilateral exchange rates deflated using different relative price and cost measures (see below). The real EER of the euro is hence defined as:

(1.3) $$REER^t = \prod_{i=1}^{N} \left(\frac{d_{euro}^t e_{i,euro}^t}{d_i^t}\right)^{w_i}$$

[1] For additional information, see the "Daily nominal effective exchange rate of the euro" section of the ECB's website.

where N stands for the number of trading partners in the reference group, $e_{i,euro}^{t}$ is an index of the average exchange rate of the currency of trading partner i vis-à-vis the euro in period t, d_i^t, d_{euro}^t are the deflators for the euro area and trading partner i, and w_i is the trade weight assigned to the currency of trading partner i.

Trade basis

The weights are based on bilateral data on trade in manufactured goods, as defined in Sections 5 to 8 of the Standard International Trade Classification (i.e. excluding agricultural products, raw material and energy products)[2], and trade in services (Total EBOPS Services) for the periods 1995-97, 1998-2000, 2001-03, 2004-06, 2007-09, 2010-12, 2013-2015, 2016-18 and 2019-21. However, manufacturing-focused real effective exchange rates and harmonised competitiveness indicators, deflated by producer prices (PPI) or unit labour cost in the manufacturing sector (ULCM), rely on weights solely based on trade in manufactured goods.

Trading partners

The EERs are calculated for three groups of trading partners:

- EER-12: this group is composed of Australia, Canada, Denmark, Hong Kong, Japan, Norway, Singapore, South Korea, Sweden, Switzerland, the United Kingdom and the United States.
- EER-18: this group includes Bulgaria, China, Czech Republic, Hungary, Poland and Romania in addition to the trading partners in the EER-12.
- EER-41: in addition to the trading partners in the EER-18, the EER-41 includes Algeria, Argentina, Brazil, Chile, Colombia, Iceland, India, Indonesia, Israel, Malaysia, Mexico, Morocco, New Zealand, Peru, the Philippines, Russia, Saudi Arabia, South Africa, Taiwan, Thailand, Turkey, Ukraine and the United Arab Emirates.

The selection is based on the importance of the trading partners for the euro area and on data availability, in particular the availability of high-quality data on price and cost indicators for use in the calculation of the real EERs.

Weighting scheme

The EERs of the euro are calculated using trade weights that combine information on both exports and imports, excluding intra-euro area trade. Import weights are each trading partner's simple share in total euro area imports. Export weights, on the

[2] These categories comprise chemicals and related products, manufactured goods classified chiefly by material, machinery and transport equipment, and miscellaneous manufactured articles.

other hand, are double-weighted to account for "third-market effects". More specifically, they capture the effect of competition faced by euro area exporters in foreign markets not only from domestic producers but also from exporters from third countries.[3] The overall weight of each partner country i is obtained as the weighted average of the export and import weights.[4]

Updating of trade weights

When the EERs of the euro were initially calculated in 1999, the first set of trade weights was based on data for the three-year period from 1995 to 1997. This weighting scheme remained in place until the first five-yearly update in 2004, when the weights for the period 1995-97 were recalculated taking into account data revisions for that period, and new trade weights were calculated for the three-year period from 1999 to 2001.

In 2007 a Eurosystem workshop recommended that the trade weights be updated more frequently. It was thus decided to update them every three years (instead of every five years) in order to reflect developments in the pattern of international trade in a more timely fashion.

In the second update of the trade weights, in 2009, the weighting scheme for 1995-97 (as calculated in 2004 and adjusted after the euro area enlargements) was maintained, and new trade weights were calculated on the basis of revised manufacturing trade data for the three-year periods 1998-2000, 2001-03 and 2004-06.

In the third update, carried out in January 2012, all existing weights were updated with revised manufacturing trade data; moreover, trade weights for the period from 2007 to 2009 were added.

In the fourth update, carried out in August 2015, all existing weights were updated with revised manufacturing trade data and trade weights for the period from 2010 to 2012 were added.

In the fifth update, carried out in August 2017, all existing weights were updated with revised manufacturing trade data and trade weights for the period from 2013 to 2015 were added. As a result, seven sets of trade weights are currently available, based on trade data for the periods 1995-97, 1998-2000, 2001-03, 2004-06, 2007-09, 2010-12 and 2013-15. Fixed chain-linking on a three-yearly basis is used for the EERs of the euro, so the indices are chain-linked at the end of each of the seven periods.

[3] See Schmitz, Martin, De Clercq, Maarten, Fidora, Michael, Lauro, Bernadette and Pinheiro, Cristina, "Revisiting the effective exchange rates of the euro", Occasional Paper Series, No 134, ECB, Frankfurt am Main, June 2012.

[4] Harmonised competitiveness indicators for individual euro area countries, following the same methodology and data sources as the EERs, are also published on the ECB's website.

In the sixth update, carried out in July 2020, major methodological changes were introduced. For the first time, new trade weights were calculated combining manufacturing trade and services trade data for the period 1995-2018. The seventh update took place in September 2023, revising all previous periods and adding new weights for 2019-21.

As a result, nine sets of trade weights are currently available, based on trade data for the periods 1995-97, 1998-2000, 2001-03, 2004-06, 2007-09, 2010-12, 2013-15, 2016-18 and 2019-21. Fixed chain-linking on a three-yearly basis is used for the EERs of the euro, so the indices are chain-linked at the end of each of the seven periods.

Besides these updates, the overall trade weights and final EERs were recalculated every time there was an enlargement of the euro area, since a country joining Monetary Union is excluded from the groups of euro area trading partners and included in the euro area computations. Most recently, the trade weights underlying the calculation of the EERs of the euro and the harmonised competitiveness indicators (HCIs) of the euro area countries have been updated to reflect the enlargement of the euro area to include Croatia on 1 January 2023.

Deflators

Deflators for the real EERs are: consumer price indices (CPIs), producer price indices (PPIs), GDP deflators and unit labour costs, both for the total economy (ULCT) and for the manufacturing sector (ULCM). Deflator data are collected from several sources (mainly Eurostat, the OECD, the BIS and the IMF). For both the euro area and EU countries, the price and cost measures are based on harmonised concepts (the Harmonised Index of Consumer Prices, PPI, unit labour costs based on the European System of Accounts 2010 and GDP deflators). In cases where deflators are only available with a time lag, the latest observations are estimated. The data are seasonally adjusted and, if quarterly data are not available, disaggregated from annual data.

EERs based on the complete set of deflators are calculated for the EER-12 group and the EER-18 group, while for the EER-41 group CPI and GDP are the only available deflators.

Exchange rates

The bilateral exchange rates used in the calculation are, in most cases, the ECB's official daily reference rates (if these are not available, indicative rates published by other international organisations are used).

For the period before 1 January 1999, the EERs are based on a basket of the currencies of the 11 countries that formed the euro area in January 1999. The weighted geometric averages of the exchange rates of the currencies of these countries are used to obtain a "proxy" euro exchange rate. The weights for the pre-1999 "theoretical" euro exchange rates are based on the share of each euro area country in the total manufacturing trade of the euro area with non-euro area countries in the period from 1995 to 1997.

Frequency and base period

The nominal EERs for the EER-12, EER-18 and EER-41 are available daily. All other indicators are available monthly, except for the real EER indices based on ULCT, ULCM and GDP deflators, which are available quarterly. The base period for all indices is the first quarter of 1999 (i.e. 1999Q1 = 100).

Money, credit, and banking

Monetary aggregates

Calculation of growth rates for monetary developments

The average growth rate for the quarter ending in month t is calculated as:

(1.3) $$\left(\frac{0.5I_t + \sum_{i=1}^{2} I_{t-i} + 0.5I_{t-3}}{0.5I_{t-12} + \sum_{i=1}^{2} I_{t-i-12} + 0.5I_{t-15}} - 1\right) \times 100$$

where I_t is the index of adjusted outstanding amounts as at month t (see also below). Likewise, for the year ending in month t, the average growth rate is calculated as:

(1.4) $$\left(\frac{0.5I_t + \sum_{i=1}^{11} I_{t-i} + 0.5I_{t-12}}{0.5I_{t-12} + \sum_{i=1}^{11} I_{t-i-12} + 0.5I_{t-24}} - 1\right) \times 100$$

Calculation of transactions

Monthly transactions are calculated from monthly differences in outstanding amounts adjusted for reclassifications, other revaluations, exchange rate variations and any other changes which do not arise from transactions.

If L_t represents the outstanding amount at the end of month t, C_t^M the reclassification adjustment in month t, E_t^M the exchange rate adjustment and V_t^M the other revaluation adjustments, the transactions F_t^M in month t are defined as:

(1.5) $$F_t^M = (L_t - L_{t-1}) - C_t^M - E_t^M - V_t^M$$

Similarly, the quarterly transactions F_t^Q for the quarter ending in month t are defined as:

(1.6) $$F_t^Q = (L_t - L_{t-3}) - C_t^Q - E_t^Q - V_t^Q$$

where L_{t-3} is the amount outstanding at the end of month $t\ -3$ (the end of the previous quarter) and, for example, C_t^Q is the reclassification adjustment in the quarter ending in month t.

For those quarterly series for which monthly observations are now available (see below), the quarterly transactions can be derived as the sum of the three-monthly transaction figures in the quarter.

Calculation of growth rates for monthly series

Growth rates can be calculated from transactions or from the index of adjusted outstanding amounts. If F_t^M and L_t are defined as above, the index It of adjusted outstanding amounts in month t is defined as:

(1.7) $$I_t = I_{t-1} \times \left(1 + \frac{F_t^M}{L_{t-1}}\right)$$

The base of the index (for the non-seasonally adjusted series) is currently set as December 2010 = 100. Time series for the index of adjusted outstanding amounts are available on the ECB's website (http://www.ecb.europa.eu/stats/money/aggregates/aggr/html/index.en.html).

The annual growth rate at for month t – i.e., the change in the 12 months ending in month t – can be calculated using either of the following two formulae:

(1.8) $$a_t = (\prod_{i=0}^{11} \left(1 + \frac{F_{t-i}^M}{L_{t-1-i}}\right) - 1) \times 100$$

(1.9) $$a_t = \left(\frac{I_t}{I_{t-12}} - 1\right) \times 100$$

Unless otherwise indicated, the annual growth rates refer to the end of the indicated period. For example, the annual percentage change for the year 2002 is calculated in formula (1.9) by dividing the index for December 2002 by the index for December 2001.

Growth rates for intra-annual periods can be derived by adapting formula (1.9). For example, the month-on-month growth rate a_t^M can be calculated as:

(1.10) $$a_t^M = \left(\frac{I_t}{I_{t-1}} - 1\right) \times 100$$

Finally, the three-month moving average (centred) for the annual growth rate of M3 is obtained as $(a_{t+1} + a_t\ + a_{t-1})/3$, where a_t is defined as in formula (1.8) or (1.9) above.

Calculation of growth rates for quarterly series

If F_t^Q and L_{t-3} are defined in formula (1.6), the index I_t of adjusted outstanding amounts for the quarter ending in month t is defined as:

$$I_t = I_{t-3} \times \left(1 + \frac{F_t^Q}{L_{t-3}}\right) \tag{1.11}$$

The annual growth rate in the four quarters ending in month t (i.e., a_t) can be calculated using formula (1.9).

Seasonal adjustment of the euro area monetary statistics[5]

The approach used for seasonal adjustment of the euro area monetary statistics is based on multiplicative decomposition using X-12-ARIMA[6] . The seasonal adjustment may include a day-of-the-week adjustment, and for some series it is carried out indirectly by means of a linear combination of components. This is the case for M3, which is derived by aggregating the seasonally adjusted series for M1, M2 less M1, and M3 less M2.

The seasonal adjustment procedures are first applied to the index of adjusted outstanding amounts[7].The resulting estimates of seasonal factors are then applied to the levels and to the adjustments arising from reclassifications and revaluations, in turn yielding seasonally adjusted transactions. Seasonal (and trading day) factors are revised at annual intervals or as required.

[5] For details, see “Seasonal adjustment of monetary aggregates and HICP for the euro area”, ECB, August 2000 and the "Monetary and financial statistics" sub-section of the “Statistics” section of the ECB’s website (http://www.ecb.europa.eu/stats/money/aggregates/aggr/html/index.en.html).

[6] For details, see Findley, D., Monsell, B., Bell, W., Otto, M. and Chen, B. C., "New Capabilities and Methods of the X-12-ARIMA Seasonal Adjustment Program", Journal of Business and Economic Statistics, 16, 2, 1998, pp.127-152, or "X-12-ARIMA Reference Manual", U.S. Census Bureau, Washington, D.C. For internal purposes, the model-based approach of TRAMO-SEATS is also used. For details of TRAMO-SEATS, see Gómez, V. and Maravall, A., "Programs TRAMO and SEATS: Instructions for the User", Banco de España, Working Paper No 9628, Madrid, 1996.

[7] It follows that for the seasonally adjusted series, the level of the index for the base period (i.e. December 2008) generally differs from 100, reflecting the seasonality of that month.

Financial markets and interest rates

Securities

Calculation of growth rates for debt securities and listed shares

Growth rates are calculated based on financial transactions and therefore exclude reclassifications, revaluations, exchange rate variations and any other changes which do not arise from transactions. They can be calculated from transactions or from an index of notional stocks. If N_t^M represents the transactions (net issues) in month t and L_t the level outstanding at the end of month t, the index It of notional stocks in month t is defined as:

(1.12) $$I_t = I_{t-1} \times \left(1 + \frac{N_t^M}{L_{t-1}}\right)$$

The base of the index is set equal to 100 in December 2020. For selected time series on debt securities at face value, which have been extended with historical data from the discontinued securities issues statistics, the base of the index is set equal to 100 in December 2008. The growth rate a_t for month t, corresponding to the change in the 12 months ending in month $t,$ can be calculated using either of the following two formulae:

(1.13) $$a_t = (\prod_{i=0}^{11}\left(1 + \frac{N_{t-i}^M}{L_{t-1-i}}\right) - 1) \times 100$$

(1.14) $$a_t = \left(\frac{I_t}{I_{t-12}} - 1\right) \times 100$$

The method used to calculate the growth rates for debt securities and listed shares is the same as that used for the monetary aggregates, the only difference being that an “N” is used instead of an “F”. This is to show that the method used to obtain “net issues” for securities issues statistics differs from that used to calculate equivalent “transactions” for the monetary aggregates.

The average growth rate for the quarter ending in month t is calculated as:

(1.15) $$\left(\frac{0.5I_t + \sum_{i=1}^{2} I_{t-i} + 0.5I_{t-3}}{0.5I_{t-12} + \sum_{i=1}^{2} I_{t-i-12} + 0.5I_{t-15}} - 1\right) \times 100$$

where I_t is the index of notional stocks as at month t. Likewise, for the year ending in month t, the average growth rate is calculated as:

(1.16) $$\left(\frac{0.5I_t + \sum_{i=1}^{11} I_{t-i} + 0.5I_{t-12}}{0.5I_{t-12} + \sum_{i=1}^{11} I_{t-i-12} + 0.5I_{t-24}} - 1\right) \times 100$$

Macroeconomic and sectoral statistics

Measuring inflation - HICP

Seasonal adjustment of the Harmonised Index of Consumer Prices (HICP)

The seasonal adjustment of the euro area HICP is conducted with X-13 in JDemetra+. The adjustment of the overall HICP is carried out indirectly by aggregating the seasonally adjusted euro area series for processed food, unprocessed food, industrial goods excluding energy, and services. Energy is added without adjustment since there is no statistical evidence of identifiable seasonality. The euro area HICPs for services is also adjusted for calendar effects. For additional information, see the box entitled "Harmonised Index of Consumer Prices - Easter effects and improved seasonal adjustment", Economic Bulletin, Issue 3, ECB, 2016. Seasonal factors are revised at annual intervals or as required.

Sector accounts

Equality of uses and resources

In the Integrated economic accounts, financial accounts section the data conform to a basic accounting identity. For non-financial transactions, total uses equal total resources for each transaction category. This accounting identity is also reflected in the financial account i.e., for each financial instrument category, total transactions in financial assets equal total transactions in liabilities. In the other changes in assets account and the financial balance sheets, total assets equal total liabilities for each financial instrument category, with the exception of monetary gold and special drawing rights, which are by definition not a liability of any sector.

Calculation of balancing items

The trade balance equals euro area imports minus exports vis-à-vis the rest of the world for goods and services.

Net operating surplus and mixed income is defined for resident sectors only and is calculated as gross value added (gross domestic product at market prices for the euro area) minus compensation of employees (uses) minus other taxes less subsidies on production (uses) minus consumption of fixed capital (uses).

Net national income is defined for resident sectors only and is computed as net operating surplus and mixed income plus compensation of employees (resources) plus taxes less subsidies on production (resources) plus net property income (resources minus uses).

Net disposable income is also defined only for resident sectors and equals net national income plus net current taxes on income and wealth (resources minus uses) plus net social contributions (resources minus uses) plus net social benefits other than social transfers in kind (resources minus uses) plus net other current transfers (resources minus uses).

Net saving is defined for resident sectors and is calculated as net disposable income plus the net adjustment for the change in the net equity of households in pension fund reserves (resources minus uses) minus final consumption expenditure (uses). For the rest of the world, the current external account is compiled as the trade balance plus all net income (resources minus uses).

Net lending/net borrowing is computed from the capital account as net saving plus net capital transfers (resources minus uses) minus gross capital formation (uses) minus acquisitions less disposals of non-produced non-financial assets (uses) plus consumption of fixed capital (resources). It can also be calculated in the financial account as total transactions in financial assets minus total transactions in financial liabilities (also known as changes in net financial worth (wealth) due to transactions).

For the household and non-financial corporation sectors, there is a statistical discrepancy between the balancing items computed from the capital account and the financial account.

Changes in net financial worth (wealth) due to transactions are computed as total transactions in financial assets minus total transactions in financial liabilities, whereas other changes in net financial worth (wealth) are calculated as (total) other changes in financial assets minus (total) other changes in financial liabilities.

Net financial worth (wealth) is calculated as total financial assets minus total financial liabilities, whereas changes in net financial worth (wealth) are equal to the sum of changes in net financial worth (wealth) due to transactions (lending/net borrowing from the financial account) and other changes in net financial worth (wealth).

Changes in net worth (wealth) are calculated as changes in net worth (wealth) due to savings and capital transfers plus other changes in net financial worth (wealth) and other changes in non-financial assets.

The net worth (wealth) of households is calculated as the sum of the non-financial assets and net financial worth (wealth) of households

Annual growth rates for financial transactions

The annual growth rate $g(f_t)$ for financial transactions is calculated as:

$$g(f_t) = \left(\frac{\sum_{i=0}^{3} f_{t-i}}{F_{t-4}}\right) \times 100 \qquad (1.17)$$

where f_t stands for the transactions in quarter t, and F_{t-4} for the end-of-quarter stock value four quarters earlier.

Balance of payments and other external statistics

Summary current and capital account, Services, Investment income, Current and capital account

Seasonal adjustment of the balance of payments current account

The approach used is based on multiplicative decomposition, using JDemetra+ platform and selecting either X-13-ARIMA or TRAMO-SEATS method depending on the item. The raw data for goods, services, primary income, and secondary income are pre-adjusted in order to take into account significant working day effects. The working day adjustment for goods and services takes account of national public holidays. The seasonal adjustment of these four items of the current account is carried out using these pre-adjusted series. The seasonal adjustment of the total current account is carried out by aggregating the seasonally adjusted euro area series for goods, services, primary income, and secondary income. Seasonal (and trading day) factors are revised at biannual intervals or as required.

Summary financial account, Direct investment, Portfolio investment, Other investment, Financial account

Calculation of growth rates for the quarterly and annual series

The annual growth rate for quarter t is calculated on the basis of quarterly transactions (F) and positions (L) as follows:

$$a_t = \left(\prod_{i=t-3}^{t} \left(1 + \frac{F_t}{L_{t-1}}\right) - 1\right) \times 100 \tag{1.18}$$

The growth rate for the annual series is equal to the growth rate in the last quarter of the year.