

Special sessions organized by Eurostat and IPTS:

Methods for the Construction of National and Consolidated Supply-Use and Input-Output
Tables in Europe and its use for the estimation of the European Carbon Footprint

**Treatment of the Intra-EU Trade Flows to Obtain
Consolidated European Union and Euro Area Use Tables***

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Abstract

A procedure consisting of a series of seven steps has to be performed to arrive at a consolidated EU use table when starting from a simple aggregation of individual EU country tables. A prerequisite of the latter table is the distinction between intra-EU and extra-EU trade flows, both for imports and exports. Due to the change in geographical detail from individual EU member countries to the EU level, the former international intra-EU trade flows now have to be interpreted as domestic transactions of the EU. The main objective of the procedure is to balance the intra-EU import matrix with the information on intra-EU exports. The fact that the mirror flows do not match is due to a range of issues. A structural discrepancy is caused by the difference in valuation as imports are valued in cost-insurance-freight prices, while the exports in the table are recorded in basic prices. The first step of the procedure corrects for the taxes less subsidies incorporated in the value of imports. The second, third and fourth steps adjust the intra-EU and extra-EU import matrices or the intra-EU and extra-EU export matrices to correct for the double-counting of transit trade flows. In the fifth step all values of the intra-EU import matrix are rescaled to match the total of the intra-EU export vector – a requirement in order to be able to balance the intra-EU import matrix with the values of the intra-EU export vector. In the sixth step the matrix is balanced using the GRAS algorithm, which effectively redistributes trade and transport margins from the goods in which value they were included to the rows representing the trade and transport services. The final step consists of merging the balanced intra-EU import table with the domestic table, which can now be done without violating the accounting identities that reign supply-use frameworks.

* This work is part of Eurostat's eeSUIOT project (Creating consolidated and aggregated EU27 Supply, Use and Input-Output Tables, adding environmental extensions (air emissions), and conducting Leontief-type modeling to approximate carbon and other 'footprints' of EU27 consumption for 2000 to 2006).

1 Introduction

This paper reflects part of two combined projects that are commissioned by Eurostat Unit C.2: National accounts – production, and Eurostat Unit E.7: Environmental accounts and climate change. The first project focuses on harmonizing supply and use tables to arrive at a consolidated EU27 table. The second project entails the creation and analysis of European environmentally extended input-output tables.

Progress made during the first project has been published before in Rueda-Cantuche, Beutel, Neuwahl, Mongelli, & Loeschel (2009). In this paper a consolidation method was envisioned that has been adjusted and extended over the course of the second project and is described in this paper.

In the consolidation process the focus of the table shifts from the level of individual countries to the EU27 level. At the EU27 level the formerly intra-EU trade flows now have to be considered as domestic EU27 inter-industry flows. A prerequisite for the consolidation procedure is the availability of an intra-EU import matrix (separated from the extra-EU import matrix) and an intra-EU export column (separated from the extra-EU export column). The main objective of the procedure is to balance the intra-EU import matrix with the information on intra-EU exports. In the final step of the procedure, the intra-EU imports can be added to the EU27 table containing the aggregated domestic flows, without violating the accounting identities that govern an input-output table.

2 Treatment of intra-EU trade flows

The method described in this paper requires the availability of harmonized tables for each of the individual countries. These individual country use tables first need to be aggregated together into one EU table, which consists of simple sum of (1) all domestic use tables, (2) all intra-EU import tables, and (3) all extra-EU import tables, including the respective final use categories. Note that also the exports are split into intra-EU and extra-EU exports. A simplified graphical representation of this EU use table is given in Figure 1. These tables have been prepared in the first project by the Joint Research Centre's Institute for Prospective Technologies (JRC-IPTS) and Konstanz University of Applied Sciences.

Figure 1: Scheme of aggregated EU Use table

domestic intermediate use	domestic final demand	1	2
intra-EU import use	intra- EU import final demand	3	4
extra-EU import use	extra- EU import final demand	5	6

Legend for Figure 3.1

Numbers refer to the columns in Figure 3.1.

1: exports to intra-EU countries

2: exports to extra-EU countries

3: transit trade – imported from intra-EU, exported to intra-EU

4: transit trade – imported from intra-EU, exported to extra-EU

5: transit trade – imported from extra-EU, exported to intra-EU

Due to the change in geographical detail from individual EU member countries to the EU level, the former international trade flows between member countries now have to be interpreted as domestic transactions of the EU economy. At this point the intra-EU imports are still represented separately (the grey area), although at the level of the entire EU economy these flows are now domestic transactions. The same holds for intra-EU exports, column 1 in Figure 3.1.

In order to merge the intra-EU trade flows with the domestic transactions table with the sum of purely domestic transactions a procedure consisting of seven steps has to be undertaken. The main objective is to balance the intra-EU import table with the information on intra-EU exports. The procedure allows the table to be merged without violating the accounting identities that reign supply-use frameworks. Each trade flow is reported by two countries. One of the reporters is the exporting country and the other reporter is the importing country. The two values representing exactly the same trade flow usually do not (fully) match. This observation is referred to as the mirror trade statistics puzzle.

The fact that the reported intra-EU imports per product do not match the reported intra-EU exports for each product is due to a number of issues. The discrepancy between the values is partially due to a structural difference between the values; exporting countries

usually report their exports in free-on-board prices whereas importing countries report their imports in cost-insurance-freight prices. (Section 2.13 p. 18 of Eurostat, 2006). The difference between these two prices is made up of the international trade and transport margins that are added to the price of a good (or service) when traded across national borders. In free-on-board prices the trade and transit services exported are recorded in the rows pertaining to the service sectors. In cost-insurance-freight prices, the trade and transit margins used to transport the goods are included in the prices of the good and are not present anymore in the rows pertaining to the service sectors. Part of the trade and transport margins included in imported goods from country R by country S, will balance against the trade and transport margins recorded as exports to country S by country R. A discrepancy will remain in case foreign carriers deliver the trade and transport services.

Additional explanations for the difference between export and import values are methodological differences, time lags, statistical confidentiality, different practices in the treatment of revisions and currency conversion issues. For more information see section 2.17, pp. 20 – 23, Eurostat (2006). Information on a range of underlying issues determining the quality of external trade statistics can be found in Eurostat (2010).

In the aggregated EU table imports are valued in cost-insurance-freight prices, while the exports are recorded in basic prices. In order to merge the intra-EU import table and the domestic table, both need to be valued in the same prices. As the domestic table is in basic prices, the information on intra-EU exports in basic prices is used to balance the intra-EU import table. See Table 3.1 for the valuation layers of prices of goods and services traded internationally.

Note that there are three valuation layers between exports in basic prices and imports in cost-insurance-freight prices: (1) taxes less subsidies levied in the country of export, (2) trade and transport margins for transportation in the country of export, and (3) international trade and transport margins for the transport from the border of the exporting country to the border of the importing country (see Table 1).

Table 1: Valuation layers in international trade

Country	International trade (exports by R/imports by S)
R	Exports by R in basic prices (of R)
R	+ Valuation layer: taxes and subsidies
R	+ Valuation layer: trade and transport
R	= Exports f.o.b. R
International	+ Valuation layer: international trade and transport margins
S	= Imports c.i.f. S
S	+ Valuation layer: taxes and subsidies
S	+ Valuation layer: trade and transport
S	Imports by S in purchaser prices (of S)

3 Description of steps taken to arrive at a consolidated EU use table

Point of departure is the simply summed up EU Use table. Table 2 gives an overview of the steps taken to a consolidated EU use table. The first step of the procedure corrects for the taxes less subsidies levied in the country of exports, which are incorporated in the value of imports. The second, third and fourth steps adjust the intra-EU and extra-EU import matrices or the intra-EU and extra-EU export matrices to correct for the double-counting of transit trade flows. In the fifth step all values of the intra-EU import matrix are rescaled to match the total of the intra-EU export vector – a requirement in order to be able to balance the intra-EU import matrix with the values of the intra-EU export vector. In the sixth step the matrix is balanced using the GRAS algorithm, which effectively redistributes trade and transport margins from the goods in which value they were included to the rows representing the trade and transport services. The final step consists of merging the balanced intra-EU import table with the domestic table. These steps will be described in more detail below.

Table 2: Overview of steps taken to arrive at the consolidated EU Use table

<i>Step 1:</i>	adjust for taxes less subsidies on intra-EU imports --- Steps 2 to 4 correct for double counting of transit trade within the EU ---
<i>Step 2:</i>	correct for trade flows imported from intra-EU, exported to extra-EU
<i>Step 3:</i>	correct for trade flows imported from extra-EU, exported to intra-EU
<i>Step 4:</i>	correct for trade flows imported from intra-EU, exported to intra-EU
<i>Step 5:</i>	re-scale all import values in order to impose that total intra-EU imports equal total intra-EU exports
<i>Step 6:</i>	balance the intra-EU import table with the intra-EU export vector using GRAS
<i>Step 7:</i>	aggregate the domestic and balanced intra-EU tables to arrive at the consolidated Use table at basic prices

3.1.1 Step 1: adjust for taxes less subsidies on intra-EU imports

The value recorded as total taxes less subsidies on intra-EU exports (in the row of taxes less subsidies and the column of intra-EU exports) is distributed over the exporting EU industries using the share of each industries' taxes less subsidies in total taxes less subsidies on intermediate demand and final demand excluding exports. The value is added to the respective industry and final demand category in the row of taxes less subsidies.

To keep total outputs by industry unchanged the values of the taxes less subsidies assigned to each industry are deducted from their intra-EU imports in the same proportion as their intermediate import input structure and final use structure per final demand category.

3.1.2 Step 2: correct for trade flows imported from intra-EU and re-exported to extra-EU

Column 4 in Figure 3.1 records imports from intra-EU by EU countries, which are also recorded as exports by the original EU exporting country. The original exporters are unaware that the importing country actually re-exports the goods and services and record the trade as regular exports to an EU country. As these exports are re-exported to a country outside the EU, the original recording as exports to an EU country is incorrect.

From which country these flows originate is unknown, so no correction can be made at the individual country level, unless additional data is available on the origin of the transit trade recorded by each country. At the EU level this correction is possible, because the sum of all individual country transit trade columns matches the level of information needed to do this correction.

Column 4 gives exactly the information on how much of the exports recorded as exports to EU countries are in fact exports to non EU countries. The values present in column 4 therefore need to be subtracted from the column with intra-EU exports (column 1) and

added to the column with extra-EU exports (column 2). In other words, a shift has to be made from intra-EU exports to extra-EU exports of the magnitude recorded in column 4.

3.1.3 Step 3: correct for trade flows imported from extra-EU and re-exported to intra-EU

Column 5 contains information on the imports from extra-EU countries that are exported to countries in the EU. The final importer countries record trade flows from EU countries while these are actually imported from countries outside the EU. The correction therefore entails reducing the reported imports from EU countries and increasing the reported imports from countries outside the EU. The values in the column are proportionally distributed over the values of the intra-EU import table. For each import value defined by product and industry, that products' import share in total imports (intermediate imports plus final demand imports except re-exports) multiplied by the re-export value is subtracted from the intra-EU import value and added to the extra-EU import value. This implies decreasing the intra-EU import values and increasing the extra-EU import values by exactly the same value per product, per importing industry or final demand category.

3.1.4 Step 4: correct for trade flows imported from intra-EU and re-exported to intra-EU

The imports in column 3 are recorded by the original exporting country as exports to intra-EU countries. Both the exporting country and the importing country record these trade flows in the correct way, so no adjustment has to be made. Maintaining these values would result in double counting as the values are already included in the values reported by the original exporting country and the final importing country. Therefore, the values in this column are deleted.

Note that transit trade column 6; imports from extra-EU countries exported to extra-EU countries, is maintained in the same form in the consolidated table. Both the original exporting country and the final importing country are non-EU countries. This information cannot be used for adjustments in the consolidated EU table.

3.1.5 Step 5: re-scale all import values in order to impose that total intra-EU imports equal total intra-EU exports

At the product level, intra-EU imports and intra-EU exports need to match. This implies that each of the row sums of the intra-EU import table (without the columns for re-exports, which at this step have both been set to zero) have to match the values reported in the intra-EU export column. The intra-EU import table is colored grey in the figure, and the intra-EU export column is column number 1. The procedure to achieve the matching of the intra-EU imports and intra-EU exports is performed in the next step. However, to undertake this procedure, it is required that the overall total of the intra-EU import table is equal to the total

of the intra-EU export factor. To achieve this all values in the intra-EU import table are rescaled by multiplying each intra-EU import value by the sum of the intra-EU export values, divided by the overall sum of the intra-EU import table, including intermediate and final demand categories, without re-exports. The rescaling factor for the EU tables for 2000 up to and including 2006 is on average 1.10, with all values within a 0.02 positive or negative deviation from this value. This means that the total intra-EU export value is on average 10% higher than the total intra-EU import value reported.

The intra-EU trade discrepancy that is due to valuation differences and statistical errors is offset against the extra-EU imports. The difference between the original intra-EU import values and the rescaled intra-EU import values is added to the corresponding value in the extra-EU import table (per product imported and importing industry or final demand category).

3.1.6 Step 6: balance the intra-EU import table with the intra-EU export vector using GRAS

The generalized RAS method is used to balance the intra-EU import totals per product with the intra-EU exports. It is a bi-proportional adjustment method very similar to RAS with the difference that it can deal with negative values in the same fashion it uses the information of the positive values (Junius & Oosterhaven, 2003). The method is fully mechanical, i.e. no ad hoc decisions have to be made. Its solution is equivalent to adding minimum information to the old table such that it just satisfies the new totals (see Bacharach, 1970, for an extensive treatment). Its origins are discussed in Lahr & Mesnard (2004) in the special issue of Economic Systems Research on Biproportional Techniques in Input-Output Analysis. GRAS can be applied to any table for which an initial structure is given (or assumed), and new row and column totals are supplied, provided that the total of the row totals and the total of the column totals are equal. It has been widely used to update input-output tables for example by Stone (1961). (See also Miller & Blair, 2009). In addition, it can be used to balance the derived import and export data matrices with the original total import and export data from the IOT (Linden, J. A. van der & Oosterhaven, 1995 and Oosterhaven, Stelder, & Inomata, 2008).

By using the export values in basic prices as row constraint in the GRAS procedure, the trade and transport margins included in the import c.i.f. values are effectively redistributed to the rows which the corresponding services. The intra-EU export column **1**, used as constraint in the GRAS procedure, is in basic prices. Therefore, the balanced intra-EU import use table is also in basic prices.

3.1.7 Step 7: aggregate the domestic and balanced intra-EU tables to arrive at the consolidated Use table at basic prices

In the last step the balanced intra-EU trade flows are added to the table with the simple aggregation of the domestic EU flows. Each value of the balanced intra-EU import table (per product and sector or final demand category except exports) is added to its corresponding value in the EU domestic table.

4 Concluding remarks

- Due to merging the intra-EU trade flows with the domestic transactions, and the adjustment for incorrect or double recordings of transit trade, export and import values in the consolidated table only concern extra-EU trade.
- The balance of total demand and total supply and the balance of total input and total output of the SUTs is maintained in the consolidated table. Intra-EU export values and intra-EU import values are merged with the domestic transactions. The difference between the balanced import use table and the unbalanced import use table is offset against the extra-EU trade flows.
- GDP for the EU is not altered by the method. The expenditure approach to calculate GDP entails summing household, non-profit institution and government consumption, gross capital formation (investment) and exports less imports. In the procedure, exports are decreased by the amount of intra-EU exports and imports are decreased by the amount of intra-EU imports, because these flows are merged with the domestic transactions. As both exports and imports decrease by the same amount, the net values of exports less imports do not change.

By correcting for the transit trade as has been described in this document it is assumed that re-exports are not again re-exported by the “final” importer.

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