

The nominal and real effective exchange rates of the euro

This article presents the results of the work undertaken by the European Central Bank (ECB) and the national central banks (NCBs) starting in 1999 to compile effective exchange rate indicators for the euro which are based on a commonly agreed methodological framework and which are appropriate for the needs of the Eurosystem. This work has produced two sets of indicators: (i) one nominal and several real effective exchange rate indices based on different price and cost deflators for a narrow group of countries consisting of 13 industrial and newly industrialised trading partners of the euro area; and (ii) a nominal and a real effective exchange rate index for a broad group of 39 trading partners, including emerging market and transition economies. The narrow and broad groups of partner countries accounted for roughly 62% and 89% respectively of total euro area manufacturing trade (imports and exports) in 1995-97.

The methodology used to compute the trade weights on which the Eurosystem's set of effective exchange rates is based is similar to that underlying the effective exchange rate indices published by the Bank for International Settlements (BIS). The weights used in setting up the indices are overall trade weights based on extra-euro area manufacturing trade and take account of "third market" effects. The weighting scheme is fixed; however, the weights themselves will be revised every five years. Historical data for both the narrow and broad sets of indicators are computed by means of aggregating euro area countries' data and using a "theoretical" euro, calculated on the basis of participating countries' currencies before 1999.

I Introduction

The nominal effective exchange rate (EER) is a summary measure of the external value of a currency vis-à-vis the currencies of the most important trading partners, while the real EER – obtained by deflating the nominal rate with appropriate price or cost indices – is the most commonly used indicator of international price and cost competitiveness.

In preparation for the start of Stage Three of Economic and Monetary Union (EMU), the ECB and the NCBs of participating countries began their work on the composition of a set of EER indicators for the single currency based on a commonly agreed methodological framework. This undertaking was aimed primarily at addressing the lack of indicators which treat the euro area as a whole, while ensuring the use of methodologies that would be both scientifically satisfactory and tailored to the specific needs of the Eurosystem.

In the light of these primary objectives, two sets of EER indicators have been compiled on the basis of a narrow and a broad group of trading partners, in order to deal effectively with the trade-off between trade coverage and availability, as well as the timely updating

of the indicators. Specifically, this dual approach ensures that: (i) the external value of the euro and the competitiveness of the euro area in terms of prices and costs can be assessed in a comprehensive manner against a relatively small number of countries which account for a sufficiently large portion of euro area trade and for which reliable data are available in a timely fashion; and (ii) euro area competitiveness can be evaluated, albeit only in terms of relative consumer prices, against an extended group of trading partners which also encompasses accession countries and emerging market economies in Asia, Latin America and eastern Europe, as well as relevant trading partners in other parts of the world.

The wider coverage of the broad group of trading partners is intended to serve an additional purpose. The group is sufficiently broad to enable *national competitiveness indicators* to be constructed for euro area countries using the commonly agreed methodological framework. Such indicators may provide useful information on the competitive position of individual euro area countries, considering that trade patterns

vis-à-vis the outside world may differ between these countries.

The Eurosystem's set of real EER indicators for the euro presented in this article is designed primarily to measure changes in the international price and cost competitiveness of the euro area and, consequently, these indicators may not be particularly suitable for use in assessing the impact of exchange rate changes on domestic inflation through import prices. In order to address the latter issue, the possibility of constructing a real

EER indicator based on import prices and appropriate weights is under consideration.

Finally, it should be noted that the term "competitiveness" in this article refers exclusively to relative price and cost developments between the euro area and its trading partners, as the real EER indicators do not take into account other aspects of international competitiveness, such as product quality, innovation and flexible labour markets.

2 Methodological issues

Trade basis for the calculation of the weights

The weights required for setting up the nominal and real EERs of the euro are computed on the basis of manufacturing trade flows (three-year average over the period from 1995 to 1997) as defined in Sections 5 to 8 of the Standard International Trade Classification (SITC 5-8). Manufacturing trade constitutes the most appropriate trade basis for the Eurosystem's set of EERs, mainly owing to the large share of manufacturing goods in total euro area trade. Although it would, in principle, be desirable to include trade in services, data on transactions in services and their prices are relatively scarce and show a low level of comparability across countries.

Selection of partner countries

The euro area has significant trade relationships with a large number of countries around the world. This means that effective exchange rate developments of the euro and competitiveness developments in the euro area have to be measured relative to many currencies and trading partners worldwide, including emerging market economies and economies in transition. At the same time, however, for several of these countries, necessary data on price and cost indicators,

in particular, may not be available on a timely or high-frequency basis; some of these countries may also be prone to inflation, with currencies experiencing large and prolonged nominal depreciations accordingly. Therefore, the Eurosystem has adopted a two-pronged approach to the compilation of its set of EER indicators, by considering two groups of countries: a narrow group comprising 13 industrial and newly industrialised trading partners of the euro area, and a broad group with 39 trading partners.

The selection criteria for the countries of each of the two groups are different and relate not only to the relative importance of the respective countries as trading partners of the euro area, but also to the properties which the resultant EER indicator is required to exhibit. The narrow group, which covers a significant portion of total euro area manufacturing trade (62% in 1995-97), is made up of those trading partners of the euro area for which (i) significant trade links with the euro area exist, (ii) exchange rate data are available on a daily basis, and (iii) a sufficiently broad range of price and cost indices exists on a monthly or quarterly basis and in a relatively timely and reliable fashion.

The broad group of partner countries covers 89% of euro area external trade in manufacturing goods in the period from 1995 to 1997. In addition to the countries in

Table I**Weights in the ECB's narrow and broad effective exchange rate indices***(as percentages)*

Partner countries	Simple share in the euro area's manufacturing trade ¹⁾	Overall weight in the narrow EER index ²⁾	Simple share in the euro area's manufacturing trade ¹⁾	Overall weight in the broad EER index ²⁾
Broad group ³⁾			100	100
Narrow group ³⁾	100	100	69.32	69.69
<i>Australia</i>	1.27	1.12	0.88	0.79
<i>Canada</i>	1.84	1.93	1.28	1.45
<i>Denmark</i>	3.91	3.45	2.71	2.55
<i>Greece</i>	1.87	1.47	1.30	1.10
<i>Hong Kong SAR</i>	2.68	3.83	1.85	2.03
<i>Japan</i>	10.01	14.78	6.94	9.98
<i>Norway</i>	2.10	1.68	1.45	1.32
<i>Singapore</i>	2.36	3.44	1.63	2.04
<i>South Korea</i>	2.92	4.80	2.03	2.76
<i>Sweden</i>	7.07	6.14	4.90	4.31
<i>Switzerland</i>	11.20	8.71	7.76	6.44
<i>United Kingdom</i>	29.48	23.92	20.43	17.85
<i>United States</i>	23.29	24.72	16.15	17.07
Additional countries in the broad group			30.68	30.31
<i>Algeria</i>			0.38	0.32
<i>Argentina</i>			0.58	0.53
<i>Brazil</i>			1.42	1.43
<i>China</i>			3.69	3.99
<i>Croatia</i>			0.51	0.49
<i>Cyprus</i>			0.15	0.10
<i>Czech Republic</i>			2.09	1.83
<i>Estonia</i>			0.17	0.15
<i>Hungary</i>			1.77	1.52
<i>India</i>			1.32	1.46
<i>Indonesia</i>			0.94	0.91
<i>Israel</i>			1.26	1.08
<i>Malaysia</i>			1.18	1.30
<i>Mexico</i>			0.69	0.82
<i>Morocco</i>			0.72	0.63
<i>New Zealand</i>			0.14	0.20
<i>Philippines</i>			0.44	0.42
<i>Poland</i>			2.61	2.29
<i>Romania</i>			0.73	0.68
<i>Russia</i>			2.11	2.33
<i>Slovakia</i>			0.69	0.76
<i>Slovenia</i>			0.95	0.81
<i>South Africa</i>			0.89	0.89
<i>Taiwan</i>			1.94	2.13
<i>Thailand</i>			1.10	1.20
<i>Turkey</i>			2.21	2.04

Sources: Eurostat (Comext) and ECB calculations.

1) Simple import and export shares in total euro area manufacturing trade excluding "third market" effects.

2) Overall weights are a weighted average of simple import shares and double export weights, i.e. taking into account "third market" effects.

3) The narrow and broad groups account for 62% and 89% respectively of total euro area manufacturing trade in 1995-97.

the narrow group, it incorporates other countries which possess one or more of the following features: (i) an individual share in total euro area manufacturing trade larger than 1%, (ii) being among the EU accession countries, and (iii) significant trade links with individual euro area countries, although the share relative to overall euro area manufacturing trade may be small. In conjunction with these selection criteria, the composition of the broad group was also determined by timely and reliable availability of the Consumer Price Index (CPI) on a monthly basis.

In terms of overall trade weights, the euro area's two main trading partners are the United States and the United Kingdom, which have very similar weights, amounting to around 24% each in the narrow index and 17% in the broad index (see Table I). The weights of the third and fourth most important trading partners – Japan and Switzerland – in the narrow index are 15% and 9% respectively, while in the broad index these are 10% and 6% respectively. All other trading partners have a share of less than 5% in both the narrow and the broad indices, indicating a broad dispersion of euro area external trade.

In terms of a regional grouping, the industrial economies outside the euro area within Europe clearly constitute the most important regional group for the euro area's external trade, carrying a weight of around 34% in the broad index coverage. The second largest region is Asia, with some 20%, followed by North America, with around 18%. The transition economies in eastern Europe together with Russia account for a total of some 11% and Latin America for around 5%. The remainder includes countries in Africa, the Middle East and Oceania. Those trading partners which have been excluded from the broad group, although they account for approximately 11% of total euro area manufacturing trade, exhibit small individual trade shares with the euro area and weak trade relationships with individual euro area countries.

The weighting method

The methodology adopted to compute the trade weights required for the construction of the EER indices of the euro is similar to that underlying the EER indices published by the Bank for International Settlements (BIS). The Eurosystem's nominal EERs are constructed by applying overall trade weights to the bilateral exchange rates of the euro against the currencies of the trading partners (see Annex I). The overall weights incorporate information on both exports and imports, excluding trade within the euro area. The import weights are the simple shares of each partner country in total euro area imports from the partner countries. Exports are double weighted in order to account for third market effects, so as to capture the competition faced by euro area exporters in foreign markets from both domestic producers and exporters from third countries. As the double weighting of exports requires a measure of the domestic supply of manufactured goods in each export market, the latter was estimated by subtracting each partner country's net exports of manufactured goods from its value added in manufacturing.

The overall trade weights obtained for both groups of trading partners are presented in Table I, alongside the simple shares of the partner countries in total euro area manufacturing trade (i.e. the average of imports plus exports). A simple comparison between the two sets of weights for each grouping reveals the practical implications of accounting for third market effects. Those trading partners which are important global suppliers of manufactured goods and compete strongly with euro area exporters in third markets tend to have larger overall trade weights than their corresponding simple shares in total euro area manufacturing trade would imply. This is particularly true for the United States, Japan and the newly industrialised Asian economies.

This weighting scheme is fixed in the sense that the same set of weights is applied

uniformly to the whole period over which the EER indices are calculated. The weights will, however, be revised every five years in order to give due consideration to shifts in international trade flows.

A proxy for the exchange rate of the euro in the period from 1990 to 1998

Owing to the fact that euro exchange rates are only available from the start of Stage Three of EMU, earlier EER data are based on a basket of the currencies of those countries which now constitute the euro area. The weights for the pre-1999 “theoretical” euro exchange rates are based on the share of each euro area country in total manufacturing trade (three-year 1995-97 average) of the euro area vis-à-vis non-euro area countries. In order to ensure consistency with the weighting method used to compute the overall trade weights for the euro EERs, total manufacturing trade is defined as the sum of total euro area exports plus euro area imports from the partner countries. This entails two sets of weights for the theoretical euro, depending on whether the narrow or the broad group of trading

partners is used (see the footnote to Table 2). The resulting theoretical euro composite indicator summarises the exchange rate developments of the countries which now form the euro area, thereby providing a synthesis of the external value of euro area currencies in the 1990s (see Annex I).

Choice of deflators

The real effective exchange rates of the euro measure the competitiveness of euro area suppliers in terms of prices or costs relative to their trading partners. These indicators are defined as the relative prices between the euro area and its partner countries expressed in a common currency and are constructed by deflating the nominal EER index by appropriate price or cost indicators.

In the case of the narrow group of partner countries, the competitive position of the euro area is measured in terms of several deflators, namely consumer prices, producer (or wholesale) prices and unit labour costs in manufacturing (ULCM). Work to supplement the set of the Eurosystem’s EERs with additional deflators, such as GDP

Table 2

Weights for constructing the “theoretical” euro before 1999 ¹⁾

(as percentages)

EMU legacy currencies	“Theoretical” euro weights in the narrow index	“Theoretical” euro weights in the broad index
Deutsche Mark	34.66	35.52
French franc	17.83	17.38
Italian lira	14.34	14.20
Dutch guilder	9.19	9.32
Belgian and Luxembourg franc	8.01	8.04
Spanish peseta	4.95	4.94
Irish pound	3.75	3.47
Finnish markka	3.27	3.07
Austrian schilling	2.91	3.02
Portuguese escudo	1.08	1.05

Sources: Eurostat (Comext) and ECB calculations (based on 1995-97 data).

1) The use of two sets of weights for the “theoretical” euro is a consequence of the weighting method employed in computing the double export weights for the EER indices. According to this procedure, the exports of manufactured goods, as well as the domestic output of the manufacturing sector of the countries not included in the narrow (broad) group, termed “rest of the world” for convenience, are assumed not to compete with goods produced by the competitor countries (see Appendix I in P. Turner and J. Van’t dack: “Measuring International Price and Cost Competitiveness”, BIS Economic Paper No. 39, 1993). Thus the definition of total euro area trade underlying the computation of the weights for the theoretical euro does not include imports from the “rest of the world” countries.

deflators and unit labour costs for the whole economy, is currently under way. For the broad group, only consumer prices are being used, owing to a lack of timely and comparable data on other measures of prices and costs.

Price developments against the two groups are summarised by applying the overall trade weights to the relevant price indices of the trading partners. As far as the euro area is concerned, such developments are described, to the extent possible, by means of comparable euro area indicators. Specifically, the Harmonised Index of Consumer Prices (HICP) and the manufacturing producer price indices (PPIs) compiled by Eurostat were used as indicators of consumer and producer price developments in the euro area respectively. In the absence of published unit labour cost data from Eurostat, the area-wide ULCM was obtained by aggregating appropriately the ULCM indicators of euro area countries.

Base period and frequency of the EER indicators

The base period for all EER indicators is the first quarter of 1999 (1999 Q1 = 100). The

base period was selected simply on the grounds that it coincides with the start of Stage Three of EMU and is sufficiently broad to minimise any potential biases emanating from the selection of a particular trading day as the base for the indices. The base period chosen does not relate to any notion of an “equilibrium” value of the euro.

With regard to the data frequency of the EER series, the nominal EER index for the narrow group of trading partners is published daily on the ECB’s website, as it constitutes a summary measure of short-term foreign exchange market developments. The nominal EER indicator for the broad group will be published monthly. The CPI-based narrow real EER index is published monthly, and this will also be the case for the CPI-based real EER index for the broad group and the PPI-based index for the narrow group. The narrow real EER index deflated by unit labour costs in manufacturing will be published quarterly. The lower frequency for some indicators is dictated by data availability. Table 3 presents an overview of the set of EER indicators in terms of availability and frequency of publication.

Table 3
The ECB’s set of nominal and real EER indicators ¹⁾

EER indicator	Highest frequency of data availability	Historical period covered	Publication date
<i>Narrow group</i>			
Nominal EER	Daily	1990 to date	October 1999
Real EER (deflated by)			
CPI	Monthly	1990 to date	October 1999
PPI	Monthly	1990 to date	April 2000
ULCM	Quarterly	1990 to date	April 2000
<i>Broad group</i>			
Nominal EER	Monthly	1993 to date	April 2000
Real EER (deflated by)			
CPI	Monthly	1993 to date	April 2000

Source: ECB.

1) CPI, PPI and ULCM refer to consumer prices, producer prices and unit labour costs in manufacturing deflators respectively.

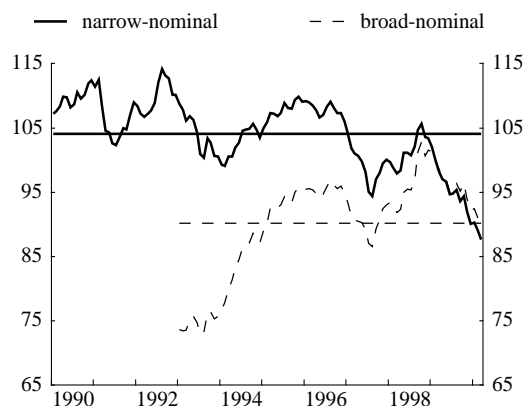
3 The euro's nominal and real external value

The *nominal* effective exchange rate (EER) developments for the euro are summarised by the nominal EER indicators. These indices are computed as a geometric weighted average of the bilateral exchange rates of the euro against the currencies of the trading partners. The weights used are the overall trade weights presented in Table I, while bilateral exchange rates are mostly monthly averages of daily spot foreign currency quotations of the euro. The narrow nominal EER index is computed for the period as from January 1990, while the broad nominal EER is available only as from January 1993, owing to missing data on a number of transition economies in eastern Europe.

The presence of economies with at times relatively high inflation (in Asia, Latin America and eastern Europe) among the trading partners making up the broad group suggests that the nominal EER of the euro, based on the broad group, will be influenced by the depreciating nominal external value of the currencies of those countries. This point is

Chart 1
Nominal effective exchange rate of the euro against the currencies of the narrow and broad groups of trading partners¹⁾

(monthly averages; index: 1999 Q1 = 100)



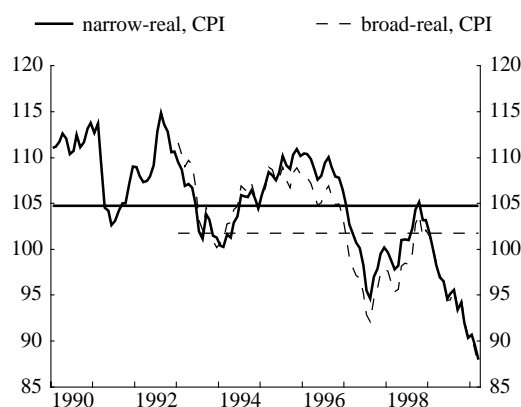
Source: ECB.

1) Data are ECB calculations. An upward movement of the index represents an appreciation of the euro. The horizontal lines show the average over the period shown. The latest observations are for March 2000.

Chart 2

CPI deflated real effective exchange rate of the euro against the currencies of the narrow and broad groups of trading partners¹⁾

(monthly averages; index: 1999 Q1 = 100)



Source: ECB.

1) Data are ECB calculations. An upward movement of the index represents an appreciation of the euro. The horizontal lines show the average over the period shown. The latest observations are for March 2000.

shown in Chart 1, on which the nominal EER indices for the two groups of partner countries are plotted. In the course of the 1990s the narrow and broad nominal EER indices of the euro exhibit divergent behaviour. The broad nominal EER indicator points to a strong nominal appreciation of the euro against the currencies of the euro area's trading partners between 1993 and 1998, amounting to 38%. This contrasts sharply with the narrow nominal EER which shows a nominal depreciation of around 5% over the same period. Nonetheless, once the relative price movements in the euro area and in the respective groups of trading partners are taken into account, i.e. when the real EER indices for the two groups are computed, the discrepancy observed between the narrow and broad indicators is greatly reduced (see Chart 2). Taking into consideration the latter observation and the increasing importance of the emerging market and transition economies in world trade, the real EER index for the broad group could provide a useful

measure of the euro area's competitiveness. Moreover, it could serve as a platform for deriving real EER indices of the euro area against selected regional country groupings in the near future.

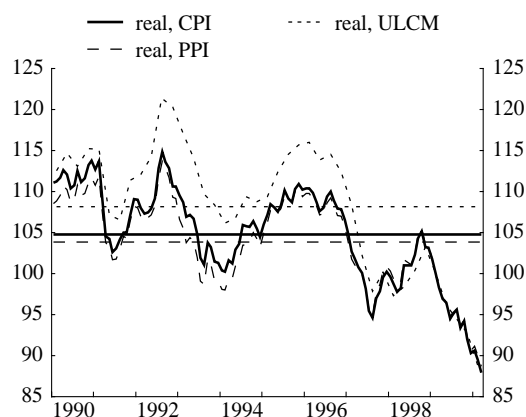
Turning to developments in the international price and cost competitiveness position of the euro area in the 1990s, as measured by real effective exchange rates, both CPI-deflated real EER indices point to a gradual improvement over the period for which these indicators are calculated. Between the first quarter of 1990 and the fourth quarter of 1999 the narrow real EER index registered an effective depreciation of 17.2%, while the broad real EER declined by approximately the same rate as the narrow index (i.e. 16.2%) between the first quarter of 1993 and the fourth quarter of 1999. Looking at Chart 2, euro area competitiveness improved following the crisis in the ERM in 1992 as the currencies of several countries which later participated in the euro area depreciated against the currencies of major trading partners. Subsequently, the real effective exchange rate appreciated in the period from early 1994 to around mid-1996. Between the third quarter of 1996 and the third quarter of 1997, the nominal weakening of EMU constituent currencies mainly against the US dollar as well as the loss of competitiveness of emerging market and transition economies caused the euro area real EER to depreciate below the low reached in the first quarter of 1994. Nonetheless, in the aftermath of the financial and currency crisis in Asia, i.e. between the third quarter of 1997 and the fourth quarter of 1998, almost all of the gain in the price and cost competitiveness of the euro area that had occurred in the 12 months preceding the crisis dissipated.

Following the launch of the single currency, the degree of competitiveness of the euro area vis-à-vis its trading partners changed course again. Between the first and fourth quarters of 1999 the real effective depreciation of the euro amounted to 7.8% against the currencies of the trading partners

Chart 3

The real EER of the euro for the narrow group under alternative deflators¹⁾

(monthly/quarterly averages; index: 1999 Q1 = 100)



Source: ECB.

1) Data are ECB calculations. An upward movement of the index represents an appreciation of the euro. The horizontal lines show the average over the period shown. The latest observations are for March 2000 and Q1 2000.

in the narrow group and 7.5% against those in the broad group. As CPI inflation in the euro area and its trading partners in the narrow group evolved very similarly, the improvement in euro area competitiveness in 1999 stemmed almost entirely from the nominal depreciation of the euro. The effective depreciation of the euro over this period was mainly driven by the weakening of the euro against the currencies of the euro area's largest trading partners, particularly the United States, Japan and the United Kingdom. The real external value of the euro against the currencies of the partner countries in the broad group declined in 1999 by the same amount as the decline against those in the narrow group over the same period.

The use of alternative deflators for the narrow group of partner countries for which such information is available results in indicators of the euro's real external value which largely reflect the same pattern as the CPI-based narrow real EER index (see Chart 3). In terms of levels, the PPI-deflated narrow real EER is practically indistinguishable from its CPI counterpart. The real EER index based on unit labour costs in manufacturing

(ULCM) shows a somewhat larger effective depreciation, which is, however, mostly a result of movements which occurred in the early and mid-1990s. Between the first quarter of 1990 and the fourth quarter of 1999 euro area suppliers became more competitive by some 18% in terms of relative unit labour costs as compared with improvements of around 17% and 15% in terms of relative consumer and producer prices respectively. Since the launch of the single currency, the cumulative real effective

weakening of the euro as measured by the ULCM-deflated EER index has been similar to that shown by the CPI and PPI-deflated real EER indicators.

From a historical perspective, both the CPI-deflated real EER index for the broad group as well as the real EER indices for the narrow group were below their corresponding 1990-00 (1993-00 for the broad group) averages in the first quarter of 2000 (see Charts 2 and 3).

Annex

Formulae used for the calculation of the effective exchange rates

The methodology underlying the calculation of the Eurosystem's set of effective exchange rates is similar to that used by the Bank for International Settlements (BIS) (see P. Turner and J. Van't dack: "Measuring International Price and Cost Competitiveness", BIS Economic Paper No. 39, 1993). The indices are computed as geometric weighted averages of relative price indicators using the formulae set out below.

General formula for the effective exchange rate (EER)

The general formula for the calculation of the real EER (REER) in period t is:

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

where N stands for the number of partner countries in the EER index, d_i is the deflator for partner country i , d_{euro} is the deflator for the euro area, $e_{i,euro}$ is the exchange rate of the currency of partner country i vis-à-vis the euro and w_i is the overall trade weight assigned to the currency (or partner country) i .

The nominal EER (NEER) is derived in a similar fashion by leaving out the deflators from the aforementioned formula. Hence the formula for the NEER is:

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

Double export weights

Let us assume that the euro area exports to H foreign markets ($H > N$) and x_j^a denote the gross exports flow in the reference period from the euro area to market j . The share of each market in total exports is then calculated as:

$$x_j = x_j^a / \sum_{j=1}^H x_j^a, j = 1, 2, \dots, H.$$

These simple export shares are adjusted in order to take account of third market effects. On the assumption that the N partner countries are the only suppliers in the H foreign markets and that exports of manufactured goods, as well as the domestic supply of the manufacturing sector of the countries not included among the partner countries (i.e. $H-N$), termed "rest of the world" for convenience, do not compete with goods produced by the partner countries, the double export weight of each partner country is defined as:

$$w_i^x = \sum_{j=1}^H S_{i,j} x_j, i = 1, 2, \dots, N,$$

with $S_{i,j}$ being the share of country i 's supply in market j and given by:

$$S_{i,j} = S_{i,j}^a / \sum_{i=1}^N S_{i,j}^a,$$

where $S_{i,j}^a$ (for $i \neq j$, $i = 1, 2, \dots, N$ and $j = 1, 2, \dots, H$) denotes the gross export flows from country i to market j , and $S_{i,i}^a$ (for $i = 1, 2, \dots, N$) represents the gross domestic production destined for the domestic market of country i .

Import weights

The import weight of partner country i is not subject to any adjustment and, consequently, coincides with its simple import share (m_i) in total euro area imports from the N partner countries, i.e.

$$w_i^m = m_i = m_i^a / \sum_{i=1}^N m_i^a, \quad i = 1, 2, \dots, N,$$

where m_i^a denotes the gross import flows in the reference period into the euro area from country i .

Overall trade weights

The overall trade weight of each partner country is then obtained as

$$w_i = \left(\frac{x^a}{x^a + m^a} \right) w_i^x + \left(\frac{m^a}{x^a + m^a} \right) w_i^m, \quad i = 1, 2, \dots, N,$$

where $x^a = \sum_{j=1}^H x_j^a$ denotes the exports of the

euro area to the H foreign markets and

$m^a = \sum_{i=1}^N m_i^a$ denotes the imports of the euro

area from the N partner countries.

The proxy for the euro

For the purpose of calculating the exchange rate of the euro up to 31 December 1998, the exchange rates of the national currencies of euro area countries are aggregated in order to obtain a "theoretical" euro exchange rate (that is, a proxy for the exchange rate of the euro) according to the following formula:

$$e_{i,euro}^{(t)} = \prod_{k=1}^n (e_{i,k}^{(t)})^{w_k^e}, \quad i = 1, 2, \dots, N,$$

where n stands for the number of EMU legacy currencies, $e_{i,euro}^{(t)}$ is the proxy for the exchange rate of the partner country's currency i against the euro, and $e_{i,k}^{(t)}$ is the exchange rate of the partner country's currency i against the euro area country's currency k .

The weights applied are the shares of each euro area country in the total manufacturing trade of the euro area and are obtained as follows: let t_k^a denote the total gross trade flow of euro area country k , where the total gross trade flow is defined as total euro area exports to the H foreign markets plus total euro area imports from the N partner countries. These data are consistent with the data on exports and imports used for deriving the overall trade weights for the euro EER in

the sense that $\sum_{k=1}^n t_k^a = \sum_{j=1}^H x_j^a + \sum_{i=1}^N m_i^a$. The

weights for the calculation of the theoretical euro exchange rate are then given by:

$$w_k^e = t_k^a / \sum_{k=1}^n t_k^a, \quad k = 1, 2, \dots, n.$$