EU inter-country supply, use and input-output tables — Full international and global accounts for research in input-output analysis (FIGARO)

ISABELLE REMOND-TIEDREZ AND
JOSE M. RUEDA-CANTUCHE (ED.)

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Preface

The current European Statistical Programme (ESP) addresses high-level requests from policy-makers, including measures for higher-quality and timelier statistics to support the Commission's 10 political priorities and the European Parliament's political agenda.

In particular, the development of experimental European Union (EU) inter-country supply, use and input-output tables, supports the objective to enhance the indicators and statistical information available on economic globalisation and global value chains for both decision-makers and the public.

This work will contribute to more informed decision making and better understanding of the economic, social and environmental impacts of globalisation.

Jointly with the European Commission's Joint Research Centre, Eurostat has developed a methodology for the construction of the EU inter-country supply, use and input-output tables by reusing available data, preparing the way for regular data production and dissemination. This work has been done in cooperation with international agencies such as the Organisation for Economic Cooperation and Development (OECD) and the United Nations (UN), with the aim of having the EU tables integrated as much as possible with global tables.

In this series of Eurostat Working Papers, the full process of compilation of the so called FIGARO (Full International and Global Accounts for Research in Input-Output Analysis) tables is described in detail. In order to promote transparency and facilitate user interaction, one full chapter is devoted to the quality assessment of the results obtained while others develop in detail the methodological assumptions made in the course of the compilation process.

The FIGARO project requires the combination of data coming from business statistics, trade statistics, national accounts and balance of payments in order to provide the most detailed portrait of the EU economy. The FIGARO tables provide a comprehensive description of the EU economy identifying the products supplied in the EU either by domestic production or imports (by country of origin) as well as the use of products by firms and households for intermediate or final purposes (by country of destination). They form a powerful tool for different types of economic analysis, such as the study of global value chains, trade and jobs analyses and environmental footprints, as well as providing a consistent framework for balancing national accounts, balance of payments and international trade statistics data.

The FIGARO Project will continue with the production of annual time series of the FIGARO tables for the period 2010 to 2016 (also including projections for 2017-2018) by 2020, both in current and previous year prices.

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1 Introduction

1.1 Background

Over the last decade, the scientific community has been working on the construction of several multi-regional input-output (MRIO) databases. The main objective has varied from environmental applications (e.g. footprints) to socioeconomic applications (e.g. global value chains — GVCs). Two outstanding examples are:

- the OECD's TiVA (trade in value added) initiative ([1]), under which annual global inter-country input-output tables were constructed for the period 1995-2011; and
- the EU-funded project ([2]) 'World input-output database: Constructions and applications' (WIOD), under which annual current and deflated inter-country input-output tables were constructed for the same period (and recently updated to 2014).

The development of various databases alongside each other has given researchers the opportunity to compare their approaches. Methodologies and their underlying assumptions differ between the databases and so do the results, although in some cases the differences may also come from the different direct input data (e.g. carbon dioxide footprints). As a result, convergence of these methods is now called for.

Eurostat, together with the European Commission's Joint Research Centre (JRC), has taken up the challenge to develop a statistical standard recognised by international organisations such as the OECD, the United Nations Statistics Division (UNSD) and the WTO. The project is called Figaro, which stands for 'Full international and global accounts for research in input-output analysis'.

This project fits into the medium-term strategy for national accounts in the context of the European statistical programme for 2013-2017. It covers the following main subjects:

- **economic globalisation**: this involves enhanced measurement of globalised production; analysis of global value chains, through appropriate input-output tables and global business statistics;
- **economic and social performance**: this involves the implementation of ESA 2010 and the database for growth and productivity measurement;
- **environmental sustainability**: the EU supply, use and input-output tables are an input for input-output modelling with environmental accounts.

([1]) http://www.oecd.org/sti/ind/inter-country-input-output-tables.htm

http://www.oecd.org/sti/ind/measuringtradeinvalue-addedanoecd-wtojointinitiative.htm

([2]) www.wiod.org

The project's underlying methodology is set out in Regulation (EU) No 549/2013 of the European Parliament and of the Council of 21 May 2013 on the European System of National and Regional Accounts in the European Union.

In April 2018, the Figaro ([3]) project produced an experimental database of **EU inter-country supply, use and input-output tables** ('EU-IC SUIOTs') for the reference year 2010 in line with the European System of Accounts (ESA) 2010 methodology. Based on the experience gained in the project, a work plan will be developed for the annual production of EU-IC-SUIOTs and the production of a time series of EU-IC-SUIOTs from 2010 to 2015 ([4]). This time series will also be expanded up to 2018 by 2020 in order to satisfy the needs of the various Commission directorate-generals (DGs) and general users of this database. EU-IC-SUIOTs constitute a further development of the consolidated SUIOTs for the EU and the euro area, which are currently published on a regular basis ([5]).

This project relies on the reuse of available Eurostat data and is based on the latest relevant ESA 2010 methodological framework. This ensures quality assurance of the data in the national accounts framework. The Figaro project also aims to create the conditions for sustained data provision of EU-IC-SUIOTs.

The EU-IC-SUIOTs are developed based on the considerations set out below.

- Regular coordination and interaction between Eurostat's global business statistics and macroeconomic data statistics on an annual basis (e.g. trade statistics, trade by enterprise characteristics, business statistics, national accounts).
- A careful check of the user needs of various Commission DGs for policy analysis, i.e. economic and financial affairs, trade, environment, research and innovation, employment. This would also cover other EU institutions such as the European Central Bank. User needs around the Commission include studies and analyses supporting EU trade policy (e.g. global value chains), industrial policy (e.g. economic growth), economic policy (e.g. European Semester), social policy (e.g. employment) and climate change and environmental policy (e.g. footprints).
- An institutional perspective. This is obtained by setting up consistent EU-IC-SUIOTs that are recognised by international agencies such as the OECD, WTO and the UNSD and used as such in global inter-country input-output frameworks. National compilers in EU Member States are also involved to ensure that they take ownership of the national data used in constructing the EU-IC-SUIOTs.

The experimental EU-IC-SUIOTs ([6]) provide an **industry breakdown of 64 activities**. The EU-IC-SUIOTs use the latest statistical classifications of economic activities and products currently applied in the EU: NACE Rev. 2 (International Standard Industrial Classification (ISIC) Rev. 4) and CPC (Central Product Classification)/CPA (Classification of Products by Activity) 2008. The tables cover the EU Member States (EU-28) plus the United States (US) to capitalise on work already undertaken by Eurostat in recent years so that US data are also presented in NACE Rev. 2 and CPA 2008 classifications ([7]).

The data presented on the Eurostat's experimental statistics page are the first version of the EU-IC-SUIOTs compiled under the Figaro project. The Figaro methodology was presented during the project to various technical groups such as the National Accounts Working Group, Eurostat's directors of macroeconomic statistics as well as international bodies (OECD and UNSD) and the

([3]) https://ec.europa.eu/eurostat/web/experimental-statistics/figaro

([4]) Input-output tables — IOTs — 2010-2015; Supply and use tables — SUTs — 2010 and 2015.

([5]) However, the methodology underlying the consolidated EU tables is different from the one applied in the Figaro tables.

([6]) Once Eurostat starts regularly producing the Figaro tables, the most recent year/years will provide a breakdown of at least 10 activities until more detailed input data will be available from EU countries.

([7]) Eurostat has developed a methodology for converting US data from the NAICS classification to NACE and CPA classifications. For additional details on the methodology used, see: http://ec.europa.eu/eurostat/documents/51957/51999/Compilation-usa-suiot-2008-2011.doc academic community (e.g. the International Input-output Association, Hispanic-American Input-output Society).

The EU-IC-SUIOTs serve to support analyses of the economic, social and environmental consequences of globalisation in the EU by providing analysts with input data for studies on competitiveness, growth, productivity, employment, environmental footprints and international trade (e.g. GVCs). They aim to be the national and international agencies' reference for analysis of trade, globalisation, socioeconomic, national accounts and environmental policies.

This report describes the method Eurostat has developed to construct EU-IC-SUIOTs. The approach builds on the OECD's most recent work on the construction of: (i) balanced bilateral trade statistics (Fortanier and Sarrazin, 2016; Fortanier et al., 2016; Miao and Fortanier, 2017); and (ii) global inter-country input-output tables (Ahmad, 2017).

Following Fortanier and Sarrazin (2016), the entire process for the construction of EU-IC-SUIOTs is characterised by the following key features: transparency, modularity, collaboration and collective ownership and a long-term outlook.

On transparency, this means that any necessary adjustment of the reported official data is well documented, and the balancing procedure is based on simple and transparent calculations. This therefore avoids as much as possible mathematical model-based optimisation techniques.

The modular construction of EU-IC-SUIOTs involves different steps (or building blocks). The entire process involves five main (official) data sources:

- national accounts (as benchmark);
- national input-output framework ([8]) (supply and use tables (SUTs) and input-output tables (IOTs));
- international merchandise (goods) trade data;
- international services trade data;
- business statistics ([9]).

All of these are used to construct the three main data inputs that feed the process for constructing the EU IC-SUIOTs, namely:

- a balanced bilateral trade database (for goods and services);
- a full set of national SUTs (basic and purchasers' prices);
- a full set of national IOTs ([10]).

The EU IC-SUIOTs are designed to continuously build on the work of EU national statistical offices. This increases collaboration and generates collective ownership at EU level. The same applies to other international agencies such as the OECD. The project is for the long term and aims to be a permanent source of data for users, with frequent updates and annual (and five-yearly) publications.

([8]) ESA2010, par. 9.02: The core of the input-output framework is the supply and use tables in current prices and prices of the previous year. The framework is completed by the input-output tables which are derived from the supply and use tables by using assumptions or additional data.

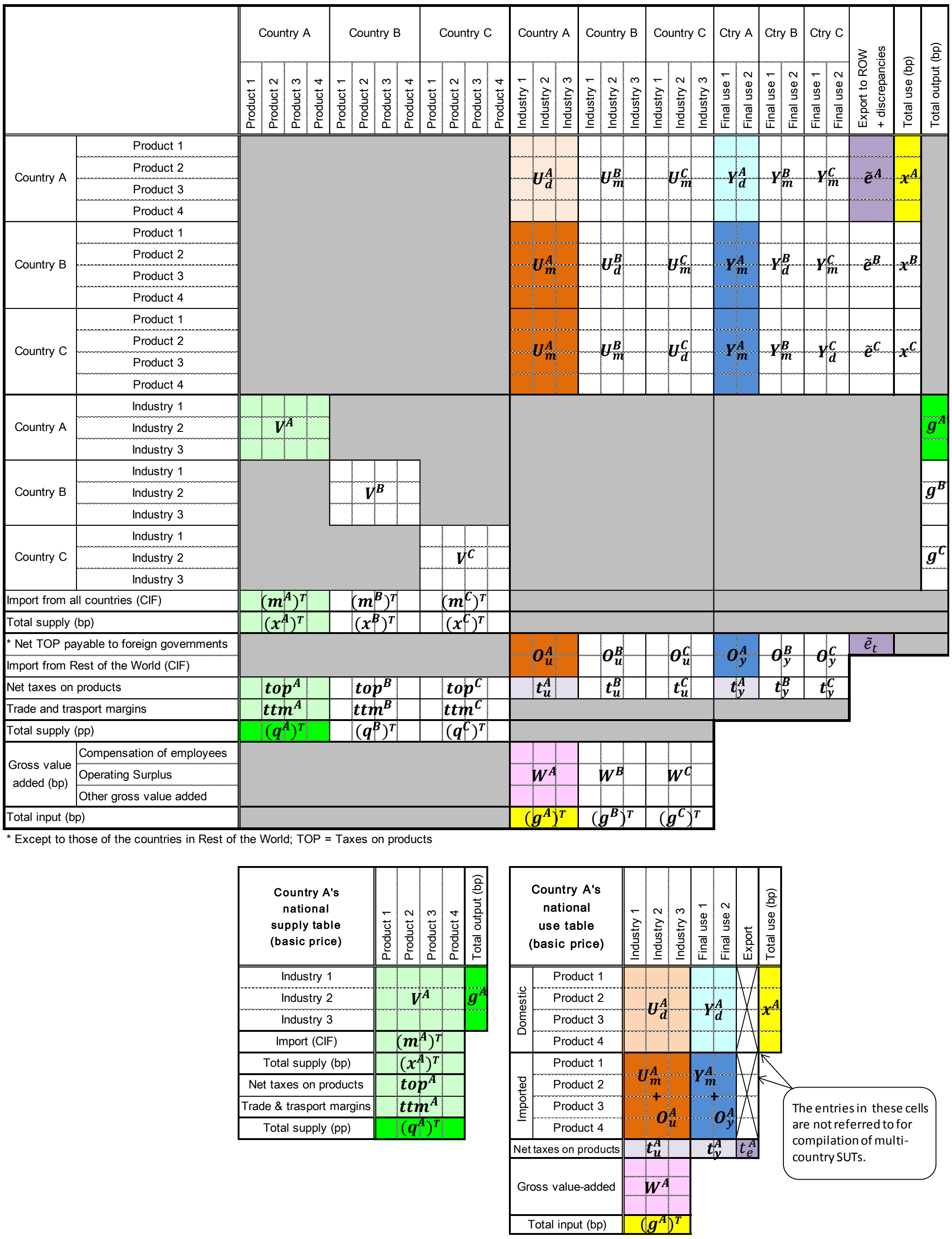
([9]) Business statistics have not been used so extensively in the Figaro project as the other national data sources yet.

([10]) Although the national IOTs do not enter the process to construct the EU-IC-SUIOTs, they contribute in validating the national SUTs or in estimating use tables in basic prices whenever these are missing.

1.2 Concept and data framework

Following United Nations (2018), Figure 1.1 presents the conceptual correspondence of inter-country SUTs to the national SUTs framework for three countries, four products and three industries. The segments without cells (shown in grey) correspond to data that are not available by design. The other coloured cells refer to the entries based on the source data of Country A, with each colour showing the link to the relevant segment in the national SUTs.

Figure 1.1: Inter-country SUTs and the conceptual correspondence to a national SUTs framework



Source: UN, 2018

As shown in Figure 1.1, the domestic transaction parts (in pale colours) of the inter-country SUTs can be directly moved from the original tables into the uniform product/industrial classification (for the EU, NACE Rev. 2 classification of activities and CPA 2.1 classification of products). In contrast, international transaction parts (in dark colours) require some processing before linking, as illustrated below (UN, 2018).

The list of labels and notation is shown below Figure 1.1, where superscript *r* is the country code (*r* = A, B, and C) and superscript *T* indicates a transpose of a vector/matrix. Upper-case bold italic refers to a matrix, lower-case bold italic to a vector, and lower-case italic to a scalar.

$\boldsymbol{V}^r$ domestic output matrix (= transpose of supply matrix)

$\boldsymbol{U}_d^r$ intermediate use matrix for domestic products

$\boldsymbol{U}_m^r$ intermediate use matrix for imported products

$\boldsymbol{Y}_d^r$ final use matrix for domestic products

$\boldsymbol{Y}_m^r$ final use matrix for imported products

$\tilde{e}^r$ export to rest of the world and statistical discrepancies

$\boldsymbol{top}^r$ net taxes on products (TOP), by product or taxes less subsidies on products (TLS)

$\boldsymbol{ttm}^r$ trade and transport margins and insurance costs (TTM), by product

$\boldsymbol{m}^r$ total import, by product

$\boldsymbol{O}_u^r$ other entries for intermediate use

$\boldsymbol{O}_y^r$ other entries for final use

$\tilde{\boldsymbol{e}}_t$ net taxes on products paid out by the countries in rest of the world

$\boldsymbol{t}_u^r$ net taxes on products for intermediate use, by industry, derived through the conversion of matrices into basic price using top^r in the supply table

$\boldsymbol{t}_y^r$ net taxes on products for final use, by final use sector, derived through the conversion of matrices into basic price using top^r in the supply table

t_e^r net taxes on products for export, derived through the conversion of the export vector into basic price using top^r in the supply table

$\boldsymbol{W}^r$ gross value added

$\boldsymbol{q}^r$ total supply, purchasers' price

$\boldsymbol{x}^r$ total supply/use, basic price (= total output by product)

$\boldsymbol{g}^r$ total input/output, basic price, by industry

bp basic price supply

pp purchasers' price

CIF cost, insurance and freight

National accounts constitute the benchmark for the international comparison of economies, provided that they are compiled based on international agreed standards. The **System of National Accounts**

(SNA ([11])) describes a coherent, consistent and integrated set of macroeconomic accounts in the context of a set of internationally agreed concepts, definitions, classifications and accounting rules. Among other accounts, it provides an overview of economic processes, recording how production is distributed among consumers, businesses, government and foreign nations. Consequently, the national accounts are one of the building blocks of macroeconomic statistics, forming a basis for economic analysis and policy formulation.

A national input-output framework consists of national SUTs and IOTs ([12]). SUTs can be interpreted as the mixed output of industries and the use of inputs by industries respectively. The **supply table** consists of a matrix of goods and services (rows) produced by industries (columns), plus additional information on imports (in CIF), trade and transport margins (TTM) and taxes less subsidies (TLS) on products; all of these make up the total supply of products of an economy. The **use table** depicts domestically produced and imported intermediate and final uses in the form of two separate matrices. They may be valued at basic prices and at purchasers' prices. There are additional column vectors that show the final use categories, i.e. final consumption, investment and exports (free on board — FOB), and additional rows that depict gross value added split into labour costs, capital use, other TLS on production and net operating surplus. Imports are shown in the national SUTs with a separation between intermediate and final uses by product but not by countries of origin, while exports are shown by product but neither by intermediate and final uses nor by countries of destination, all of which is crucial for the construction of global (or regional) inter-country SUIOTs. These tables form the basis for the subsequent construction of inter-country input-output (ICIO) tables and with it input-output modelling and GVC analysis.

The extension from national to inter-country SUIOTs involves splitting the national SUT imports of intermediate and final goods and services by country of origin (and exporting industries). This in turn produces an indirect estimation of the exports of intermediate and final goods and services by country of destination (and importing industry). It could also be the other way round, i.e. by splitting national SUT exports by country of destination and by type of use (intermediate or final), the imports of goods and services by country of origin (and exporting industry) can be estimated indirectly. The OECD and Eurostat prefer the latter option due to the fact that both exports in the national SUTs (at purchasers' prices ([13])) and in merchandise trade statistics are valued FOB, which is the appropriate valuation for the first step in the construction of an inter-country SUT. The two approaches should not differ in principle as long as the view of bilateral trade among countries is balanced at the level of each good and service and both exports and imports are valued FOB. However, this is not the case in the real world and asymmetries on reported bilateral trade flows among countries exist.

Alongside national accounts and national SUIOTs, international trade in goods and services constitutes the third pillar in the construction of inter-country SUIOTs. Even though efforts are being made to overcome bilateral trade asymmetries among countries, the problem still remains. The differences between exports (imports) and mirror exports (imports) (Jansen, 2014) can be attributed to:

- different valuation of exports (FOB) and imports (CIF) value;
- product misclassification;
- time lag between exports and imports (e.g. goods leaving country A in 2017 might only reach Country B in 2018);
- goods passing through third countries (transit trade, re-exports);
- goods entering customs warehousing for several months;
- unallocated trade flows or goods being classified differently;

([11]) https://unstats.un.org/unsd/nationalaccount/sna.asp

([12]) Simplified supply, use and input-output tables are available in Eurostat (2008) in tables 1.1, 1.2 and 1.4.

([13]) Use tables at basic prices should report exports at basic prices i.e. excluding domestic trade and transport margins and taxes less subsidies on products associated to the exported goods (from the factory to the border).

- countries having different trade systems (general versus special trade system);
- goods passing through industrial processing zones that may or may not be recorded by the exporting country.

The construction of inter-country SUIOTs requires a balanced view of bilateral trade statistics among countries and of each good and service. Current efforts to create a balanced view of trade include: (i) the OECD and the WTO preparing a separate database for goods and services in addition to the global ICIO tables; (ii) the collaborative work among the North American Free Trade Agreement (NAFTA) and the Asia-Pacific Economic Cooperation (APEC) countries; and (iii) the work that Eurostat is doing for the EU countries. These include regular workshops where country representatives meet and try to gain insights into the differences recorded by their trade statistics.

Business statistics can complement inter-country SUIOTs by providing supplementary information on the size of firms, their exporter status, their ownership and the type of use (final use or intermediate use) of the goods and services consumed. Such information is partially available in the individual EU Member States on a voluntary basis but was not taken into account in the Figaro tables for 2010. Moreover, the collection of firm-level data such as foreign direct investment inflows and outflows, property income received and paid, operating surpluses, gross value added, output, financial and non-financial assets, exports and imports of processing goods is also crucial for GVC type of analyses. Collecting additional information on the countries of origin and destination of goods and services for intermediate and final uses separately for a specific industry would make a real difference in the construction of inter-country SUIOTs. The additional information described above was not used in the current Figaro tables for 2010 but will be integrated as much as possible into the future work.

2 Review of construction methods

2.1 Introduction

Applications of inter-country input-output tables (IC-IOTs) have surged in recent years in various fields of economics. Areas covered by these new applications include: the analysis of production sharing and value added trade, studying implications of international production integration on growth, competitiveness and employment, and analysis of environmental issues like CO_2 and emissions footprints and resource use.

Research in this field has been enabled by the increasing availability of IC-IOTs thanks to various efforts like the World Input-Output Database project (WIOD) and the EXIOBASE project financed by the European Commission within the 7th framework programme, the OECD-WTO TiVA initiative and others surveyed below. The various databases have been set up with different aims and backgrounds concerning specific scientific and policy-related questions. These include focusing on accounting of value added trade and production integration, impacts on growth and employment, trade policy measures, environmental issues and material flows. Other available inter-country tables do not have a fully global scope but focus on regional specific issues like the Asian production network. In addition, various attempts have been made to expand some of these inter-country tables to include further countries; such data form the basis of attempts to regionalise the data and thereby reveal intra-country linkages. It is therefore highly desirable to ensure further updates and improvements of such data, which form the basis for a growing field of research and pave ways for a broad range of potential applications in many policy-relevant areas.

These past and recent efforts to construct such IC-IOTs have, however, also: (i) revealed various weaknesses over the availability of data and information needed to construct these tables; and (ii) revealed inconsistencies within and across datasets, which thus resulted in a variety of ways and methods to overcome these shortcomings. Further important issues which require careful treatment include: (i) the treatment of re-exports; (ii) the construction or approximation of valuation matrices and specifically international trade and transport margins; (iii) estimation of import use tables and their breakdown by country of origin; and (iv) estimates of rest of the world data.

As ongoing efforts — including Figaro — to construct such IC-IOTs are much appreciated, a stock-taking exercise is useful as there is a lot that can be learned from the various strategies to construct IC-IOTs. However, ongoing and future construction efforts may need to be adapted to recent developments in data availability and changes in methodologies, in addition to being improved in various aspects. To make best use of available data, construction strategies require steady adjustment to adapt to: (i) changes in industry classifications; (ii) changes in the method of national accounts (i.e. the change from SNA1993/ESA1995 to SNA2008/ESA2010); (iii) provision of additional information like valuation matrices and use tables in basic prices and import use tables; and (iv) changes in trade data (e.g. particularly in services trade e.g. the change from the fifth to the sixth edition of the Balance of Payments and International Investment Position Manual (BPM5 to BPM6). Furthermore, to meet the needs of practitioners and policy-makers for even more detail, recent efforts to construct IC-IOTs should continue so that the tables can include details such as business statistics and household income statistics, and accompanying satellite data (e.g. detailed employment data, breakdown of value added, emissions and resource use).

The objective of this chapter is to provide a stock-taking of recent efforts to construct to global inter-country supply and use tables and input-output tables. The chapter highlights the common challenges underlying all these efforts and provides an overview of: (i) similarities and differences in strategies used to construct inter-country input-output tables with respect to data sources; and (ii) strategies for the balancing and reconciliation of data.

The report is structured as follows:

The next Section presents an overview of recent efforts and existing inter-country supply and use tables (IC-SUTs) and IC-IOTs and summarises: (i) their scope with respect to the time periods covered; (ii) the level of industry details provided; and (iii) the coverage of countries.

Subsequently, the following Section summarises the underlying data sources, including national accounts data and supply and use tables (including valuation matrices and import use tables) and trade data for goods and services. It also discusses the specific challenges mentioned above (i.e. quantification and treatment of re-exports and estimations of CIF/FOB margins). These challenges are, nonetheless, common to all efforts.

Next we review the construction of IC-IOTs based on the IC-SUTs and the construction of the rest of the world category and we conclude with the last Section.

2.2 Overview of existing interregional input-output tables

2.2.1 Overview

Over the last five years, several inter-country input-output databases have been developed by the scientific community and/or international organisations. Some of these efforts data back further, while some initiatives have involved only sporadic work and others have been discontinued. The aim of this section is to provide an overview of important current international projects to construct global inter-country supply and use and input-output tables. For a broad overview of coverage see Table 2.1.The underlying documentation is presented in box 2.1 .

These databases have been set up with various aims, such as: (i) research on environmental issues (e.g. the EXIOBASE and EORA databases); (ii) trade modelling and the impact of trade policy measures (the GTAP (Global trade analysis project) database); and (iii) more recently, to focus on accounting for various impacts of value added trade and production integration (the OECD-WTO TiVA and WIOD databases). Other tables (like IDE-JETRO and YNU-GIO) are inter-country tables but do not have a fully global scope.

Table 2.1: Overview of existing IC-IOTs

	Countries	Industries	Years	Free availability of tables	Updates intended	Website
EORA	187	Varying across countries; simplified version with 26 industries	1990-2012	Yes	Yes	http://worldmrio.com/ http://www.worldmrio.com/simplified/
EXIOBASE	44 countries; 5 world regions	200 products; 163 industries	2000; 2007	Yes	No	http://www.exiobase.eu/
GTAP-MRIO (Open:EU)	140 GTAP countries and regions	57 GTAP commodities	1990, 1992, 1997, 2001,2004;2007	Up to GTAP7	Infrequently	https://www.gtap.agecon.purdue.edu/
IDE-JETRO (AIIOT)	10 countries	76 sectors	1985; 1990; 1995 ; 2000; 2005	2,005.0	No	http://www.ide.go.jp/English/Data/Io/index.html
OECD-WTO TiVA (Release 2016)	62 countries (incl. RoW)	34 industries	1995-2011	Yes	Yes	http://www.oecd.org/trade/input-outputtables.htm
WIOD Release 2013	41 countries (incl. RoW)	35 industries	1995-2011	Yes	No	http://www.wiod.org/new_site/home.htm
WIOD Release 2016	44 countries (incl. RoW)	56 industries	2000-2014	Yes	Infrequently	http://www.wiod.org/new_site/home.htm
YNU-GIO	29 countries and 5 world regions	35 industries	1997-2012	Yes	No	http://www.recessa.ynu.ac.jp

Note: Information taken from websites (July 2018); this table does not include information on underlying tables (e.g. supply and use tables) or accompanying satellite accounts.

Box 2.1 Documentation of IC-IOTs

EORA

Lenzen, M., K. Kanemoto, D. Moran, A. Geschke (2012), Mapping the Structure of the World Economy, Environmental Science and Technology, 46(15) pp 8374-8381, DOI:10.1021/es300171x.

Lenzen, M., Moran, D., Kanemoto, K., Geschke, A. (2013), Building Eora: A Global Multi-regional Input-Output Database at High Country and Sector Resolution, Economic Systems Research, 25:1, 20-49, DOI:10.1080/09535314.2013.769 938.

EXIOBASE

Bouwmeester, M.C. (2011), Algorithm Applied on the Full EXIOPOL SUT Data Set and Documentation Provided, EXIPOL Deliverable III.4.a-4, RU Groningen, thet Netherlands.

Koning, A.de, R. Heijungs and A. Tukker 2013, Technical Report: Full EXIOBASE database management system including agreed scripts operational, Deliverable: DIII.4.b-5.

Tukker, A., de Koning, A., Wood, R., Hawkins, T., Lutter, S., Acosta, J., Rueda-Cantuche, J.M., Bouwmeester, M., Oosterhaven, J., Drosdowski, T., Kuenen, J. (2013), EXIOPOL —— Development and illustrative analyses of a detailed global MR EE SUT/IOT, Economic Systems Research, 25 (1), pp. 50-70.

Wood, R., T. Bulavskaya, O. Ivanova, K. Stadler, M. Simas, A. Tukker, S. Lutter, J. Kuenen, R. Heijungs (2013), Report D7.2 —— Update EXIOBASE with WP3-6 input, Report; (http://www.exiobase.eu/index.php/publications/documentation).

Wood, R., T. Hawkins, T. van Bree, W. Manshanden and E. Poliakov (2010), Development of Harmonized Supply and Use Tables for the EXIOPOL Database, Norwegian University of Science and Technology (NTNU), Trondheim, Norway; Project No 037033 6th EU Framework Project.

GTAP-MRIO

Andrew, R.M. and G.P. Peters (2013), A Multi-Region Input-Output Table Based on the Global Trade Analysis Project Database (GTAP-MRIO), Economic Systems Research, 25:1, 99-121.

Narayanan, B. and T.L. Walmsley (2008), Global Trade, Assistance and Production: The GTAP 7 Data Base, Purdue University, Center for Global Trade Analysis.

Narayanan, G., B., A. Aguiar and R. McDougall (2015), "An Overview of the GTAP 9 Data Base", Journal of Global Economic Analysis 1(1), pp. 181-208.

Peters, G., R. Andrew and J. Lennox (2011), Constructing a Multi-Regional Input-Output Table Using the GTAP Database, Economic Systems Research, 23, 131-152.

IDE-JETRO

Meng, B., Y. Zhang and S. Inomata (2013), Compilation and Applications of the IDE-JETRO's International Input-Output Tables, Economic Systems Research, 25:1, 122-142.

OECD

Fortanier, F. K. Sarrazin, and B. Wistrom (2015), Towards a balanced and international merchandise trade dataset, Meeting of the Task Force on International Trade Statistics, Item 9 of the Agenda —— Asymmetries in trade statistics, TFITS (2015)9.

Miao, G. and F. Fortanier (2016), Estimating CIF-FOB margins on international merchandise trade flows, STD/CSSP/WPTGS(2016)8.

OECD (2015), Towards a global matrix of trade in services for TiVA: Progress report, Working Party on International Trade in Goods and Services Statistics, ST/CSSP/WPTGS(2015)27.

Spinelli, F. and S. Mirodout (2015), Estimating bilateral trade in services by industry —— the EBTSI data set, OECD.

WIOD

Dietzenbacher, E. B. Los, R. Stehrer, M. Timmer and G. de Vries (2014), The Construction of World Input-Output Tables in the WIOD project, Economic Systems Research, 25(1), 71-98.

Timmer, M.P., E. Dietzenbacher, B. Los, R. Stehrer and G.J. de Vries (2015), An Illustrated User Guide to the World Input-Output Database: the Case of Global Automotive Production, Review of International Economics., 23: 575--605.

Timmer, M.P. (ed.), I. Arto, V. Andreoni, A.A. Erumban, J. Francois, A. Genty, R. Gouma, B. Los, F. Neuwahl, O. Pindyuk, J. Pöschl, J.M. Rueda-Cantuche, R. Stehrer, G. Streicher, U. Temurshoev, A. Villanueva, G.J. de Vries (2012), The World Input-Output Database (WIOD): Contents, Sources and Methods, WIOD Working Paper Nr. 10.

Timmer, M. P., Dietzenbacher, E., Los, B., Stehrer, R. and de Vries, G. J. (2015), 'An Illustrated User Guide to the World Input-Output Database: the Case of Global Automotive Production', Review of International Economics., 23: 575--605

Timmer, M. P., Los, B., Stehrer, R. and de Vries, G. J. (2016), 'An Anatomy of the Global Trade Slowdown based on the WIOD 2016 Release', GGDC research memorandum number 162, University of Groningen

YNU-GIO

Sato, K. and N. Shrestha, (2014) Global and Regional Shock Transmission: An Asian Perspective,' CESSA Working Paper, 2014-04.

2.2.2 Dimensionalities

The first obvious way to characterise the various databases is to refer to number of years and countries they included, and to the level of industry details (or commodities) that they ultimately provide; in some cases more detailed industries or commodities are used in the construction process. Table 2.1 provides this basic information.

With respect to the ***number of countries***, two databases — EORA and GTAP-MRIO — cover more or less all countries in the world (though in the case of GTAP-MRIO some of the smaller countries are grouped into several broader regions). Other databases — EXIOBASE, OECD-WTO and WIOD — focus on a group of economies mostly determined by data availability of SUTs and IOTs. In these cases the number of countries covered range from 43 countries in the WIOD (Release 2016) and 44 countries in EXIOBASE3, to 65 countries covered by the OECD-WTO TiVA 2018 database; in the latter case China and Mexico are split to better account for processing trade. In all these cases an additional endogenous rest of the world category is estimated, capturing the remaining part of the world as a single entity (see Stadler et al. (2014) for an evaluation of procedures to estimate a 'rest of the world'). In all these databases all EU Member States are included (Croatia is not included in the 2013 release of WIOD). Finally, the IDE-JETRO database covers 10 endogenous countries but splits exports and imports as exogenous demand components to four regions and YNU-GIO 29 countries and five world regions.

A second characteristic is the ***number of industries*** finally reported in the IC-IOTs. These numbers range from 163 industries in the EXIOBASE3 database to 26 industries in the EORA (though a version with much more details — though different across countries — is generally available). The IDE-JETRO database with 76 industries is also rather detailed. The GTAP-MRIO provides information on 57 industries, of which 20 are agricultural industries. The 2013 release of the WIOD database provides data for 35 industries, which correspond to the ISIC Rev. 3/NACE Rev. 1 classification. The 2016 release of WIOD and the OECD-WTO 2018 TiVA database provide details for 56 and 36 NACE Rev. 2/ISIC Rev. 4 industries, respectively.

Finally, with respect to ***time***, three datasets so far provide a full time series of IC-IOTs:

- The EORA covers 1990 to 2015 (though based on information mostly on 2000). The 2013 release of WIOD provides data for 1995-2011, whereas the 2016 release provides data for 2000-2014. Unlike EORA, this time series is based on yearly information for SUTs (to the extent available).
- The OECD-WTO effort (2018 release) managed to provide tables for the years 2005-2015, while the IDE-JETRO databases provide data as far back as 1975 but report data only every 5 years in the recent versions.
- Finally, GTAP-MRIO and EXIOBASE provide data only for a few years: 1995-2011 in the case of EXIOBASE, and data for base years 2004, 2007 and 2011 (and selected years from 1990 onwards) for GTAP-MRIO.

2.3 Underlying data sources

The construction of the IC-IOTs is based on two underlying sources of data: (i) national accounts data and supply and use tables; and (ii) trade data (for goods and services). National accounts data are used as benchmarks for the information provided in the SUTs (or IOTs) at industry level as these are available on an annual basis and are more frequently updated. Trade data are used to link the national supply and use tables across countries.

2.3.1 National accounts and supply and use tables

A. OVERVIEW

Table 2.2 consolidates the information concerning the underlying data sources for national accounts data and SUTs for the various initiatives. All but one of the datasets considered rely on information from SUTs and/or IOTs. This exception is the GTAP-MRIO, which is based on a consistent trade dataset to which (total) IOTs and SNA data are benchmarked. The IDE-JETRO dataset is exclusively based on input-output data whereas the IC-IOTs provided by EXIOBASE, OECD-WTO and WIOD start with SUTs. In some cases, however, SUTs are derived from existing IOTs using specific assumptions. EORA uses a mixture of SUTs and IOTs (in various details and dimensions, i.e. industries and commodities).

Concerning the sectoral details, IDE-JETRO, OECD-WTO and WIOD provide data at the one- and two-digit NACE/ISIC levels (as some industries or products are further aggregates), but do not aim to disaggregate industries or commodities. This results in a common industry classification for each country before constructing the international linkages. EXIOBASE undertakes a further disaggregation of the SUTs based on various data and assumptions. The GTAP-MRIO takes over the industry classification as used in the GTAP project. Finally, the EORA database uses the most detailed information available by country; data for other countries are estimated on the basis of a common industry classification.

B. BENCHMARKING TO SNA DATA

In all cases but one, the tables are benchmarked to recent and revised national accounts data before being further processed to generate the inter-country dimensions. The one exception is the GTAP-MRIO, which is based on the GTAP trade data. However, this benchmarking is done in different ways. In the EORA approach, benchmarking to SNA (and other) data occurs within a large-scale optimisation approach also providing valuation matrices and the inter-country tables. In the other cases this is mostly performed before the construction of the international dimensions for each national SUT. In the EXIOBASE project this is achieved using a non-linear programming approach applied to the more detailed SUTs constructed. In the IDE-JETRO and WIOD approach, this has been achieved by a RAS (bi-proportional adjustment method) or SUT-RAS procedure (see Temurshoev and Timmer, 2011), respectively. In these cases the information provided in the SUTs is adjusted to the most recent national accounts data. The OECD-WTO TiVA construction effort applies a more elaborated method using information from trade data to adjust exports and imports in the SUTs. These are then used to calculate consistent bilateral trade flow matrices.

C. VALUATION TABLES

An important step in all efforts to construct IC-IOTs is to transform use tables in purchasers' prices into use tables in basic prices, i.e. to construct valuation matrices for 'taxes less subsidies on products' (TLS) and 'trade and transport margins' (TTM). For EORA, this is performed as part of the large-scale optimisation approach, whereas in GTAP-MRIO this is already taken into account in the underlying trade data used.

Table 2.2: Data sources

	EORA	EXIOBASE	GTAP-MRIO	IDE-JETRO	OECD-WTO	WIOD (Release 2016)
Base data	IOTs, SUTs	SUTs; IOTs to estimate SUTs	GTAP trade data	IOTs	SUTs; IOTs to estimate SUTs	SUTs
	Different dimensions	Further disaggregation	Sector level determined by GTAP trade data	Aggregation to common level	Adjusted to common classifications	Adjusted to common classifications
Harmonisation/ Benchmarking to SNA	SNA data as constraints in large-scale optimisation approach	SUTs benchmarked to SNA	Based on GTAP data (balanced beforehand)	IOTs benchmarked to SNA	SUTs benchmarked to SNA	SUTs benchmarked to SNA
Valuation (USEpp to USEbp)	Constructed during large-scale optimisation approach	Based on/estimated from existing information; or 'similar country assumption'	Based on GTAP data providing information on international margins (and taxes)	Based on/estimated from existing information	Based on/estimated from existing information	Based on USE in basic prices
Import use tables	Constructed during large-scale optimisation approach	Based on existing information or 'similar country assumption'	Constructed using proportionality assumption	Based on existing information; in 2005 specific survey conducted	Mostly based on available information; else estimated using modified proportionality assumption	Constructed from imports in SUP using modified proportionality assumption

Source: Author's assessment

In three out of the other four cases — EXIOBASE, IDE-JETRO, the OECD-WTO TiVA initiative — valuation matrices for TTM and TLS and therefore use tables (and IO tables) in basic prices are either taken from existing information or calculated based on various assumptions using existing information (e.g. from previous years, etc.) to the extent possible. In some cases, estimates are also made on the basis of a 'similar country' (see Rueda-Cantuche et al., 2017, for an evaluation effort). Consistency is assured by applying RAS or other optimisation procedures. The WIOD (2013 release) project opted to estimate valuation matrices and therefore use tables in basic prices based on a common procedure (the SUT-RAS procedure) for all countries (even if valuation matrices were available), starting from use tables in purchasers' prices and the information of trade and transport margins and taxes less subsidies on products in the respective columns of the supply tables (see Temurshoev and Timmer, 2012, for details of the SUT-RAS approach). As more recently EU countries also report use tables in basic prices the 2016 release of WIOD was based on this information (or applying the SUT-RAS procedure if these were not available). This availability of use tables in basic prices for EU countries constitutes an improvement as many non-European countries provide tables in basic prices only.

D. IMPORT TABLES

The construction efforts for import use tables (in most cases in CIF values corresponding to the information on imports CIF from the supply table) are also handled differently. The EXIOBASE, IDE-JETRO and OECD-WTO approaches rely on available information as above (i.e. further construction of import use tables is done only if no prior information is available). IDE-JETRO undertook a specific survey (for the 2005 data) to achieve better information about the imports of the using industries (to avoid a proportionality assumption). GTAP-MRIO applies a proportionality method to constructing import use tables, based on trade shares across countries of origin of the importing country. In the EORA this is achieved as part of the large-scale programming effort, based on information if available beforehand. In the WIOD project, import use tables are estimated for all countries based on the same procedure: i.e. information from existing import use tables has not been used so far as for many non-EU countries such information was not available.

In all cases where import use tables have to be constructed a proportionality assumption has to be applied. This means that the imports (from the information given in the supply tables) are allocated over the using industries proportionally to the use of commodities in the total use table (in basic prices). This can be referred to as a 'horizontal proportionality assumption'. At least in the OECD-WTO and WIOD construction procedure, a 'modified horizontal proportionality assumption' has been applied by splitting import use into various use components (intermediates, consumption, gross fixed capital formation), with information derived from detailed trade data. In these cases, import levels of a specific product are first split into these three categories, which are then allocated proportionally over the various use categories (e.g. the industries in the case of intermediate imports). This modifies the 'pure horizontal proportionality assumption'. However, the proportionality assumption still has to be applied within these broader 'use categories' (particularly across all using industries) due to lack of detailed information. Similar to the rising availability of valuation matrices, more recently a number of countries (particularly EU countries) report import use tables which can be used in the construction methods.

2.3.2 Trade data

A. SOURCES

Detailed trade data are the next important component in the construction of IC-IOTs. Generally these serve for the construction of import use tables (e.g. splitting trade into use categories as just outlined in the previous section) and for the geographical breakdown of these by country of origin. Alternatively, the Figaro Project follows a strategy to split exports by country of destination instead. Data on trade in services are more challenging given: (i) some inconsistencies within and across various datasets; (ii) missing information on details (e.g. bilateral flows by detailed balance of payment categories); and (iii) lack of correspondence between balance of payment codes and the CPA classification.

B. TRADE IN GOODS DATA

The most important data source for trade in goods is the UN Comtrade database. These data are often modified and balanced (or reconciled) in various ways before being used to build IC-SUTs. The various approaches, however, differ on the exact sequencing of adjustments. OECD-WTO TiVA and WIOD start from a previously balanced dataset. They take into account mirror flows from exports and match the flows by weighting the quality of information. They also take into account that imports are reported in CIF and exports in FOB by estimating the respective margins. These trade data are then adjusted to the information on imports as reported in the supply and exports as reported in the use tables. Imports and exports in SUTs by commodity are further adjusted beforehand in the OECD-WTO TiVA approach to satisfy information from SNA data.

A second important aspect is the split of imports (and exports) into use categories differentiating intermediates, final consumption and gross fixed capital formation. The OECD-WTO and the WIOD project document attempts to do this by applying a 'modified broad economic categories (BEC) classification'. In these cases trade data at the detailed 6-digit HS (Harmonised System) product level are classified as intermediates, final consumption or gross fixed capital formation goods based on the UN BEC classification; in both cases mentioned this classification has been improved further on and adjusted to account for multi-use products.

As outlined above, this has implications in the process of constructing import use tables if needed, i.e. whether one: (i) applies the 'horizontal proportionality assumption' over all using industries and consumers; or (ii) differentiates by various use categories (e.g. intermediates, final consumption and gross fixed capital formation) referred to as 'modified horizontal proportionality assumption'. Similarly, when splitting import use tables by country of origin, this differentiation is taken into account as geographical sourcing structures might differ for intermediates, final consumption goods and gross fixed capital formation goods. Nonetheless, one has to apply a 'vertical proportionality assumption' as the trade data do not make it possible to account for sourcing structures of a specific CPA product differentiated by using industry or by final consumption categories.

The construction of import use tables by country of origin is already based on the harmonised data in the cases just described. In a slightly different manner, in the EXIOBASE project trade data are first used to separate out import use tables (in CIF), which are then made consistent applying a non-linear programming approach (CIF/FOB adjustments are applied later in the process). In the IDE-JETRO approach, some further information is collected from national sources. However, the global balancing issue in this case is less relevant (as some exports are from exogenous countries and regions). In EORA, trade relations are included in the large-scale optimisation approach as a further constraint. Finally, in the GTAP-MRIO project the trade data form the bases from the beginning on which IC-IOTs are benchmarked.

C. TRADE IN SERVICES DATA

Many of these aspects described in the previous section create bigger problems for trade in services. First, trade in services databases, which are available from various sources (underlying data sources are UN and Eurostat), suffer various problems. The most important problems are: (i) the data are often incomplete as regards the number of trading partners in various categories (including total bilateral trade in services); (ii) there are large discrepancies in mirror flows; and (iii) there are inconsistencies across various levels of aggregation.

Therefore, the data need to be heavily adjusted in one way or the other. To the extent information is available the OECD-WTO imputes data by mirror flows and on the basis of gravity estimates. Efforts in the WIOD project aim to provide a consistent database by combining various sources, build mirror flows and make them consistent across various aggregates. This was similarly the case for the GTAP-MRIO data, which rely on GTAP trade data (though from much earlier years). IDE-JETRO also incorporated information from national statistics.

The second important challenging issue is the lack of correspondence between BoP categories, which are the classification for trade in services data, and the (more detailed) CPA categories. Consequently, only broad correspondences can be applied. Due to a lack of better information these are often built on the basis of a value judgement.

The third issue again concerns the split of imports by use categories. Imports cannot be broken down by use categories on the basis of services trade data, even if the breakdown were to be incomplete. This is because unlike in the case of trade in goods data, we cannot extract such detailed information from trade in services data. This problem is relevant for the construction of import use tables (which, as outlined above, is becoming less of an issue as many countries report such tables). This is because data do not allow for differentiation between use categories and therefore the 'horizontal proportionality assumption' cannot be modified. This is also the case for the split of import use tables into countries of origin where 'vertical proportionality' has to be assumed.

D. SPECIFIC CHALLENGES

As already mentioned above, two specific challenges need to be addressed in the construction efforts. These two issues are the treatment of re-exports and the treatment and calculation of CIF/FOB margins. These are summarised in Table 2.3.

First is the calculation of ***re-exports***. In some cases like the GTAP-MRIO this problem does not exist as it is already addressed in the construction of the GTAP trade data. In the EORA approach, this is most likely built in the large-scale optimisation procedure. Comparing the two approaches in which this issue is explicitly tackled one can see that in the OECD-WTO IC-SUTs the level of re-exports (by commodity) is defined as the values provided in the import use tables (and the estimated variants). In the WIOD project re-exports are defined as the difference between imports and total domestic use if the former are larger than the latter. In both approaches re-exports are not further integrated back into the system as basically this would already again change the SUTs and import use tables balanced in previous steps (see Streicher and Stehrer, 2015, for discussion).

The second issue is the ***calculation of CIF/FOB margins*** and the resulting international trade, transport and insurance costs for trade in goods. This issue arises as imports in the supply table (in basic prices) are valued in CIF terms whereas exports (in the use tables both in purchasers' and basic prices) are valued in FOB terms. As a result, constructing an import use table based on CIF imports and stacking them into a global use table does not match with the trade flows interpreted along the rows as exports (which should then by definition be valued in CIF).

In some approaches this does not matter as these import tables are based on sources like the GTAP database, which already provides data in FOB terms, or which provides information on international trade and transport margins. In the EORA documents this is mentioned but not detailed further, although various valuation matrices are reported. When constructing the IDE-JETRO tables a specific survey was undertaken to determine the magnitudes of these international margins.

The three remaining approaches tackled this issue in different ways.

- In the OECD-WTO effort, CIF/FOB margins have been estimated based on a gravity approach and used as an additional constraint in the 3-step constrained quadratic mathematical programming procedure applied for the construction process of IC-IOTs.
- In the WIOD project, CIF/FOB margins have been estimated based on detailed trade data and a gravity approach. The overall magnitude of these international trade and transport margins is quantified as the export surplus in the 'margins sectors' (i.e. transport and trade industries comprising trade and transport services). Combining these two pieces of information, i.e. the overall level and the bilateral CIF/FOB ratios by commodity and country-pair, makes it possible to calibrate the trade matrix with the constraints (import and export levels) stemming from the SUTs and initial values for bilateral trade from the trade data using a RAS (or similar) procedure. This results in a global international trade and transport valuation matrix consistent with the global SUTs system.

- In the EXIOBASE approach, the difference between the total value of (global) imports and (global) exports is used to quantify the overall magnitude of international trade, transport and insurance costs since the former is valued CIF and the latter in FOB. Based on that information, the magnitudes of these margins by commodity-country pairs are approximated. Subtracting this difference (based on a proportionality assumption) from the import use tables in CIF and applying a GRAS results in a global import use table in FOB terms and the corresponding valuation matrix.

Table 2.3: Treatment of re-exports and international trade, transport and insurance costs (CIF/FOB margins)

	EORA	EXIOBASE	GTAP-MRIO	IDE-JETRO	OECD-WTO	WIOD
Re-exports			Already built-in in balanced trade data		Export column in import use tables	Defined as exports larger than domestic use
					Leave system	Leave system
cif/fob adjustment		Difference between total value of imports and exports; GRAS	Data already in fob	For 2005 specific survey undertaken	Bilateral cif/fob margins estimated with gravity	Bilateral cif/fob margins estimated with gravity
		Valuation matrix as difference between ImpUSEbcif and			Adjustments in 3-step constrained quadratic mathematical programming	RAS procedure when reconciling with SUTs export and import levels

Source: Own elaboration

These approaches so far only correct for the use of international trade, transport and insurance services. However, in none of these approaches is the supply of these services treated or modelled completely satisfactorily (for an attempt see Streicher and Stehrer, 2015).

2.4 Construction of global IC-IOTs

The final step is the **derivation of IC-IOTs from IC-SUTs**. This is still the most important tool for applications of such data (rather than supply and use tables) but is not needed in all cases. The EORA data already provides IC-IOTs by mixing product and industry dimensions and various levels of details across countries. The downloadable version reports 26 ‘harmonized industries’, although these are aggregated from both industry and product dimensions across countries. The GTAP-MRIO also starts from a globally balanced system of trade data to which (national) IOTs have been benchmarked. In this case, efforts are undertaken to split these IOTs to account for trade in intermediates, resulting in an IC-IOT. Finally, the IDE-JETRO approach also started from national IOTs and therefore results again in an IC-IOT.

The other datasets provide national SUTs with the supply table in basic prices and the international use tables in basic prices (due to the efforts to construct and calculate valuation matrices for trade and transport margins and taxes less subsidies on products) and in FOB terms, i.e. net of international trade, transport and insurance costs. The use tables are split by country of origin (including domestic). Stacking these data appropriately corresponds to a ‘world SUT in basic prices’, with a final demand category being exports to rest of the world. Consequently, it is possible to apply the various models for constructing IOTs from these SUTs (e.g. see Eurostat 2008). OECD-WTO and WIOD report industry-by-industry inter-country input-output tables (IC- IOTs) based on the fixed product sales structure assumption (Model D in Eurostat, 2008), while EXIOBASE provides various IOTs (product-by-product and industry-by-industry) based on the various well-known technology ans sales structure assumptions.

A specific challenge in the construction of a global IC-IOT is the **construction of the rest of the world category**, which in most cases is characterised by about 10 % or less of global GDP and trade (depending on country coverage). In most cases the countries left out are important providers of raw materials, which impacts particularly on environmental footprints. In some cases (EORA and GTAP-MRIO) a rest of the world category is provided mostly to ensure the balancing of the system, i.e. world exports match world imports. Estimates for the rest of the world are based on estimates of output, value added and final demand from various sources (e.g. UN, United Nations Industrial Development Organization - UNIDO). Given the lack of detailed data, structures are often based on a benchmark country or a set of countries. In the EXIOBASE data this is done on a product-specific basis. Trade flows of the rest of the world with the countries in the datasets are determined by the residual of trade between the countries in the data and total exports and imports (already reconciled with trade data). Input-output structures are also approximated from the benchmark countries (this is the case for WIOD) or further manually adjusted (as in EXIOBASE). Finally, RAS procedures are applied to fit the rest of the world into the overall system such that the world global accounting identities are satisfied (for an overview of methods and outcomes see Stadler et al., 2014).

2.5 Summary

What are the lessons learned from this overview? The recently available IC-IOTs are first characterised by their coverage of industry details, years and countries, and differ with respect to the purposes and policy fields for which these have been constructed. These factors to a certain extent explain some differences in construction strategies.

Regarding these strategies, there are two core approaches to develop IC-IOTs: First, the starting point can be a set of balanced and reconciled trade data to which national input-output tables are adjusted. However, the more recent and more often applied strategies to construct IC-IOTs start from available national accounts data and supply and use tables (or partly input-output tables or a mixture of these). Most of the recently adopted approaches start from available SUTs which are first harmonised and benchmarked to available national accounts data. The exact strategies, however, differ with respect to a few common challenges. These are:

- construction or use of valuation matrices and import use matrices;
- reconciliation strategies of trade data and benchmarking with imports and exports from SUTs and national accounts;
- estimation of international trade, transport and insurance costs;
- reconciling international trade asymmetries for goods and services;
- harmonisation of different classifications of goods and services, and for industries.

One recent effort is characterised by keeping all details of data collected from national sources (even in the case of different dimensionalities and underlying SNA data) and applying a large-scale optimisation approach for one base year, with constraints provided from further data sources and respective identities and constraints.

In most cases the specific strategies and assumptions applied are dictated by shortcomings and inconsistencies of specific data sets, the lack of compatibility across data sources and the lack of detailed data for some issues. So it is not surprising that the various efforts have taken various routes in adjusting data to arrive at consistent and balanced IC-IOTs. In addition, data available often differ from country to country. Therefore, one general question is whether it is better to apply a common approach across all countries (leading to a consistent treatment) or to use best data available, which leads to mixed information sets across countries applied to construction IC-IOTs; the recent initiatives differ with respect to this decision. Fortunately, however, the data situation is steadily improving, leading to adjustments of the construction strategies. Only in fewer cases the construction of a fully consistent and harmonised global inter-country supply, use and input-output system still faces some methodological challenges, which future research will surely be able to solve.

Finally, some of these issues to resolve deficiencies or lack of data, harmonising data and reconciliation across countries and methodological issues in the construction of IC-IOTs cannot be deal with at a single country level alone. Instead they require multi-country (or even global) efforts and cooperation across international statistical agencies and national statistical offices of countries.

3 Methodological overview

3.1 Construction approach: overview

Inter-country SUIOTs depict the production and consumption of products by economic activities (or industries) and economic agents in a number of countries and across trading partners. National import matrices reflect the average user's structure (across all trading partners) by each reporting country and product. By contrast, merchandise trade statistics and international services trade provide the geographical distribution of the trade flows (and the trading partner shares) but not who the users were. Therefore, a careful combination of both databases allows the identification of trading partners and users in order to construct inter-country SUIOTs. Of course, some adjustments must first be made due to different valuation schemes (basic prices, purchasers' prices, CIF, FOB, etc.).

This methodology has pros and cons. On the positive side, it makes it possible to use detailed bilateral trade flows and user's structures of national import tables to construct the inter-country supply, use and input-output tables. Alternatively, trade data classified by broad economic classifications (BEC), trade enterprise characteristics statistics on goods (TEC) and on services (STEC) as well as Comext data at HS6 classification can provide guidance on the distinction between intermediate and final users. However, there are limitations to this approach, most of them caused by the absence of available data.

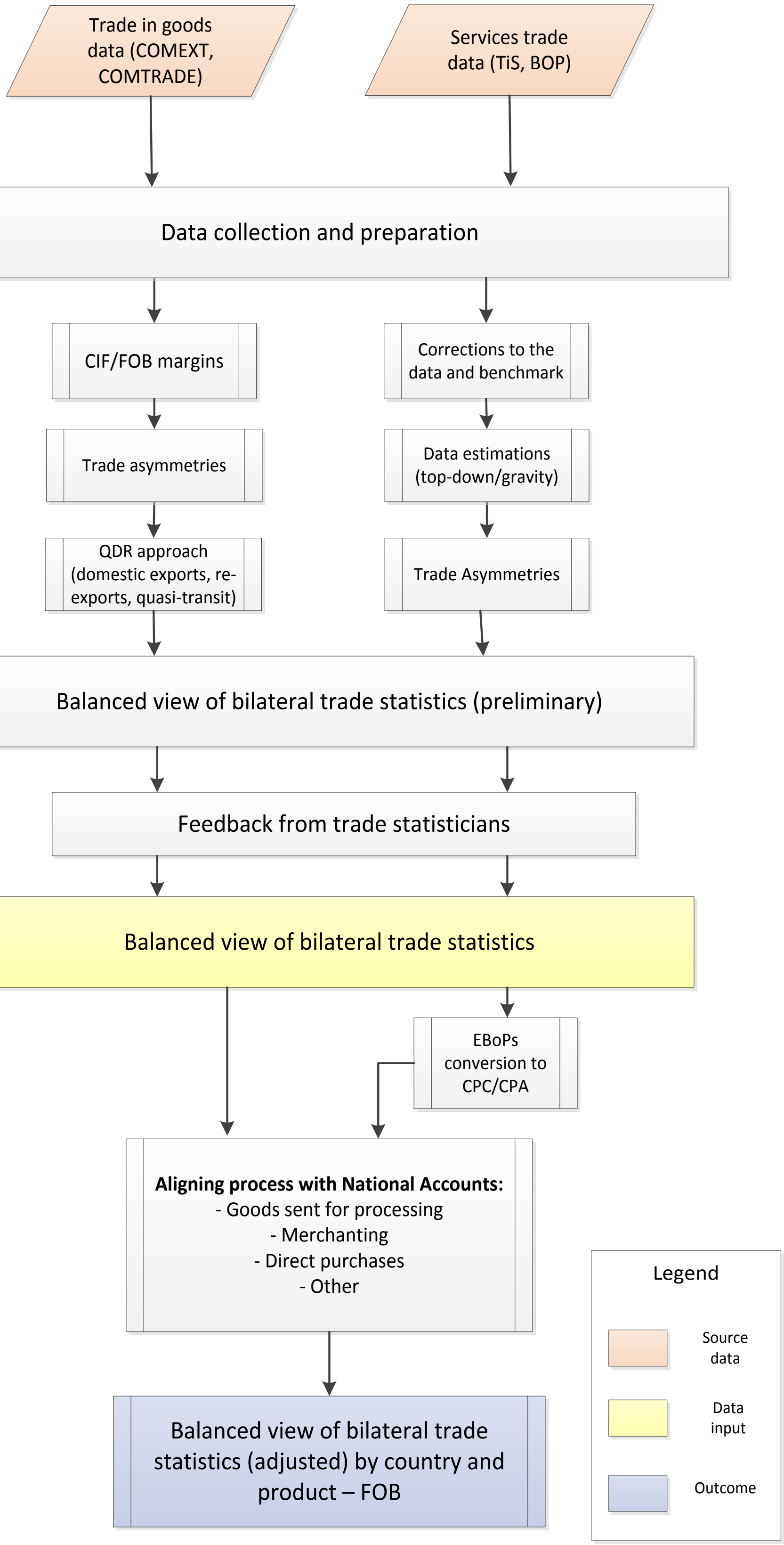
- Bilateral goods trade flows have to be previously balanced (removing asymmetries) and import values converted to FOB with some assumptions on CIF-FOB margins.
- In services, there is much less information (compared with trade in goods) and there is reduced number of services categories (extended balance of payments services (EBOPS)). Moreover, a conversion matrix to CPA is needed.
- Only one common row structure across all countries of origin, coming from the national import tables (previously converted to FOB with some assumptions on CIF-FOB margins), is applied in the absence of other data.

In any case, following up on the previous sections, the construction of EU-IC-SUIOTs involves different building blocks, as shown in Figure 3.1 and Figure 3.2. The entire process involves five main building blocks of (official) source data (shown in the orange boxes):

- national accounts (as benchmark);
- a national input-output framework (SUTs and IOTs);
- international merchandise (goods) trade data;
- international services trade data and balance of payments data;
- business statistics.

All of these are used to construct the three main data inputs (shown in the yellow boxes of Figure 3.1 and Figure 3.2) that feed the process for constructing the inter-country SUIOTs:

Figure 3.1: Construction of the (adjusted) balanced view of trade in goods and services



Source: Own elaboration.

- a balanced view of bilateral trade (in goods and services);
- a full set of national SUTs (basic and purchasers' prices); and
- a full set of national IOTs.

The blue boxes indicate the desired output data from the process.

While national accounts and national input-output frameworks paint individual pictures of the national economies across the EU or worldwide a balanced view of bilateral trade brings all of them together in a consistent framework. Figure 3.2 illustrates the estimation process. Goods and services trade data merit different treatments, even though both suffer from the same problem of bilateral trade asymmetries, i.e. when the export values reported by one country do not match the values (mirror exports) reported by its counterpart. The same applies for imports. In some cases, the information is also unobserved, unallocated or confidential, which calls for additional estimations in order to have a complete dataset.

For merchandise trade statistics, exports are valued FOB and imports are valued CIF. Different valuations are therefore one of the reasons for a trade asymmetry in goods, and these need to be corrected before trying to find solutions for the asymmetries. In the absence of available data from the EU Member States, we used the OECD dataset of CIF-FOB valuation adjustments ([14]) to convert imports CIF into FOB valuation.

Inter-country SUTs require the country of origin and intermediate/final destination to be identified when dealing with bilateral trade. For goods trade data, a combination of Comext and UN Comtrade databases was used to differentiate between domestic exports, re-exports and quasi-transit trade. First, the Comext goods trade data were balanced. However, the number and size of bilateral trade asymmetries can be enormous and overwhelming. The strategy adopted therefore involved manually addressing the largest differences and trying to find a consensus on a single figure, provided there was sufficient time and resources. All remaining differences were further reconciled based on a symmetry index (or reliability index) used to compute a weighted average of the two reported values available for each bilateral trade flow. The weightings were based on the proportion of each country's total trade that roughly matches the partners' reported trade. This process follows the same philosophy as the OECD reconciliation methodology (Fortanier and Sarrazin, 2016) and the earlier methodology developed in the Global trade analysis project (GTAP ([15])).

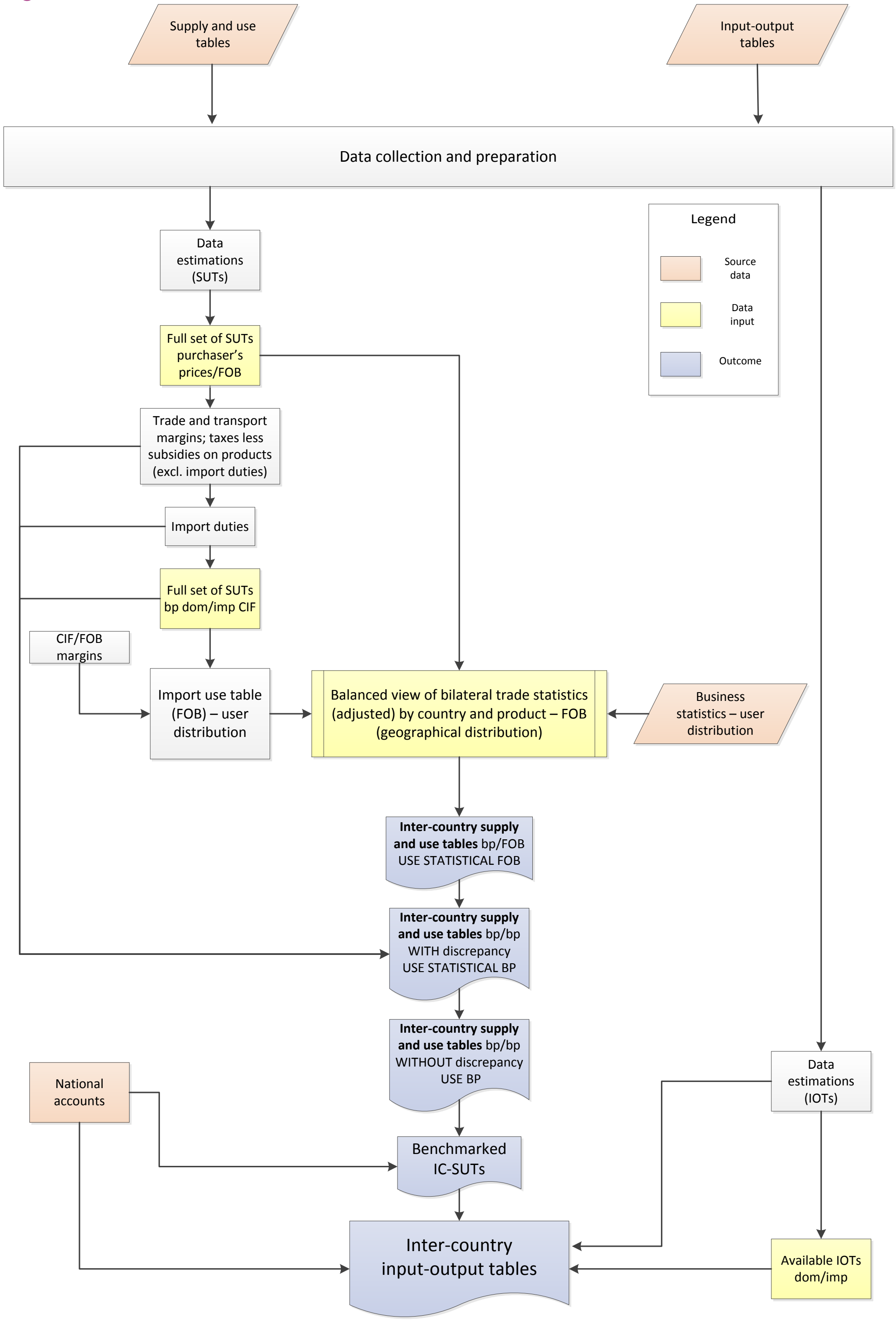
Second, quasi-transit trade was removed from Comext by difference with UN Comtrade trade data. Implicitly, there is the assumption that UN Comtrade reflects merchandise trade without quasi-transit trade. Next, in the case of re-exports, the re-exporter country is not the country of origin or, in other words, the country that produced the re-exported goods. As a result, some adjustments had to be made in the balanced trade dataset to properly reflect the geographical allocation of exports and imports to the producer country. These adjustments were made on the basis of Comext data on imports by country of origin. Subsequently, an estimation of domestic exports and re-exports resulted from these adjustments.

On international services trade data, there are various reasons why the availability and quality of services trade data is unsatisfactory, certainly when compared to goods trade statistics. Unlike goods that can be seen and physically measured and observed as they cross borders, service transactions can be performed via a number of modes (Rueda-Cantuche et al., 2016); only the financial flows can be observed as a rule, although it is also difficult trying to single out the corresponding services delivered (Fortanier et al., 2016). As a result, a variety of different data sources and estimation techniques need to be used in practice, and these can sometimes differ by country. Data confidentiality and the different classification of services (EBOPS versus CPA/CPC) can also complicate the scheme. Once a complete (albeit unbalanced) dataset of bilateral trade flows of

([14]) http://stats.oecd.org/Index.aspx?DataSetCode=CIF_FOB_ITIC

([15]) This methodology is, however, done at country level and with procedures that are less automated procedures. https://www.iioa.org/conferences/22nd/papers/files/1803_20140510051_ConstuctingofTradeDataforGTAPI-OConference.pdf services data was achieved, the same balancing approach and principle (symmetry index) set out in Fortanier and Sarrazin (2016) was followed to estimate a single value for each bilateral trade flow. Manual adjustments are also recommended for the largest asymmetries provided there is sufficient time and resources. In the next sections, we will go into this aspect in more detail.

Figure 3.2: Construction of the EU-IC-SUIOTs



Source: Own elaboration.

During the project, the quality of the results obtained was checked from the balanced view of trade with national or international trade statisticians, wherever possible, both for goods and services trade. Ideally, this feedback loop would be regularly established to derive subsequent revised and enhanced balanced datasets.

According to Ahmad (2017), there are still two sources of differences between the balanced view of bilateral trade in goods and services and the comparable view of imports and exports shown in national accounts (and national SUTs ([16])):

- an unallocated component reflecting the outcome of the balancing process (that can be allocated on a proportional basis if needed for analytical purposes); and
- the adjustments needed to align the concepts underlying the balanced bilateral trade estimates with the concepts and coverage of the SNA.

On concepts, differences include: (i) the treatment of goods sent abroad for processing and merchanting activities; and (ii) differences in coverage — including imputations of unobserved trade (e.g. smuggling, low-level trade below a certain threshold used by customs officials), re-exports and purchases by non-residents in the recording economy.

By definition, the EU-IC-SUIOTs are valued at basic prices ([17]), including both exports and imports. The importance of basic prices relies on the fact that, unlike purchasers' prices ([18]), basic prices reallocate TTM and TLS on products. All these features would distort the input structures of the inter-country use table in such a way that global value chains analyses would not be accurate. However, there is an exception, i.e.: basic prices might lead to an inaccurate representation of the position of distribution services in the global value chains.

Use tables are generally shown at purchasers' prices, which indicate the price users pay for goods and services for final use or intermediate inputs (including TTM and TLS). This is consistent with the way information is collected, i.e. mainly through surveys involving producer companies and consumers. With the appropriate reallocation of TTM from the goods to the corresponding trade and transport sectors and the reallocation of the associated TLS on products to a separate row, use tables are transferred into basic prices. As in merchandise trade statistics, exports are valued FOB (free on board), including all domestic TTM from the factory to the border of the exporting country and also any domestic-related taxes or subsidies on the products sold. Imports are valued at CIF values in the supply table, including international freight and insurance costs of international transportation.

At national level, it is therefore crucial to have a set of SUTs both at purchasers' prices and at basic prices for the construction[19] of EU-IC-SUIOTs. Ideally, fully fledged TTM matrices as well as TLS on products (with import duties separated) would be preferable. For 2010, all this (except import duties) is guaranteed by the European Commission ESA2010 data transmission programme, although with some exceptions because of derogations. If necessary, missing tables were estimated using the methodology described in Rueda-Cantuche et al. (2017).

([16]) The gross national income (GNI) inventories for 2010 list the necessary adjustments to be provided by EU Member States in accordance with paragraphs 3.163 to 3.178 of the ESA 2010.

([17]) ESA2010, par. 3.44: 'the basic price is the price receivable by the producers from the purchaser for a unit of a good or service produced as output minus any tax (i.e. taxes on products) payable on that unit as a consequence of its production or sale, plus any subsidy (i.e. subsidies on products) receivable on that unit as a consequence of its production or sale. It excludes any transport charges invoiced separately by the producer. It also excludes holding gains and losses on financial and non-financial assets'.

([18]) ESA2010, par. 1.97: 'as a result of transport costs, trade margins and taxes less subsidies on products, the producer and the user of a given product usually perceive its value differently. In order to keep as close as possible to the views of the transactors, the ESA 2010 system records all uses at purchasers' prices, which include transport costs, trade margins and taxes less subsidies on products, while output is recorded at basic prices, which exclude those elements'.

([19]) Even when the construction is made on the basis of use tables at basic prices, use tables at purchasers' prices are used to check export (fob) values against those of international trade in goods statistics.

On national IOTs, these are not strictly necessary for the construction of inter-country IOTs provided there are inter-country SUTs. This is, for instance, the WIOD and the OECD's experience, which produce industry-by-industry global ICIO tables on the basis of previously estimated inter-country SUTs. Standard models described in the 'Eurostat Manual on Supply, Use and Input-Output Tables' (Eurostat, 2008) such as the product technology assumption (Model A) and the industry technology assumption (Model B) can serve to produce product-by-product inter-country IOTs on a piecemeal basis (country-wise). Alternatively, fixed industry (Model C) or fixed product (Model D) sales structure assumptions can be used to produce industry-by-industry inter-country IOTs. The OECD uses Model D in its construction of industry-by-industry global ICIO tables. Moreover, the situation could become more difficult if official national IOTs were considered as benchmark, instead of deriving the inter-country IOTs from inter-country SUTs, as done in the Figaro project.

As shown in , the adjusted balanced view of bilateral trade (valued FOB and at purchasers' prices) has to be first compared against the export values of the national use table at purchasers' prices (also valued FOB) for checking purposes. Second, a set of national SUTs at basic prices was used with a distinction made between domestic and import uses. Domestic use tables were placed along the main diagonal of the inter-country use table.

National import flow matrices are valued CIF. They were therefore converted to FOB values in order to use the previous adjusted balanced view of trade. The CIF-FOB valuation adjustments database developed by the OECD was used for this. As a result, the derived national import flows do not necessarily have to match those of the balanced international trade import figures. However, these discrepancies can be reduced (but not eliminated entirely) through a series of transparent and replicable conversion matrices; the main idea is to allocate differences across products in order to preserve each country's recorded imports by industry and the geographical allocation of the balanced view of trade.

Export values were then converted from FOB prices to basic prices by reallocating trade and transport margins and TLS on products (excluding import duties) in the exporting countries. However, the lack of available national matrices of import duties made the full conversion impossible so the corresponding net taxes on products payable to foreign governments were not separated in the conversion process.

The end result of the entire process is an EU inter-country SUT valued at basic prices that can be converted into inter-country IOT using standard methods described by Eurostat (2008).

The final EU-IC-SUIOT contains a column and a row of discrepancies ([20]). Depending on particular needs and preferences, these discrepancies can:

- either remain as such and even be used as an indicator to identify areas where further work is needed to reconcile national and bilateral statistics ([21]);
- may also include vintage problems between the official SUT figures and revised figures of GDP and other macroeconomic variables that did not lead to the corresponding changes in the SUTs.

The Figaro project decided to provide both tables — with discrepancy items (statistical use table) and without discrepancy items (use table). Lastly, an additional benchmark to the latest figures of national accounts might be needed at the end of the process ([22]). A final simple balancing procedure would be used across the full table to implement this.

([20]) This is a result of the decision to fully constrain the system to the officially published GDP of each country and the fact that the sum of intra-EU exports included in these GDP numbers is larger than the sum of intra-EU imports.

([21]) The discrepancies can also be eliminated by a final, simple balancing procedure (e.g. generalised RAS (GRAS)).

([22]) For 2010, however, the Figaro project did not include this benchmark but instead input data corresponding to the latest data transmissions submitted by the Member States up to the end of 2016. During the validation and estimation process national data were then set to these macro-economic statistics on GDP, final consumption and gross capital formation.

Regarding national SUTs, the EU-IC-SUTs will preserve (without any change) the national values in the SUTs of 2010 for the domestic use tables (intermediate and final use, including exports at basic prices), value added components, taxes less subsidies on products and GDP.

As a result, Eurostat is publishing experimental statistics: the derived statistical EU-IC-SUIOTs and the inter-country use tables and inter-country input-output tables, both in industry-by-industry format and product-by-product format.

3.2 Figaro construction in practice: Eurostat's methodology

In reality, the construction of inter-country SUIOTs is mired in empirical challenges, including the need to make up for the at times (but not for 2010) limited availability of national SUIOTs and level of detail;

- estimating missing countries, import flow matrices and/or trade and transport margins matrices;
- reconciling international trade asymmetries (goods and services) with an appropriate geographical allocation of trade by countries of origin and destination;
- overcoming national data inconsistencies between national accounts and trade statistics, particularly those caused by goods sent abroad for processing and merchanting in the 2008 SNA;
- estimating international trade, transport and insurance costs matrices;
- estimating direct purchases abroad by residents and purchases of non-resident in the domestic territory;
- harmonising different classifications for products (HS, EBOPS, CPA) and for differences in industries (ISIC, NACE, national systems);
- balancing and construction of inter-country SUIOTs.

This section describes these challenges in detail and how the Figaro project addressed them.

3.2.1 Estimating missing countries, import flow matrices and/or trade and transport margins matrices

Unlike countries outside the EU, most EU countries (except for those with derogations) are able to provide national SUIOTs with comparable levels of industry detail and consistent valuations (basic prices and purchasers' prices). A collection of national SUTs (at basic prices) with a distinction between domestic and import uses is required ([23]). In addition, use tables at purchasers' prices are needed to compare their export values with the resulting balanced view of international trade. The sectoral classification is NACE Rev. 2, with the commodity classification referring to CPA/CPC 2008. The tables comprise 64 industries and 64 commodities, which can also be easily referred to ISIC Rev. 4 classification.

A collection of national IOTs with a distinction between domestic and import uses is required via the national accounts transmission programme every 5 years (for reference years ending by 0 and 5). However, this collection is usually incomplete given that some of the EU Member States ask for data submission derogations. Moreover, the compilation process to construct input-output tables across Member States is not as homogenous as for the supply and use tables. The usual standard

([23]) ESA 2010 Transmission programme of data (link) p. 102.

assumptions are frequently accompanied by manual corrections that reflect country-specific knowledge or overall balancing adjustments. In the Figaro project the inter-country input-output tables were compiled directly on the basis of the derived inter-country supply and use tables instead of estimating national missing IOTs beforehand ([24]).

When estimating missing tables, the project used a study outsourced by Eurostat (Rueda-Cantuche et al., 2017). This examined a few non-exhaustive methods for estimating trade and transport margins matrices, domestic and import use tables at basic prices and use tables (totals) at basic prices with a selection of auxiliary information. The study also provided an indication of how much the estimates matched reality in the absence of other official tables. Their main conclusion was that the usage of tables from previous years generally provides the best options in each case. This is mainly because they gather detailed country-specific information that is not expected to change in the short term. On trade, transport and insurance costs, it is better to start with an estimation of matrices of TLS on products. The TTM matrix would then be calculated by difference with respect to the use table at basic prices (if available). This solution performed better than the other way round. For the split between domestic and imported uses, the availability of a previous year's IOT or current IOT of imports makes a difference. In the case of missing use tables (total) at basic prices, using the joint structure of the trade, transport and insurance costs matrices and the TLS matrices from a previous year proved to be the best option i.e. difference between the use table at purchasers' prices and the use table at basic prices from a previous year, if both are available.

At the end of this step, we have achieved a complete harmonised set of supply and use (domestic and import CIF) tables in basic and purchasers' prices for all EU countries, including their trade and transport margins and taxes less subsidies on products tables.

3.2.2 Creating a coherent view of EU bilateral trade statistics of goods

The process for constructing a balanced bilateral trade dataset for goods and services is less straightforward. For goods trade data, a combination of Comext and UN Comtrade databases was used to differentiate between domestic exports, re-exports and quasi-transit trade.

Comext has higher quality data in principle than UN Comtrade due to the existing production process and the amount of resources available. It is also a richer database, including information on country of consignment (mandatory) and country of origin (voluntary) and provides a higher level of granularity. Comext is also the official reference on international trade in goods in the European Statistical System and is a statistical product well recognised by users. However, the main caveat with Comext is that it uses the Community principle for intra-EU trade instead of the national principle, which is more suited to Figaro. The Community principle includes quasi-transit trade, which distorts the view of the true economic relationship among Figaro countries. The difference between the two principles provides an estimation of quasi-transit trade.

UN Comtrade, in contrast, uses the national principle, i.e. quasi-transit trade is excluded in most cases. It also includes many more declarants or reporting areas (around 170, while Comext includes richer data information whenever a EU Member State is concerned). However, UN Comtrade does not provide both the country where the good was originated and the country from where it was dispatched. This information is useful to understand the re-exports dynamic.

Re-exports ([25]) are foreign goods imported and then exported without being processed or changed substantially from one country to another via a third country (re-exporter). The goods need to cross

([24]) The Figaro project used (nation-wise) the industry technology assumption (Model B, Eurostat, 2008) for product-by-product IOTs and the fixed product sales structure assumption (Model D, Eurostat, 2008) for industry-by-industry IOTs. Official IOTs (of whatever type — product-by-product or industry-by-industry) may also be used as constraints to the system in each case. This latter option is not included in the Figaro process for the reference year 2010. Constraining the EU ICIO tables to the national IOTs will be investigated in the near future.

([25]) In re-exports, there must be a change of ownership; otherwise it would be considered quasi-transit trade, which should not be taken into account for national accounts.

the borders of the third country. SUTs/SNA typically include re-exports (also designated as foreign exports) in the export column of the import use table by type of product (although this might not be true for all countries). However, international merchandise (goods) trade statistics do not distinguish between domestic and foreign exports (re-exports). International merchandise trade data would therefore require some additional information and adjustments to separate domestic exports from re-exports in order to be aligned with the SUT/SNA total values of domestic and foreign exports. As mentioned before, these adjustments were estimated by combining UN Comtrade and Comext databases.

The best option is therefore to use both databases, taking the best features from each. This can be illustrated with a real example involving crude oil trade between Spain and Portugal. UN Comtrade and Comext both report around EUR 576 million of Portuguese imports (CIF) of crude oil from Spain. Both databases also report exports (FOB) of crude oil from Spain to Portugal of around EUR 510 million. The difference between import and export values can easily be attributed to product misclassification, time lag between exports and imports or any other reason for asymmetries. Here both databases provide more or less the same values. There was therefore no quasi-transit trade. However, by looking at the information on country of origin in Comext, which is not available in UN Comtrade, Portugal reports EUR 505 million of crude oil imported from Algeria (country of origin) and EUR 71 million coming from Spain (country of origin). This clearly indicates that Spain is re-exporting crude oil from Algeria to Portugal for an amount of EUR 505 million. This is confirmed by the total output of mining and quarrying products (including crude oil) from the Spanish supply table, which amounts to around EUR 110 million of production, of which EUR 71 million is exported to Portugal (domestic exports). A part of the Spanish re-export value would correspond to an international trade margin charged by Spain, which can easily be assumed — in the absence of other information — to be the same as that for the Spanish domestic margin for the same product (assuming 10 % without loss of generality). By combining all the above information, the following conclusions can therefore be made: (a) there is domestic trade flow of crude oil between Algeria and Portugal (EUR 454.5 million); (b) there is another domestic trade flow of crude oil between Spain and Portugal (EUR 71 million); and (c) there is a domestic trade flow (of services) between Portugal and Spain (margin on re-exports, EUR 50.5 million).

In short, quasi-transit trade flows are estimated by first comparing Comext with UN Comtrade. Second, by comparing country of consignment with country of origin in Comext (excluding quasi-transit trade), the gross value of re-exports and their origin are estimated. Third, these gross values are further split into the net value of the goods re-exported and their associated trade services. Domestic exports are easily identified — by definition, country of consignment and country of origin are the same.

Trade statisticians are familiar with trade asymmetries. For the sake of consistency, a balanced view of international trade requires that exports/imports and mirror exports/mirror imports coincide. However, this is not generally the case for several reasons. One of them is simply the different valuation between exports (FOB) and imports (CIF), with the latter including international transport and insurance costs. Before addressing a realistic analysis of trade asymmetries, import (CIF) values must therefore be converted into import (FOB) values. To do this, we need data on CIF-FOB margins on a bilateral basis and for individual products.

In the absence of direct information by EU ([26]) Member States, the CIF-FOB margins by product and partner of each bilateral trade flow are taken from the estimations made by the OECD (Miao and Fortanier, 2017).

Once imports have been converted to FOB, the next step is to reconcile bilateral trade flows. A symmetry index ([27]) (or reliability index) is used to compute a weighted average of the two reported values available for each bilateral trade flow. The weightings are based on the proportion of each country's total trade that roughly matches the other partner's reported trade. This process basically follows the same philosophy as the OECD reconciliation methodology (Fortanier and Sarrazin, 2016). However, some manual corrections have to be made beforehand for the biggest asymmetries and with the information provided by the Member States affected, whenever available.

One last important issue before the final balancing of asymmetries is the treatment of confidential ([28]) data, of trade not geographically specified and of trade not allocated, which in some cases can be substantial (e.g. German and Austrian trade in petroleum and natural gas). Proportionality was generally assumed across countries or products before applying the symmetry index.

Both Comext and UN Comtrade were reconciled by Eurostat at HS six-digit level separately and independently of each other. These two balanced datasets then constituted the starting points for estimating the breakdown of Comext data (i.e. balanced trade flows by country of consignment) into domestic exports, re-exports and quasi-transit trade. In the absence of additional information, the same geographical distribution across trading partners was assumed for quasi-transit trade and re-exports. As mentioned before, domestic trade margins were used to estimate the part of the gross value of re-exports that would correspond to the associated trade service, thereby assuming the same margin for domestic and international transactions. Finally, bilateral trade flows were re — directed to accurately reflect the country of origin whenever it was different from the country of consignment.

In the absence of information about country of origin, country of consignment is generally assumed to be the same as country of origin, which might lead to an overestimate of the domestic share of the total trade flow. To correct for this bias, we constrained the share of (domestic exports)/(domestic exports + re-exports) to the one provided by the national use tables at basic prices ([29]) (domestic over total use tables) by reporting country and product.

([26]) Unfortunately, this information is rarely available for EU Member States. Alternatively, the difference between exports (fob) and mirror exports (CIF) can be used as a proxy variable to try and create a gravity model based on: (i) geographical distance; (ii) GDP per capita of reporter and partner countries; (iii) average annual oil price; (iv) EU median unit values (at CPA08-4 digit level) as a proxy of insurance costs; (v) a dummy variable reflecting contiguity of countries; (vi) fixed factor effects for products and partner countries; and (vii) a time trend. Data on imports and exports for the gravity model were taken from the Comext database (EU trade since 1988 by CPA_2008 — DS-057009) for 1995-2015. Imports and exports were available in both monetary values (EUR) and quantities (100 kg) for all EU Member States at 4-digit level and by partner country. Gravity variables (distance and contiguity) were taken from the Centre d'études prospectives et d'informations internationales (CEPII) database. GDP per capita (current US$) came from the World Bank, while the average oil price was obtained from the Europe Brent Spot Price FOB (dollars fob (dollars per barrel) issued by the U.S. Energy Information Administration. Finally, Eurostat exchange rates were used to convert GDP per capita and the oil price from US$ to EUR. The results were not satisfactory enough as they seemed to be overestimated in comparison to the OECD data. Actually, our dependent variable might well include other additional concepts different from just the transportation and insurance costs due to the fact that we used the difference between exports (fob) and mirror exports (CIF) as a proxy.

([27]) The symmetry index is calculated as follows. For each reporter *i*, partner *j*, product *k* in a given year, the Asymmetry Level (AL) is calculated as follows: $AL_{ijk} = \frac{|X_{ijk} - M_{jik}|}{X_{ijk} + M_{jikt}}$, where X and M refer to reported exports and imports respectively. Subsequently, only those export and import values for which $AL_{ijkt} \leq 0.10$ are retained (exports (X^r) and imports (M^r). The export symmetry index SI^x is then calculated as the ratio of the sum of retained export values as a share of total exports (by reporter, product and year), while the import symmetry index SI^m is similarly defined as the sum of retained import values as a share of total imports, and is used for the country weightings: $SI_{ik}^x = \sum_j \frac{X_{ijk}^r}{X_{ijk}}$ *and* $SI_{ik}^m = \sum_j \frac{m_{ijk}^r}{m_{ijk}}$.

([28]) Ideally, confidential data should be used as much as possible as long as no disclosure is made. Currently, confidential data in merchandise trade statistics are merged with trade that is not geographically specified and/or not allocated.

([29]) The underlying assumption is that national use tables use tables give an upper limit for the ratio of domestic trade over total trade. This ratio is then assumed not to be underestimated.

The derived three-layer balanced view of bilateral trade flows, which makes a distinction between domestic exports, re-exports and quasi-transit trade, can also be useful for other purposes: (ii) domestic exports can be compared with the export values shown in the use tables at purchasers' prices; (iii) re-export values can be used to split the re-export column of a use table of imports by trading partner (provided some adjustments are made beforehand to convert imports to FOB and to purchasers' prices); (iv) associated trade margins to re-exports can also be used to estimate international trade margins by product.

So far, we have achieved a balanced bilateral trade in goods dataset at the HS 6-digit level in FOB (and also in CPA by aggregation). However, the dataset is not completely in line with the information given in the SUTs.

3.2.3 Creating a coherent view of EU bilateral trade statistics of services

As mentioned earlier, estimating missing international services trade data can be more demanding than estimating merchandise (goods) trade data. There are various reasons why the availability and quality of services trade data is unsatisfactory, certainly when compared to goods trade statistics. Unlike goods that can be seen and physically measured and observed as they cross borders, service transactions can be performed via a number of modes (Rueda-Cantuche et al., 2016); as a rule, only the financial flows can be observed (Fortanier et al., 2016). As a result, a variety of different data sources and estimation techniques need to be used in practice, and these can sometimes differ by country. Data confidentiality and the different classification of services (EBOPS versus CPA/CPC) can also complicate the scheme.

Following Fortanier et al. (2016), we used a top-down approach to estimate missing trade (and mirror) flows for imports and exports separately using official data, wherever available. The process was divided into several steps:

- collect all available information on trade in services available in Eurostat (i.e. for 2010-2015 in BPM6 and by EBOPS2010 categories);
- compute missing (services and geographical) aggregates and check integrity rules (e.g. for negatives, consistency in sums);
- compute missing values (subtotals) with available information and simple derivations;
- compute missing values using structural information over time, linear interpolations etc.;
- use gravity models ([30]) for specific items;
- perform manual corrections based on the contributions of EU Member States in the workshops on trade asymmetries organised by Eurostat;
- distribute unallocated trade across service categories and trading partners;
- create top-down benchmarks against the aggregate values of the balance of payments data.

Total services trade by EBOPS (extended balance of payments services) category and country were available, all of which were used as a benchmark for estimating the other sub-items.

In Step 5 above, the gravity models used four types of independent variables:

- economic variables (such as GDP of reporter and partner countries, GDP per capita of reporter country and overall exports and/or imports of services by partner and reporter countries);
- distance variables;

([30]) This step could have been done last to increase the number of degrees of freedom of the models and the number of observations. This will be implemented in subsequent versions of the Figaro project.

- dummy variables specifying common border (contiguity), language affinity, territorial link (e.g. Czechia and Slovakia were one single country in the past), EU membership (for more than 20 years), euro area; and
- fixed effects for partner and year.

The models provided us with estimations of bilateral trade flows for the following items:

- travel services (SD), which consist of goods (SD1), local transport services (SD2), accommodation services (SD3), food-serving services (SD4) and other services (SD5);
- charges for the use of intellectual property rights (SH), which consist of franchises and trademark licensing fees (SH1), licences for the use of outcomes of research and development (SH2), licences to reproduce and/or distribute computer software (SH3), licences to reproduce and/or distribute audio-visual products (SH41), licences to reproduce and/or distribute products other than audio-visual ones (SH42);
- the audio-visual and related services category (SK) (see classification in annex).

These estimates were further used in steps 6 to 8 to come up with a complete dataset of bilateral trade services flows.

As mentioned before, the Figaro project benefited from the additional information provided by the conclusions of the workshop on trade in services asymmetries. The workshop was organised by Eurostat with representatives of the EU Member States side by side with the Balance of Payments Working Group meeting in October 2016. During this workshop, experts from EU Member States had the opportunity to exchange experiences, discuss bilaterally and decide on specific measures to resolve their corresponding trade asymmetries. The conclusions were discussed at subsequent meetings of the balance of payments and international trade in services working groups ([31]).

Once a complete (albeit unbalanced) dataset of bilateral trade flows of services data was achieved, the same balancing approach and principle (symmetry index) set out in Fortanier and Sarrazin (2016) was applied to EU countries to deal with trade asymmetries. Unlike merchandise trade data, the resulting balanced bilateral trade dataset had to be converted from EBOPS items into CPA/CPC products using a combination of EBOPS-CPA/CPC concordance tables (up to 5-digit level) and SUIOTs. The conversion values for item SD (Travel) were based on our own estimations of direct purchases abroad and those of SA (Manufacturing services on physical inputs owned by others) were based on our own estimates of goods sent abroad for processing. Alternatively, the use of the RACE algorithm (Rueda-Cantuche et al., 2013) to come up with country-based and service-based specific conversion tables is scheduled for the near future.

As a result, a balanced view of services trade data for all EU countries and US was achieved in CPA classification at the desired disaggregation level for the EU-IC-SUIOTs.

3.2.4 Overcoming national data inconsistencies between national accounts and trade statistics

International trade statistics, in particular merchandise trade statistics but in practice also often services trade statistics, do not follow the same concepts as those used for imports and exports in the SNA (the key accounting framework used in constructing official national SUIOTs). The difference in merchandise trade totals and national accounts totals for goods can be significant because of the adjustments for non-residents' expenditures in the domestic economy and residents' expenditures abroad, which are captured in trade in services statistics and not merchandise trade data.

([31]) A few items were corrected in step 6, including feedback from the workshops.

However, the changes made in the 2008 SNA for goods sent abroad for processing and merchanting in particular imply significant changes for some countries, notably for trading ‘hubs’ such as the Netherlands but also for countries with large processing sectors (such as Czechia for the automobile industry), and also for those countries providing the intermediate inputs and purchasing the output from processing countries.

Balances for merchandise trade statistics include all the underlying flows related to goods for processing— the processing services provided by the processing firm and the goods used by the processor in the production that were supplied without a change of ownership taking place between the principal and the processor. National SUTs that conform to the 2008 SNA require that for the processing firm (and country), merchandise trade data exclude the value of the goods imported that have not changed ownership. As a result, exports of goods by the processing firm should be excluded from the goods account; instead the processing fee charged by the processor should be recorded in services account ([32]) (i.e. balance of payments). Likewise for the principal firm (and country), exports should exclude the value of goods supplied to the processor (without a change in ownership), with a corresponding correction for any imports from the processor to the principal firm.

Bilateral partner estimates of processing fees are available in the balanced estimates of trade in services produced by countries (EBOPS, category SA: manufacturing services). However, what is also needed when aligning flows of merchandise trade data with comparable flows in SUTs are estimates of these processing services by CPA product and, in addition, estimates of the value of imported and exported goods whose ownership has not changed but which are included in merchandise trade data. By definition, this information (or at least national estimates of this information) must be available in theory to produce national SUTs ([33]). The challenge is to create equivalent estimates of these flows on a partner basis.

For example, Germany exports EUR 100 of a certain good for processing to Czechia. The good comes back to Germany (it could also be another country) processed for EUR 110. There is no change in economic ownership in the goods exported and imported. Germany should therefore have EUR 100 less of imports from Czechia and EUR 100 less of exports to Czechia. Ultimately, a manufacturing service import (classified as a good in CPA) for EUR 10 from Czechia should be allocated to Germany.

Unfortunately, the information available to make these additional adjustments to international merchandise trade data is limited, i.e. how much gross trade is related to these types of goods and the amount of processing service fees paid by country and by types of goods traded. For instance, partial information can be found in the balance of payments data — BPM6 — of countries and/or by combining business statistics and merchandise and international trade services data. The Figaro project has used the information provided in the gross national income inventories (ESA2010) and Eurostat’s report on ‘Statistics on goods under merchanting and goods sent abroad for processing’ presented at the third meeting of Eurostat’s Task Force on Integrated Global Accounts ([34]) (April 2017).

A detailed description of the work carried out under the Figaro project on the estimation of GSA (goods sent abroad for processing) and merchanting can be found in chapters 8 and 9. This work can be used to provide information on how to construct an ICIO compliant with the System of Environmental and Economic Accounts, e.g. one where GSA are still recorded as physical flows

([32]) Although these manufacturing services will eventually have to be allocated to the corresponding goods account (in CPA/NACE classification).

([33]) See columns P6D (goods sent abroad) and MCH (merchanting) in the statistical use table.

([34]) This report shows the gross flows connected to both inward processing and outward processing based on international trade in goods statistics (ITGS) sent by Member States for the years 2013-2015. The identification of these flows is made by countries using ‘nature of transaction’ codes (NoT). The report suggests that these data might be more reliable when they refer to inward processing, particularly for countries such as Bulgaria, Estonia, Croatia, Cyprus, Hungary, Latvia, Lithuania, Portugal, and Slovenia. This report also suggests that it is preferable to collect additional direct information from trade in services data rather than using NoT codes from ITGS. This recommendation will be followed in future developments of the EU-IC-SUIOTs insofar as these services trade data will be available.

crossing borders. With such purpose, a bridge column of GSA adjustments by exporting country and product is published. A fully fledged matrix of adjustments will be kept for internal use.

In this step, the balanced view of trade in goods has been adjusted for the new treatment of GSA and merchanting in the ESA2010.

3.2.5 Estimation of international trade, transport and insurance costs

As mentioned in the previous sections, for merchandise trade statistics, imports are valued CIF and exports valued FOB. In national SUTs at basic prices, import flow matrices are typically reported in CIF by product type, while total imports (summed over all products) must be valued FOB. Depending on whether the transport company is resident or non-resident, a CIF-FOB (national accounts) adjustment therefore needs to be made. The adjustment column consists of a deduction from the services items for transport and insurance with an offsetting global adjustment made to imports of goods (2008 SNA, para. 28.10).

However, the construction of inter-country SUIOTs refers in particular to a slightly different concept, the CIF-FOB reclassification ([35]). This is defined as the difference between the import flows in CIF and their mirror imports in FOB. The expected difference would be the amount of transportation and insurance costs paid either by the seller or the buyer in each transaction. Nevertheless, the 2008 SNA requires merchanting services to be added to the value of the imported good (instead of as a trade service); this leads to a new factor contributing to such a difference.

Within the inter-country SUT framework, the costs associated with the international transport and insurance of merchandise trade (also referred to as CIF-FOB margins) are crucial for two reasons: (a) to address bilateral trade asymmetries of imports and exports at the same valuation; and (b) to adjust national import flow matrices to the FOB valuation. To this end, the OECD recently published a global bilateral database of CIF-FOB margins. It combines the largest and most detailed cross-country sample of official national statistics on explicit CIF-FOB margins to date, with estimates from an econometric gravity model and a novel approach to pooling product codes across Harmonised System ([36]) nomenclature vintages. The database shows that distance, natural barriers and infrastructure continue to play an important role in shaping regional (and global) value chains. However, this database is based on BPM5. As a result, CIF-FOB margins do not capture international trade margins (merchanting), which would need to be estimated differently by looking into available data on goods purchased and goods sold under merchanting, together with the support of services trade statistics data. Nevertheless, in the absence of available data for EU countries, we had to use the OECD global bilateral database of CIF-FOB margins ([37]).

Official statistics on CIF-FOB margins are still some way far from being produced regularly by national statistical offices. This would help improve the quality of the balanced view of bilateral trade, which is used to support the construction of EU-IC-SUIOTs.

3.2.6 Direct purchases abroad

Direct purchases (**[38]**) abroad by residents (imports) and direct purchases in the domestic territory by non-residents (exports) are typically included in national accounts as a lump-sum total (including

([35]) See ESA 3.178 and 3.179.

([36]) http://www.wcoomd.org/en/topics/nomenclature/overview/what-is-the-harmonisedharmonised-system.aspx.

([37]) In the Figaro project, cif-fob margins are used to: (a) convert national import use tables from cif to fob to use the resulting row structures for the distribution of the balanced view of trade export data across intermediate and final users; and (b) convert merchandise import trade data from cif to fob as a previous step to balance the trade asymmetries.

([38]) ‘Direct purchases abroad’ include both goods and services purchased by residents abroad and by non-residents in the domestic territory. See ESA2010 3.176.

businesses, travel and government expenditures). However, they are not separated by product, as is required to perform conventional input-output analysis. Even though they are available through the balanced view of trade under the 'Travel' item in EBOPS categories (most of them but not all), they still need to be separated from pure travel services using tourism satellite accounts ([39]) (TSAs), SUIOTs or any other related source data. The estimated values are then transferred to the goods categories and partners (i.e. the country of origin of the non-resident).

Although there will be differences between the spending patterns of tourists in a given country depending on their nationality, information available in TSAs is rarely available at this level of detail. In these circumstances, the simplest way to achieve a global balance of travel expenditures by product is to assume that all tourists in a given country have the same spending patterns (by product). In other words, they purchase the same basket of goods and services for every euro spent, making use of the information on product breakdowns from TSAs in that country or, traditionally, making use of fixed assumptions.

By extension, import statistics by product are also directly generated using the statistics on exports by partner, which are generated in the balanced set of travel statistics. This in turn automatically generates a coherent and equivalent set of import statistics by partner and product. However, there may still be a difference between the equivalent national accounts estimates. This difference should then be allocated in such a way that the balanced view of trade is preserved by product across countries of origin.

Accordingly, the Figaro approach firstly benchmarked bilateral trade flows of 'Travel' services (category SD) by country to the equivalent national accounts estimates ([40]) (i.e. direct purchases abroad and purchases by non-residents in the domestic territory). The geographical balanced view of travel services is therefore changed to accommodate the national accounts values using the GRAS method. Subsequently, the resulting benchmarked and balanced view of travel services was split by CPA categories using bridge tables that preserved the balanced view of trade across the different SD sub-items (SD1 to SD5) and for each reporting country.

These bridge tables were constructed on the basis of the information provided by the UK Statistical Office in terms of the breakdown of direct purchases abroad and non-residents purchases in the domestic territory by CPA categories. Although there will be differences between the spending patterns of tourists in a given country (e.g. the UK), depending on their nationality, information is rarely available at this level of detail. Therefore, in these circumstances the simplest way of arriving at a global balance of travel expenditures by product is to assume that all tourists in a given country (e.g. UK) have the same spending patterns (by product). In other words, they purchase the same basket of goods and services for every euro spent. Therefore, we applied the CPA structure of direct purchases abroad for the UK and the UK CPA structures of non-residents' purchases in the domestic territory for the other countries.

The resulting breakdown was further refined by appropriately summing up CPA categories and come up with estimates of SD1 to SD5 sub-items. Then, these estimates were benchmarked to reflect the same structure across sub-items of the balanced view of trade for each bilateral flow. As a result, country-specific CPA distributions were obtained for splitting up the bilateral trade flows totals of travel services (SD) consistently with the underlying structures of SD1 to SD5 given by the balanced view of trade ([41]). These results will be presented separately from the EU-IC-SUIOTs.

([39]) For this project, we have used other related data sources (as explained in the text), thus leaving the use of TSAs for the near future.

([40]) The values came from Eurostat's national SUIOTs except for United Kingdom (ONS), Ireland (CSO), United States (OECD) and the rest of the world, calculated by difference with respect to the world total provided by the OECD. OECD exchange annual rates were applied for currency conversions.

([41]) The project developed a bridge table between SD sub-items and CPA. For. For SD: Accommodation and food services activities (45 %); Textiles, wearing apparel and leather products (20 %); Food products, beverages and tobacco (9 %); Education (4 %); Furniture and other manufacturing (3 %); Land transport (3 %); Chemicals and chemical products (2 %); Rubber and plastics (2 %); Motor vehicles, trailers and semitrailers (1 %); Coke and refining products (1 %); Other products (summing up 10 %).

3.2.7 Harmonising different classifications

Merchandise trade data are compiled using the Harmonised System (HS) of products. Because of the significant disaggregation of data available, these are readily convertible to the product classifications used in constructing national SUTs (which are typically much more aggregated), such as the international product standard CPC. However, the same does not hold for trade in services data, which are based on EBOPS, and where the level of detail collected by countries is often less than the comparable detail used in national SUTs. As mentioned earlier, when balancing services trade data a combination of EBOPS-CPA/CPC concordance tables, SUIOTs and other data sources such as business statistics are normally used to make such conversion.

As regards the Figaro approach, we used customised bridge tables provided by the national statistics institutes of Austria, Czechia, Estonia, Germany and Slovenia. For the other remaining countries, we produced a dummy bridge table on the basis of these available countries. The conversion was made at the most detailed level in terms of EBOPS categories, wherever available; otherwise, the upper level structures were implemented instead. For travel services (SD), the conversion shares from EBOPS to CPA were based on the estimation process of direct purchases abroad (see previous sections).

For convenience and to help better explain the classifications', the 12-key (aggregated) product groupings used in EBOPS (2010) — which is often the only level of detail produced by many economies — are shown in the box below.

Box 3.1 BPM6 services categories

SA	Manufacturing services on physical inputs owned by others
SB	Maintenance and repair services, not included elsewhere
SC	Transport
SD	Travel
SE	Construction services
SF	Insurance and pension services
SG	Financial services
SH	Charges for the use of intellectual property, not included elsewhere
SI	Telecommunications, computer and information services
SJ	Other business services
SK	Personal, cultural and recreational services
SL	Government goods and services, not included elsewhere

The challenge when constructing inter-country SUIOTs is to convert these data into equivalent CPC (or CPA classifications typically preferred). For most of the categories above, this is not an overly difficult exercise. However, two categories warrant special mention and attention: 'Manufacturing services on physical inputs owned by others' and 'Travel'.

As mentioned above, despite the CPC's international coverage, the CPA system is generally preferred in the construction of SUTs as its architecture and structure (by design) mimics that of the corresponding industry classification NACE, which is closely related to the international standard ISIC. However, 'Manufacturing services on physical inputs owned by others' are recorded under goods in the CPA classification (as the output of the manufacturing sector). Similarly, 'Travel', which covers non-residents' expenditures (exports) and residents' expenditures abroad (imports), consists of a number of products (including goods) and is usually shown as a separate item in national SUTs: i.e. a negative adjustment item in household final consumption and a corresponding positive entry in exports for non-residents' expenditures, and a positive entry to imports and equivalent positive to household final consumption. Besides the specific table for direct purchases abroad, these items are just reflected in the Figaro tables without any change from the national SUTs.

3.2.8 To balance or not to balance …and when

Figure 3.2 allows for two separate EU-IC-SUTs, i.e. with or without discrepancy items. The tables with an explicit discrepancy item ([42]) would perhaps provide a more accurate view of the underlying state of statistics available across countries and give pointers to national statistics offices ([43]) on those areas where data improvements could be made. However, most users prefer a balanced table without discrepancy items ([44]), knowing that the discrepancies above could also be negative and not just positive; this adds another level of complexity when interpreting results from unbalanced tables.

Bearing this in mind, it is important to note that any coherent and balanced view of trade (consistent with the national accounts concepts) cannot satisfy the dual constraint of no changes in current account balances and GDP (and value added by industry) if discrepancies exist between total intra-EU exports and total intra-EU imports recorded in national SUTs — which is the case. In other words, some residual (discrepancy) item is needed to overcome this contradiction unless changes to GDP and the current account balance are made; this should be avoided, as the primary focus of an EU inter-country SUIOT is to analyse the interactions between trade and production (and not least because the estimates of output and factors of production are usually of good quality). As such, the existence of a constraint to publish national accounts at EU level and also in general at global level requires a discrepancy item, independently of the balancing process.

As required by users, perhaps the simplest way to achieve EU balanced inter-country SUTs without discrepancy items is to use a standard optimisation model such as GRAS (Temurshoev et al., 2013).

The Figaro project has eventually produced two different inter-country tables: an inter-country 'statistical' use table with explicit discrepancies and an inter-country use table, where all discrepancies have been absorbed by the off-diagonal (national) blocs of the 'statistical' use table using the GRAS method.

3.2.9 Construction of inter-country supply, use and input-output tables

Once the balanced view of bilateral trade in goods and services was complete and the full set of national SUTs at purchasers' prices and basic prices (with a distinction between domestic and import uses) prepared, the next step was to build the EU-IC-SUTs at basic prices (balanced and unbalanced or without and with discrepancies, respectively).

National import use tables (CIF) are generally compiled by national statistical offices without taking into account a global or an EU view of the entire trade affecting the compiler country. Trade asymmetries are not addressed at all except in very few cases, depending very much on the willingness of the affected countries. As a result, the EU balanced view of international bilateral trade undoubtedly provides a better picture of the geographical distribution of trade and the amount of industry imports than national import use tables can do. This is the main reason why it was decided to use exports (FOB) values from the balanced view of trade to populate the EU inter-country use 3table exogenously and then estimate endogenously the corresponding national import use tables (FOB) by country of origin.

([42]) See statistical tables.

([43]) See http://ec.europa.eu/eurostat/web/links/national_statistical_offices

([44]) See Analytical tables.

First, we used the OECD CIF-FOB margins database to convert national import tables from CIF to FOB valuation and compute (average) users' structures to be further distributed across countries of origin. Since the CIF-FOB margins database did not report values across users (intermediate and final) but rather across products and trading partners only, we chose to split the country totals of CIF-FOB margins paid by product across the users' structures provided by the national import tables ([45]) (CIF).

Second, the balanced view of bilateral trade of goods and services (corrected for GSA, merchanting and direct purchases abroad) by trading partner is combined with users' structures of national import tables (FOB) in order to build up the intermediate and final trade blocs of the EU inter-country use table by product, user and trading partner. The domestic blocs (for EU countries and United States) are copied and pasted from national domestic use tables at basic prices together with their value added components and the national rows of taxes less subsidies on products. There is no attempt to estimate a domestic bloc for the rest of the world; this should come from additional coordinated work with the OECD to further integrate the Figaro tables with the global OECD ICIO tables.

The inter-country use table is then completed with:

- a single row of imports from countries besides the EU Member States and United States and a column of exports to the same geographical areas;
- a single row accounting for the reported CIF-FOB national accounts adjustment values split across users and trading partners ([46]);
- two corresponding rows for direct purchases abroad and purchases of non-residents in the domestic territory by trading partner.

The inter-country supply table is compiled just by merging national supply tables. Auxiliary columns of imports (CIF) from the rest of the world, domestic trade and transport margins, taxes less subsidies on products and international trade, transport and insurance costs are added to complete the total supply at purchasers' prices in FOB valuation.

One last adjustment is the conversion of the trade blocs from FOB to basic prices. This was done using fully fledged national trade and transport margins tables, which were used to estimate the domestic trade and transport margins associated to the bilateral trade flows of the exporting countries.

Additional auxiliary tables are also provided for the total adjustments for GSA and merchanting by reporting country and product; direct purchases abroad by product and country of origin and purchases of non-residents in the domestic territory by product and country of destination.

Last but not least, one single row and one single column of discrepancies are added to the inter-country use table to account for the difference between the estimated trade (import and export) values and those reported by national domestic (i.e. exports) and imports use tables. We have denoted this table as the 'statistical' inter-country use table because it tries to reflect the statistical concept and coverage differences between trade statistics and national accounts.

Following Ahmad (2017), misclassification of products might have happened in conversions of trade statistics by product to the corresponding products in SUTs or during the balancing of trade asymmetries in trade in goods and services statistics. Under such assumptions, an additional method can be used to reduce the discrepancies by product in a replicable and transparent manner by re-classifying product bilateral trade flows while preserving import (by trading partner) totals in each country. Although these discrepancies can be reduced (but not eliminated completely), the

([45]) By doing it this way, we are fully aware that the resulting user structures of national import tables fob will coincide with those of cif. However, applying a different user structure coming from other related data sources can make it different.

([46]) The approach is similar to the process described for the full inter-country use table; the total cif-fob national accounts adjustment is split across (intermediate and final) users on the basis of national import tables and across trading partners using the balanced view of trade in goods adjusted for GSA, merchanting and direct purchases abroad.

main idea is to allocate differences across products in a way that preserves each country's recorded imports by industry and the geographical allocation of the balanced view of trade.

Ahmad's approach to manually reduce discrepancies can be implemented either before splitting the balanced bilateral trade flows by product and trading partner across intermediate and final users or afterwards ([47]). In the first case, just a table with a balanced view of trade by product and trading partner would be required. Next, the method may reallocate row-wise negative discrepancies (lower than benchmark values) to positives if the overall total of negatives (in absolute value) is bigger than that of positives, and vice versa ([48]). As a result, all negative differences are entirely eliminated. This is done by first allocating discrepancies proportionally by trading partner, and afterwards by applying a specific conversion matrix to reallocate product flows without altering the geographical balanced view of trade. The outcome of this process would be a new balanced view of trade where all the negative discrepancies have been removed preserving the imports total in each country. This new balanced view of trade is subsequently split across intermediate and final users. We have not implemented this approach in our project yet but we envisage doing it in the following revisions of the Figaro tables.

Subsequently, remaining discrepancies are removed using the GRAS method and providing the user with a balanced and complete inter-country use table at basic prices. A last benchmarking process should be carried out to match the latest national accounts totals (e.g. GRAS).

The construction of inter-country IOTs was based on the estimated inter-country SUTs. For product-by-product IOTs, the final use component remains unchanged by definition so no further changes were made in the final use component of the inter-country IOTs. The changes therefore affect only the intermediate uses by exporting country, trade partner and product and value added by country and product (using either the product or the industry technology assumption, Eurostat, 2008). The final inter-country IOT may also have to respect available national IOTs and eventually be benchmarked against the latest aggregate national accounts data (i.e. using GRAS). However, none of these were done in the current version of the Figaro tables.

On industry-by-industry IOTs, intermediate and final uses (from the inter-country SUTs) have to change by definition while value added remains unchanged. In such a case, we assume either fixed product or fixed industry sales structures (Eurostat, 2008) for estimating the missing IOTs. The final IOT should also be benchmarked against the latest aggregate national accounts data. This was not done this time in order to reflect accurately the SUTs values, even when they were sometimes outdated.

As a final remark, using one single common methodology (e.g. industry technology assumption) across all Member States for the construction of EU inter-country IOTs may turn out to be more consistent than trying to replicate or balance available official IOTs with estimated IOTs together in one single framework. This is precisely what we did for the Figaro inter-country input-output tables.

As the very last step, we made the appropriate aggregations in products and industries to avoid disclosing confidential data from countries.

3.2.10 Assessment of the results

The modular approach adopted in the Figaro project to map the different adjustments and imputations to the original data will allow each adjustment/imputation to be measured at the different stages of the compilation process. As a result, summary statistics are provided in Chapter 0. They consist of three types of statistics based on:

([47]) This method applied to the fully fledged inter-country use table implies the use of bi-proportional adjustments (e.g. GRAS) that might not necessarily converge depending on the restrictions imposed (i.e. import totals by industry and geographical distribution of balanced bilateral trade flows remaining unchanged). We investigated this approach during the project but did not come up with solutions for all cases.

([48]) In practical terms, the reallocation should always be done this way in order to avoid having negative trade flows as a result of applying this method (see more details in chapter 0).

- the comparison between the international merchandise and services trade data and the trade values in the SUTs, including adjustments for goods sent abroad for processing and merchanting activities;
- the analysis of the row and column total discrepancies by countries, users and products;
- the analysis of the balancing adjustments made to estimate the final inter-country use table without discrepancies, by countries, users and products.

Furthermore, a set of validation rules was imposed on the national supply, use and input-output tables and the Figaro tables. They refer to integrity and consistency checks on: (i) each and every element of the tables (e.g. negatives, positives and zeros should be in the right place); (ii) on totals and subtotals within the tables; and (iii) on the balance between supply, use and input-output totals.

Further quality indicators based on Eurostat quality standards will be drawn up between 2018 and 2020.

4 Data sources

The construction process of EU-IC-SUIOTs involves five main (official) data sources:

- national accounts data (as benchmark);
- national SUTs and IOTs;
- international merchandise (goods) trade data;
- international services trade data and balance of payments data;
- business statistics ([49]).

4.1 National accounts data

National accounts constitute the benchmark for the international comparison of economies provided that they are compiled based on international agreed standards. The System of National Accounts (SNA ([50])) describes a coherent, consistent and integrated set of macroeconomic accounts in the context of a set of internationally agreed concepts, definitions, classifications and accounting rules. Among other accounts, it provides an overview of economic processes, recording how production is distributed among consumers, businesses, government and foreign nations. Consequently, the national accounts are one of the building blocks of macroeconomic statistics, forming a basis for economic analysis and policy formulation.

Therefore, it is fundamental to ensure full integration of the SUTs with the regular annual compilation of the national accounts. In this way, data in the SUTs, such as GVA and GDP, are consistent and coherent with the institutional sector accounts, and vice versa. This is achieved at national level through the compilation and balancing process of SUTs incorporating a table that cross-classifies data by industry, by type of factor incomes and by institutional sector (UN (2018), Chapter 10).

Linking SUTs to the institutional sector accounts extends the role of SUTs to increase the quality, consistency and coherency of the national accounts, where the SUTs have specific links bringing together parts of the national accounts.

Consistency between SUTs and national accounts' macro aggregates is part of the validation checks run by Eurostat on the national data. Differences could remain mainly due to national revision policies.

National accounts' macro aggregates to be compared with SUTs are transmitted in Table 1 of the ESA2010 transmission programme. This table consists of annual data for which the deadline varies

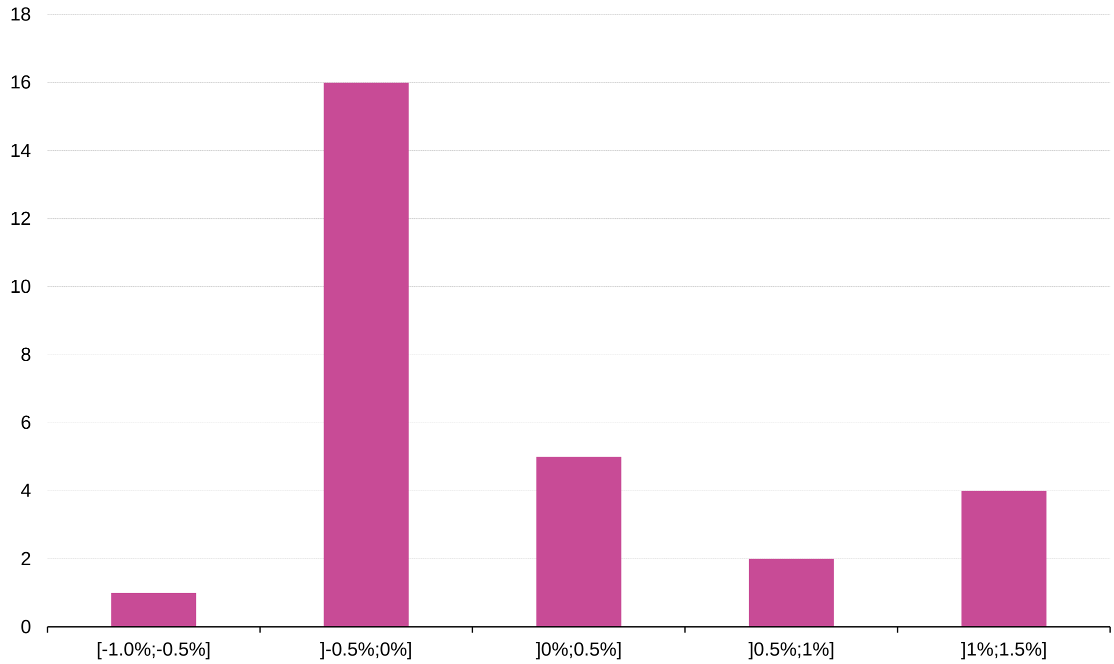
([49]) Business statistics are not described in this chapter because additional data such as trade enterprises characteristics statistics (TEC) or services trade enterprises characteristics statistics (STEC) or tourism satellite accounts (TSA) were not used for the compilation of Figaro tables yet.

([50]) https://unstats.un.org/unsd/nationalaccount/sna.asp.

from 2 to 9 months. However, the same variable e.g. P3 final consumption expenditure, is to be transmitted in Table 1 at t + 2 months as well as in Table 5 at t + 9 months. One can therefore expect revisions of the Table 1 data. The variables on which consistency checks are run between SUTs and macro aggregates data are: output at basic prices, intermediate consumption at purchasers' prices, final consumption expenditure (split by institutional sectors households, general government and non-profit institutions serving households — NPISH), gross capital formation, gross fixed capital formation, changes in inventories and valuables, exports, imports, compensation of employees, gross value added at basic prices and net operating surplus.

For the year 2010 the gross value added at basic prices of the SUTs present in Figaro is very consistent with the latest gross value added data transmitted by Member States ([51]) for the key macroeconomic aggregates. Figure 4.1 shows indeed that for most countries gross value added in the SUTs and in the macro aggregates are not different

Figure 4.1: Difference in % of the gross value added between SUTs and macro aggregates



4.2 National supply, use and input-output tables

National accounts data (including supply, use and input-output tables —— SUIOTs) are provided by EU Member States under the ESA2010 transmission programme ([52]). The European requirements for SUIOTs are presented in Box 4.1.

Data under ESA2010 methodology were transmitted to Eurostat for the first time in September 2014. However, at that time some Member States had derogations and transmitted data later. By the end of 2017 all EU Member States had transmitted the supply, use table at basic prices for the reference year 2010 (see Table 4.1) including the split between domestic and import (except Luxembourg,

([51]) As of March 2018.

([52]) See Annex B to the European System of Regional and National Accounts (ESA 2010).

which did not provide the split). The input-output table is required by the ESA2010 transmission programme as a product-by-product table. However, industry-by-industry-tables are a possible substitute to the previous requirement provided that industry is a good approximation of the product dimension.

Box 4.1 ESA 2010 requirements for supply, use and input-output tables

Table N° [1]	Subject of the tables [2]	Period covered	Frequency	Prices
15 (1500)	Supply table at basic prices incl. transformation into purchasers' prices, sup (pp) (T1)	2010 onwards	Annual	Current prices
15 (1500)	Supply table at basic prices incl. transformation into purchasers' prices	2015 onwards	Annual	Previous year's prices
16 (1600)	Use table at purchasers' prices, use (pp) (T2)	2010 onwards	Annual	Current prices
16 (1600)	Use table at purchasers' prices	2015 onwards	Annual	Previous year's prices
17	Symmetric input-output table at basic prices	2015 onwards	Five yearly	Current prices
1700	Input-output tables total (IOT total) (T3)			
1800	Input-output table of domestic output, IOT (dom) (T4)			
1900	Input-output table of imports, IOT (imp) (T5)			
16	Five additional tables	2010 onwards	Five yearly	Current prices
1610	Use table atbasic prices (total), use (bp) (T6)			
1611	Use table of domestic output at basic prices, usedom (T7)			
1612	Use table of imports at basic prices, useimp (T8)			
1620	Trade and transport margins, TTM (T9)			
1630	Taxes less subsidies on products, TLS (T10)			

[1] The 2-digit tables' number refer to the ESA 2010 transmission program; the 4-digit numbers refer to the SDMX table identifier codes.

[2] The reference with T is used in chapter 5 presenting the estimation of missing national tables.

Although the data availability of national SUIOTs is almost perfect to build up the inter-country tables, Eurostat, in collaboration with the European Commission's JRC (Rueda-Cantuche et al., 2017), put in place an estimation process for the margin matrices, domestic and import use tables at basic prices and use tables (totals) at basic prices with a selection of auxiliary information. The estimation includes a benchmark step to national accounts' macro aggregates such as GDP and its components. However, when the SUIOTs are transmitted by country, the tables are not benchmarked to the latest macro aggregates available although Eurostat applies consistency checks with macro aggregates.

The national SUIOTs for Figaro's April 2018 release were prepared much earlier, around August/September 2016. Therefore, some updates of the national SUIOTs are not incorporated in the Figaro April 2018 release and will be included in the next update of Figaro for the year 2010. The updates to be incorporated in the next Figaro release relate at least to the following countries: Belgium, Greece, Lithuania, Portugal, Czechia, Croatia and Hungary.

Table 4.1: Data availability for the reference year 2010

Country	Supply	Use at basic prices			Input-output		
		Total	Domestic	Imports	product/industry	Domestic	Imports
Belgium	x	x	x	x	p*p	x	x
Bulgaria	x	x	x	x	p*p	x	x
Czech Republic	x	x	x	x	p*p (1)	x	x
Denmark	x	x	x	x	i*i	x	x
Germany	x	x	x	x	p*p	x	x
Estonia	x	x	x	x	p*p	x	x
Ireland	x	x	x	x	p*p	x	x
Greece	x	x	x	x	p*p	x	x
Spain	x	x	x	x	p*p	x	x
France	x	x	x	x	p*p	x	x
Croatia	x	x	x	x	p*p	x	x
Italy	x	x	x	x	p*p (1)	x	x
Cyprus	x	x	x	x	p*p	x	x
Latvia	x	x	x	x	p*p	x	x
Lithuania	x	x	x	x	p*p	x	x
Luxembourg	x	x	-	-	p*p	-	-
Hungary	x	x	x	x	p*p (1)	x	x
Malta	x	x	x	x	i*i	x	x
Netherlands	x	x	x	x	i*i	x	x
Austria	x	x	x	x	p*p	x	x
Poland	x	x	x	x	p*p	x	x
Portugal	x	x	x	x	-	-	-
Romania	x	x	x	x	i*i	x	x
Slovenia	x	x	x	x	p*p	x	x
Slovakia	x	x	x	x	p*p	x	x
Finland	x	x	x	x	i*i	x	x
Sweden	x	x	x	x	p*p	x	x
United Kingdom	x	x	x	x	p*p	x	x

Legend: X available; NA non available;(1) country provides industry by industry table as well

4.2.1 Estimating missing countries, import flow matrices and/or distribution margin matrices

Most of the EU countries (except those with derogations) are able to provide national SUIOTs with comparable levels of industry detail and consistent valuations (basic prices and purchasers' prices). A collection of national SUTs (at basic prices) with a distinction between domestic and import uses is required. In addition, use tables at purchasers' prices are needed to compare their export values with the resulting balanced view of international trade. The sectoral classification is NACE Rev. 2, with the commodity classification referring to CPA/CPC 2008. The tables comprise 64 industries and 64 commodities, which can also be easily referred to ISIC Rev. 4 classification.

A collection of national IOTs with a distinction between domestic and import uses is required via the national accounts transmission programme every 5 years (for reference years ending in 0 and 5). However, this collection is usually incomplete given that some EU Member States ask for derogations from data submission. Moreover, the compilation process to construct input-output tables across Member States is not as homogenous as for the supply and use tables. The usual standard assumptions are frequently accompanied by manual corrections that reflect country-specific knowledge or overall balancing adjustments. In the Figaro project the inter-country input-output tables were compiled directly on the basis of the derived inter-country supply and use tables instead of estimating national missing IOTs beforehand. Figaro used the industry technology assumption (Model B, Eurostat, 2008) for product-by-product IOTs and the fixed product sales structure assumption (Model D, Eurostat, 2008) for industry-by-industry IOTs. Official IOTs (of whatever type

— product-by-product or industry-by-industry) may also be used as constraints to the system in each case, although they have not been used as such yet.

When estimating missing tables, the project used the estimation process defined in Rueda-Cantuche et al., 2017. This examined a few non-exhaustive methods for estimating distribution margin matrices, domestic and import use tables at basic prices and use tables (totals) at basic prices with a selection of auxiliary information. They also provided an indication of how much the estimates matched reality in the absence of other official tables. Their main conclusion was that the usage of tables from previous years generally provides the best options in each case. This is mainly because they gather detailed country-specific information that is not expected to change in the short term.

On distribution margins, it is better to start with an estimation of matrices of TLS on products. The TTM matrix would then be calculated by difference against the (if available) use table at basic prices. This solution performed better than the other way round. For the split between domestic and imported uses, the availability of a previous year's IOT or current IOT of imports makes a difference. In the case of missing use tables (total) at basic prices, the best option proved to be using the joint structure of the distribution margin matrices from a previous year (i.e. the difference between the use table at purchasers' prices and the use table at basic prices from a previous year, if both available).

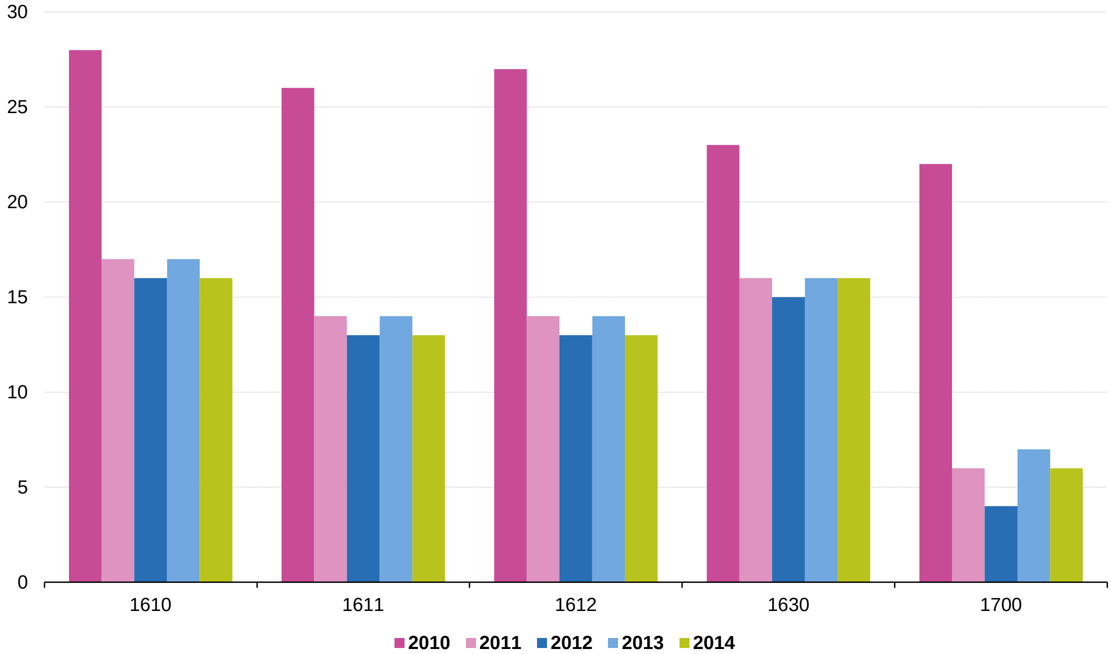
4.2.2 Data availability after 2010

The current April 2018 release focuses on the reference year 2010. The Figaro Act I project aims to produce by the end of 2020 IC-IOTs for the years 2010 to 2018 and IC-SUTs for 2010 and 2015. The ESA2010 transmission programme enables Eurostat to have a clear picture now of what the data availability is for mandatory and voluntary tables for the reference years 2010 to 2014.

The use table at purchasers' prices and the supply table at current prices are available for each of the 28 EU Member States for all years 2011 to 2014.

The voluntary tables (tables 1610 to 1630) have been transmitted for the reference years 2011 to 2014 by 13 to 17 Member States. Estimation of missing matrices will therefore apply for around half of the Member States and around 50 % of the EU gross value added to compile a full dataset of use tables at basic prices and then IO tables.

Figure 4.2: Availability of SUIO voluntary tables for the reference years 2010 to 2014 and coverage



Note: 1610 (Use table at basic prices, total); 1611 (Use table of domestic output at basic prices); 1612 (Use table of imports at basic prices); 1630 (Taxes less subsidies on products); 1700 (Input-output tables totals at basic prices). Table 1620 (trade and transport margins) availability is similar to the table 1630.

4.3 International trade in goods statistics

To create a coherent view of trade in goods between countries participating in Figaro project two components are used: the international trade in goods statistics (ITGS ([53])) published by Eurostat and the United Nations Commodity Trade Statistics Database (UN Comtrade).

ITGS measure the value and quantity of goods traded between the EU Member States (intra-EU trade) and goods traded by the EU Member States with non-EU countries (extra-EU trade).

UNSD collects, compiles and disseminates detailed trade data (by commodity/services category and by trading partner) for both merchandise trade and trade in services. UN Comtrade is the pseudonym of the database.

4.3.1 ITGS

Traditionally ITGS are based on the data collected by customs authorities on trade transactions between countries. Customs declarations are used for statistical purposes as the basic data source which provides detailed information on exports and imports of goods with a geographical breakdown.

The first piece of EU legislation on ITGS was adopted in 1975; it provided general guidelines on data collection and obliged Member States to send their data to Eurostat. The advent of the Single Market on 1 January 1993, with its removal of customs formalities between Member States and subsequent loss of trade statistics data sources, required the establishment of a new data collection system: Intrastat. Since then ITGS are based on two data collection systems: Extrastat and Intrastat.

([53]) http://ec.europa.eu/eurostat/web/international-trade-in-goods/overview.

Extrastat data on trade in goods with non-EU countries are collected by customs authorities and are based on the records of trade transactions in customs declarations, whereas Intrastat data are directly collected from intra-EU trade operators once a month.

Comext is Eurostat's reference database for detailed statistics on international trade in goods. It provides access not only to both recent and historical data of the EU and its individual Member States but also to statistics of a significant number of non-EU countries. Any aggregated and detailed statistics on international trade in goods disseminated through Eurostat website are compiled from Comext.

A. COMMUNITY AND NATIONAL CONCEPT

EU legislation serves as a basis for compiling the intra- and extra-EU trade statistics sent by the Member States and published by Eurostat. However, EU statistics, which cover the EU as a whole, and the statistics compiled and published by the Member States, are not always directly comparable. Member States may use a national concept at national level but they have to provide Eurostat with harmonised data according to the Community concept. The principal differences between the Community concept and national concepts are set out below.

- Breakdown by partner country: for arrivals, certain Member States record the country of origin as the partner country, whereas the Member State of consignment appears in the Community statistics relating to the same movements.
- Treatment of goods in transit: some Member States do not record in their national figures goods they consider to be 'in transit'. This involves, firstly, imports from non-member countries which are cleared in these Member States before being dispatched to other Member States and, secondly, goods from other Member States which are immediately re-exported to non-member countries. These flows are included in the Community statistics under intra- or extra-EU trade, as appropriate. This phenomenon is sometimes referred to as the 'Rotterdam effect'.
- Other differences: other methodological differences can cause discrepancies between national and Community statistics, for example applying the general trade system at national level rather than the special trade system.

In theory, intra-EU trade statistics based on the Community concept should be fully comparable; therefore data should generally be less affected by asymmetries than extra-EU trade statistics. Dispatches from Member State A to Member State B, as reported by A, should be almost equal to arrivals into B from A, as reported by B. Due to a different valuation principle (CIF > FOB), arrivals should be slightly higher than dispatches. However, since the Intrastat system came into operation, bilateral comparisons have revealed major and persistent discrepancies in the intra-EU trade statistics. Therefore, comparisons dealing with intra-EU trade statistics have to be made cautiously and should take into account the existence of these discrepancies. The main reasons for the discrepancies are known and are: (i) the thresholds, the non-response and their related adjustments; (ii) statistical confidentiality; (iii) triangular trade; (iv) time lags in the registration of the transactions; (v) misclassification of goods; and (vi) other methodological differences. Many Member States regularly carry out bilateral studies to find out at detailed product level where the problems are and to resolve them. However, remedies are not easily found despite all the analyses done.

Additional differences between the methodology applicable to trade statistics published by Eurostat (known as Community figures) and those published by Member States, as well as between Community figures and other international sources that affect comparability are described in the User Guide of Statistics on the trading of goods (Eurostat, 2006).

B. MEMBER STATE OF DESTINATION, CONSIGNMENT, ORIGIN

Within intra-EU trade statistics, the partner Member State for dispatches is the Member State of destination, and for arrivals the Member State of consignment. In addition, for national purposes Member States may collect the country of origin for arrivals.

In the case of dispatch, the Member State of destination is the Member State to which goods are dispatched by the reporting Member State, without — as far as it is known at the time of dispatch — being subject to any halts or legal operations which are not inherent in their transport.

If it is known at the time of dispatch that goods are to be delivered to a Member State ‘A’ but will first enter a third Member State ‘B’ where they are subject to any halts or legal operations which are not inherent in their transport, the Member State ‘B’ is the Member State of destination and Member State ‘A’ should not be reported as part of this transaction.

In the case of arrivals, the Member State of consignment is the Member State from which goods were dispatched to the reporting Member State, without any halts or legal operations which are not inherent in their transport taking place in any intermediate Member State.

If, before arriving in the reporting Member State, goods enter a third Member State and are subject to halts or operations not inherent in their transport, that third Member State should be taken as the country of consignment.

On arrival, the country of origin means the country where the goods originate. The origin of goods wholly obtained or produced in a country is attributed to that country.

As regards Intrastat, respondents can encounter difficulties in assigning the correct partner Member State on the arrival and dispatch side as a result of wrong partner country allocations due to triangular trade transactions.

C. GOODS CLASSIFICATION

One of the key requirements for trade in goods statistics is that they are classified by commodity code as set out in the EU Combined Nomenclature (CN). The CN is based on the Harmonised Commodity Description and Coding System (managed by the World Customs Organisation (WCO)). The Harmonised System (HS) is an international classification at two, four and six-digit level which classifies goods according to their nature. The CN corresponds to the HS plus a further breakdown at eight-digit level defined to meet EU needs. It includes around 9 400 eight-digit codes. Eurostat manages correspondence tables enabling the transposition of data collected according to the CN into other classifications like the Standard International Trade Classification (SITC) and the Classification of products by activity (CPA).

D. VALUATION OF TRANSACTIONS

Member States are required to obtain from records on imports and exports the **statistical value** of the goods at the national border of the importing or exporting Member States, i.e. the amount which would be paid in the event of sale or purchase at the time and place the goods cross the national border of the reporting Member State. Article 4(4) of Commission Regulation (EC) 113/2010 requires the statistical value to be **adjusted** in such a way that the statistical value contains solely and entirely the costs of transport and insurance performed to deliver the goods from the place of their departure to the border of the Member State of destination on **import (CIF value)** or to the border of the Member State of actual export on **export (FOB value)**.

4.3.2 UN Comtrade

UN Comtrade is the pseudonym for United Nations International Trade Statistics Database. Over 170 reporter countries/areas provide the United Nations Statistics Division (UNSD) with their annual international trade statistics data detailed by commodities/service categories and partner countries. These data are subsequently transformed into the UNSDUNSD standard format with consistent coding and valuation using the processing system.

The Figaro project focuses here on the use of the international merchandise trade statistics (commodities). All commodity values are converted from national currency into US dollars using exchange rates supplied by the reporter countries, or derived from monthly market rates and volume of trade. Quantities, when provided with the reporter country data and when possible, are converted into metric units. Commodities are reported in the current classification and revision (HS 2012 in most cases as of 2016) and are converted all the way down to the earliest classification SITC revision 1.

Commodities are classified according to SITC, the HS and broad economic categories (BEC).

The international recommendations are for countries to compile their data according to the 'national concept'. This is what generates the main difference between the Community concept and national concepts.

To promote the comparability of international merchandise trade statistics and taking into account the commercial and data reporting practices of the majority of countries, it is recommended that: (a) the statistical value of imported goods be valued CIF; (b) the statistical value of exported goods be valued FOB. Like in ITGS, imports are valued in CIF and exports valued in FOB.

4.3.3 Data for Figaro

The Figaro project makes use of both datasets: ITGS and Comtrade. The main difference between the two databases in terms of the national/Community concept brings benefits to the approach developed in the Figaro project in building up bilateral trade data. The main benefit relates to the breakdown of gross export values of Comtrade into quasi-transit trade, re-exports and domestic exports.

International Trade in Goods Statistics (ITGS) covers goods in quasi-transit, i.e. goods that are brought into or taken out of a Member State to be declared there as imports/exports for customs or tax purposes without the Member State having acquired the ownership of the goods. However, some Member States exclude quasi-transit from the results published in ITGS to enhance the economic relevance of their national figures. In addition, Member States exclude as well quasi-transit when sending their figures to UN Comtrade. Therefore we assume that ITGS follows the community principle (includes quasi-transit) and UN Comtrade follows the national principle (excludes quasi-transit). Voluntary information collected in Intrastat (ITGS) also facilitates the separation between country of origin and country of consignment in intra-EU trade of goods imported from non-EU countries (re-exports).

Annual ITGS data related to international trade in goods statistics are provided by the Eurostat unit 'Goods production and international trade' for the reference year 2010 up to year 2016. The annual ITGS data are compiled based on the monthly national data collection transmitted to Eurostat as the sum of the 12 months in the year. Annual data for year T is available before end of T+3 months. Comext dataset includes 28 data reporters and many trade partners.

Annual UN Comtrade data for the reference years 2010 to 2016 are available as well. UN Comtrade includes data for circa 170 data reporters.

4.4 International trade in services and balance of payments data

The balance of payments (BoP) is a statistical statement that summarises, over a given period of time, all the transactions of an economy with the rest of the world. The balance of payments records all economic transactions undertaken between the residents and non-residents of a country during a given period. A transaction is defined in the BPM6 as an interaction between two institutional units that occurs by mutual agreement or through the operation of the law and involves an exchange of value or transfer.

The balance of payments provides information on the total value of credits (or exports) and debits (or imports) for each BoP item and on the net result or ‘balance’ (credits minus debits) of the transactions with each partner.

Transactions are organised in two different accounts, the current and capital account and the financial account, whose sum of balances in principle altogether should be zero, as for each economic transaction in the current and capital account there should be (theoretically) an equivalent transaction in the financial account. Thus, the current and capital account balance determines the exposure of an economy vis-à-vis the rest of the world, whereas the financial account explains how it is financed. For the purpose of the Figaro project, only the current account is relevant. The current account shows the flows of goods, services, income and current transfers between resident and non-resident units.

Services are the second major category of the current account. In the production of data on international trade in services (ITS) the references are the IMF’s BPM6 and the UN Manual on Statistics of International Trade in Services.

4.4.1 Classification of services

An overview of the classification of services is provided in section 20.2.3. The classification is mainly product-based, but is transactor-based for travel, construction, and government goods and services not included elsewhere (n.i.e). The classification is according to the type of service, rather than the unit that provides it; for example, if a bank provides pension fund services as a secondary activity, the service is classified as pension fund services. The detailed list of goods and services under the current account of the balance of payments is presented on page 301 of the Balance of Payments and International Investment Position Manual, Sixth Edition (BPM6)[54].

Total services (S) corresponds to the sum of the 12 services categories, including an additional item SN, which stands for ‘Services not allocated’. SA and SB correspond to items newly introduced with the implementation of the BPM6 methodology (previously reported under goods). ‘Merchanting’ is no longer a part of services and has been moved under goods.

The services classification is hierarchical. Total services are represented by item S. S is composed of 12 two-letter items, SA to SL, plus SN for non-allocated trade. Each two-letter item is subdivided, etc.

For the Figaro project we are interested in certain details (see the list of detailed services categories in 20.2.3) but not all of them are part of the mandatory transmission.

The detail of the BoP data is at two-letter level while the ITS statistics data go to the most detailed level for the EU partners and United States. For the purpose of compiling Figaro tables our focus is on this detailed level so that we can to link it more easily to the CPA product classification.

To link BPM6 services categories to CPA product classification it is necessary to get data for voluntary items. For example the services category SD on travel can be disaggregated in different ways. Table 4.2 presents the mandatory items for services category SD as well as the voluntary items we are interested in for Figaro.

([54]) https://www.imf.org/external/pubs/ft/bop/2007/pdf/bpm6.pdf

Table 4.2: Example of travel services (SD)

	Mandatory items		Voluntary items
SDA	Travel; Business	**SD1**	Travel; Goods (Travel)
SDA1	Travel; Business; Acquisition of goods and Services by border, sea	**SD2**	Travel; Local transport Services
SDA2	Travel; Business; Other than acquisition of goods and Services by	**SD3**	Travel; Accommodation Services
SDB	Travel; Personal	**SD4**	Travel; Food-serving Services
SDB1	Travel; Personal; Health-related	**SD5**	Travel; Other Services than goods (Travel), local transport services
SDB2	Travel; Personal; Education-related		
SDB3	Travel; Personal; Other than heath-related and education-related		

4.4.2 Coverage

The data generally cover the EU, the euro area, EU Member States, candidate countries (Iceland, Montenegro, the Former Yugoslav Republic of Macedonia, Serbia and Turkey), Norway, Switzerland, the USA and Japan. However, both quarterly and annual statistics under balance of payments have a specific geographical coverage.

Annual ITS data according to the BPM6 methodology are available from 2010 onwards. Countries reported for the first time annual ITS in BPM6 for reference year 2013. As far as revisions are concerned, countries were free to send revisions either according to the BPM5 or BPM6 methodology. As Eurostat opted for double dissemination in both methodologies for reference years 2010-2012 for the EU aggregates, where national data were not available in BPM6 Eurostat converted the corresponding BPM5 data into BPM6 using the conversion matrix presented in the BoP Vademecum[55].

4.4.3 Data for Figaro

Trade data in services come from international trade in services statistics (ITS) and BoP datasets. The data of interest are the annual time series. Data for the years 2010 to 2014 have been provided for the Figaro project. However the April 2018 Figaro release treats only the 2010 data.

In the methodological steps described in Part II, we denote the "X-letter" item to the level of detail of the services category: SD is a two-letter item, SD1-SD5 are three-letter items and so on and so forth.

The ITS datasets present the 28 EU Member States as the reference area with a relationship to 236 partner countries. However, not all detailed services category are available for all those partner countries. Figure 4.3 gives the count of partner countries for which some data are available from the ITS dataset.

([55]) http://ec.europa.eu/eurostat/cache/metadata/Annexes/bop_its6_esms_an3.pdf

Figure 4.3: Number of partner countries data, total services, 2010

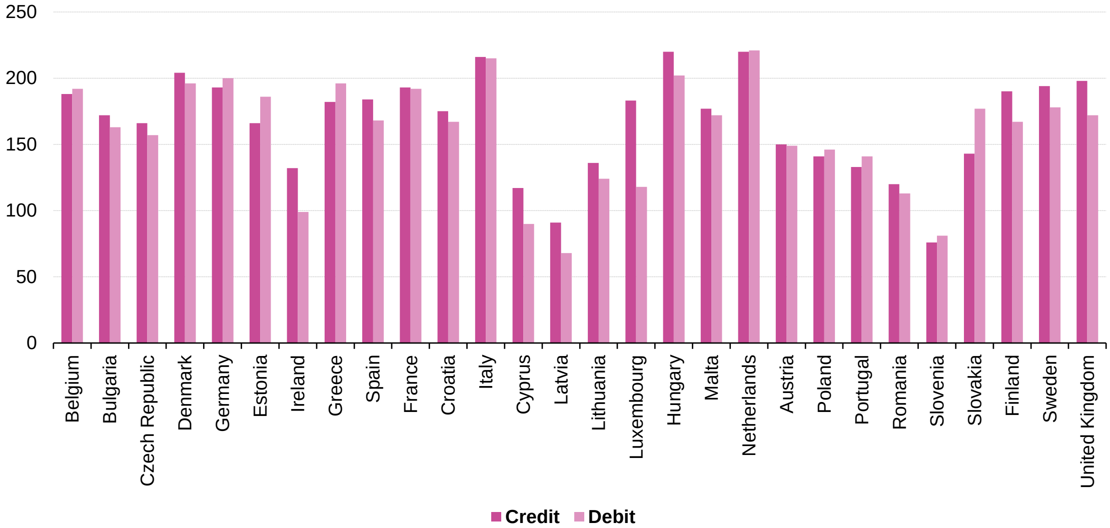


Table 4.3: Number of partner countries' data, two-letter services category,2010

Credit	SA	SB	SC	SD	SE	SF	SG	SH	SI	SJ	SK	SL	SN
Belgium	48	31	58	58	44	49	58	49	57	58	34		44
Bulgaria	50	24	58	58	3	18	43	27	57	50	47	22	
Czech Republic	46	51	59	47	44	57	33	38	55	56	36	32	
Denmark	25	42	58	53	55	48	56	55	56	57	52	49	
Germany	20	55	59	59		39	59	53	59	59	30	58	
Estonia	36	40	55	59	31	26	57	19	59	54	28	29	7
Ireland			17	31		52	48	32	55	55	5	2	
Greece	3	18	59	56	49	57	52	39	52	59	51	36	
Spain	9	34	58	58	25	45	48	42	58	57	44	22	
France	58	58	58	58	58	58	58	58	58	58	58	58	
Croatia	40	40	58	40	36	43	55	48	54	59	58	4	
Italy	57	57	58	58	36	58	57	57	58	58	53	57	
Cyprus			33	37	4	8	49		18	5	6	6	
Latvia	7	20	65	53	11	3	34	2	23	36	2	2	
Lithuania	50		54	53	22	18	34	5	35	46	20	27	
Luxembourg	8	2	47	39	23	24	59	33	59	53	26	2	
Hungary	27	49	58	35	41	51	58	56	58	58	55	52	
Malta		51	66	110	1	12	96	19	138	79	83	24	
Netherlands	70	123	171	120	110	72	175	162	214	186	114	107	
Austria	21	32	56	59	32	29	47	41	53	56	29	37	10
Poland	30	43	58	42	39	34	46	40	50	58	43	7	
Portugal	16	25	52	57	26	13	21	9	42	49	23	32	
Romania	34		41	53	24	16	17	15	43	47	25	33	
Slovenia	13	8	41	39	19	19	13	9	30	33	12	3	
Slovakia	50	72	82	81	37	39	60	65	75	101	71	11	104
Finland	56	43	58	35	48	39	26	58	59	59	30	40	
Sweden		56	58	33	47	57	38	57	58	59	45	8	
United Kingdom	6	6	57	56	34	48	53	49	55	58	49	52	

Most European countries provide data on a bilateral basis with all their partners for credit (exports) and debit (imports). At the two-letter level of services category the availability at the partner level is less complete. The situation is similar for credit and debit (see Table 4.3). Only three countries used the item SN for non-allocated services in 2010: Belgium, Austria and Slovakia.

Looking at more detailed services categories, the number of partner countries available is similar to the availability for the two-letter level, except for voluntary items such as SD1 to SD5 or SH1 to SH4. For example only Czechia, Slovenia and Sweden provide the details of SD according to the classification needed in Figaro. In the case of the Netherlands, for the three-letter services in SF (SF1 to SF4), the average number of partners with data is 44 (see Table 20.1).

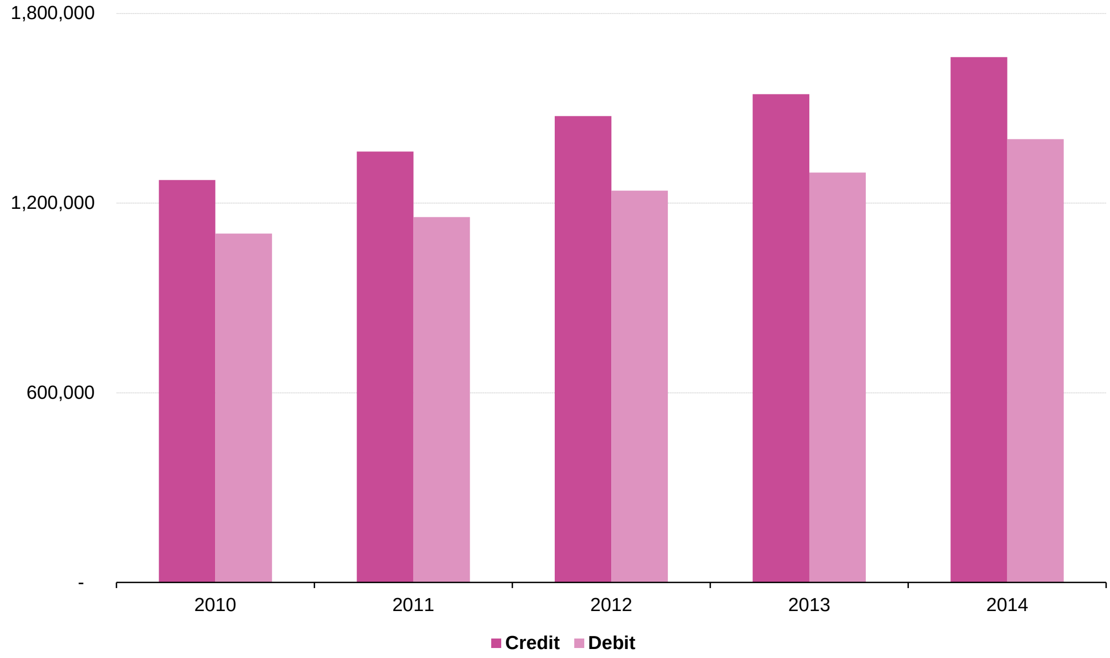
The trade in services for 2010 amounted to EUR 1 273 billion for the EU Member States in exports and EUR 1.103 billion in imports. The coverage of the services categories at two-letter level is 93 % of the total services for exports and 94 % for imports (see Table 4.4). The services categories at the three-letter level represent 71 % of the two-letter level for services for exports [resp. 69 % for imports]. The four-letter level of detail is provided for 64 % of the three-letter level for exports, etc. The most detailed level (six-letter) relates to the services categories SJ121, legal services (SJ1121, SJ1122, SJ1123, SJ1124). The six-letter details provided at EU level represent only 0.01 % of exports of legal services and 0.05 % for imports.

Table 4.4: Coverage of trade in services, EU, 2010

	Total services	2-letter services	3-letter	4-letter	5-letter	6-letter
Credit	1,273,226	93%	71%	64%	34%	0.01%
Debit	1,103,515	94%	69%	71%	35%	0.05%

The total trade in services present a growth of exports and imports for the period 2010 to 2014, as illustrated in Figure 4.4.

Figure 4.4: Total services of EU countries exports (credits) and imports (debits)



4.5 CIF-FOB margins

The valuation principles in the ESA are such that imports and exports of products should be recorded at border values. Total imports and exports are valued at the exporter's customs border, or free on board (FOB). Foreign transport and insurance services between the importer's and the exporter's borders are not included in the value of goods but are recorded under services. As it may not be possible to obtain FOB values for detailed product breakdowns, the tables containing details on foreign trade show imports valued at the importer's customs border (CIF value). All transport and insurance services to the importer's border are included in the value of imported goods. As far as these services concern domestic services, a global CIF/FOB adjustment is made in the supply and use tables to avoid counting them twice as output and import in the total supply of an economy.

In the supply, use and input-output tables, imports of goods for individual product groups are valued at the cost-insurance-freight (CIF) price at the border of the importing country.

International merchandise trade statistics (IMTS, 2010[56]) are the main source of data for goods. IMTS 2010 (para. 4.8) further recommends that the statistical value of exported goods be valued FOB and the statistical value of imported goods be valued CIF. Countries are encouraged to compile

([56]) https://unstats.un.org/unsd/trade/publications/seriesf_87Rev1_e_cover.pdf imported goods valued in FOB as supplementary information. At EU level the main data source for trade in goods statistics is described in the 'Compilers Guide for International Trade in Goods Statistics' (2017 edition). In trade in goods statistics, arrivals are valued on a CIF basis and dispatches on a FOB basis. This causes a systematic asymmetry as the value of the arrivals should be then than the value of the mirror dispatches. Therefore, to compare imports and exports in the Figaro compilation process, CIF values have been transformed into FOB values in some parts of the process, using CIF-FOB margins or rates.

The issue of different valuation does not apply in the trade in services statistics and balance of payments (BoP) statistics, as exports and imports are valued FOB.

The compilation of a balanced view of trade (see Part II) involves first of all comparing exports and mirror exports. In this way the mirror export values are calculated in FOB values, applying the CIF-FOB ratio at the four-digit levels of the trade in goods classification (i.e. the HS). The same HS4 level CIF-FOB margin is applied for all products belonging to this four-digit level.

Initially the Figaro project was supposed to estimate the CIF-FOB ratios based on additional information collected by Eurostat from the Member States. However, the data were very limited. Econometric gravity models were estimated based on the EU Member States' trade data, but the lack of information for partners outside the EU weakened the estimation. The Figaro project decided therefore to use the OECD ([57]) estimations.

The data combines the largest and most detailed cross-country sample of official national statistics on explicit CIF-FOB margins and estimates from an econometric gravity model (Miao and Fortanier, 2017). The database details the bilateral, product-level international trade and insurance costs for more than 180 countries and partners, over 1 000 individual products. The CIF-FOB ratio corresponds to: (CIF value-FOB value)/(CIF value). Data are available for the years 2010 to 2014.

Official statistics on CIF-FOB margins are still some way far from being produced regularly by national statistical offices. However, this would help improve the quality of the balanced view of bilateral trade, which is used to support the construction of EU-IC-SUIOTs.

The second step where CIF-FOB ratios are used relates to estimating the national import flow matrices by country of origin. The national import matrices are available valued at CIF. They were therefore converted to FOB values in order to use the previous adjusted balanced view of trade.

4.5.1 CIF-FOB results

In 2010, the average CIF-FOB ratio over all countries is **7.4 %** (or CIF value * 93 % = FOB value). Considering the EU Member States, the USA and all other countries as the rest of the world (RoW), the CIF-FOB average ratio for those countries as importers varies from 3.8 % (minimum for Luxembourg) to 8.3 % (maximum for Cyprus). When the countries are viewed as exporters, the average ratio varies from 4.5 % (Croatia) to 9.6 % (Luxembourg). See Figure 4.5 for more detail.

Similar statistics can be drawn at product level (see Figure 4.6). The highest CIF-FOB average ratio (12 %) applies for mining and quarrying while the lowest CIF-FOB average ratio (4.9 %) applies to the CPA 21, basic pharmaceutical products and pharmaceutical preparations.

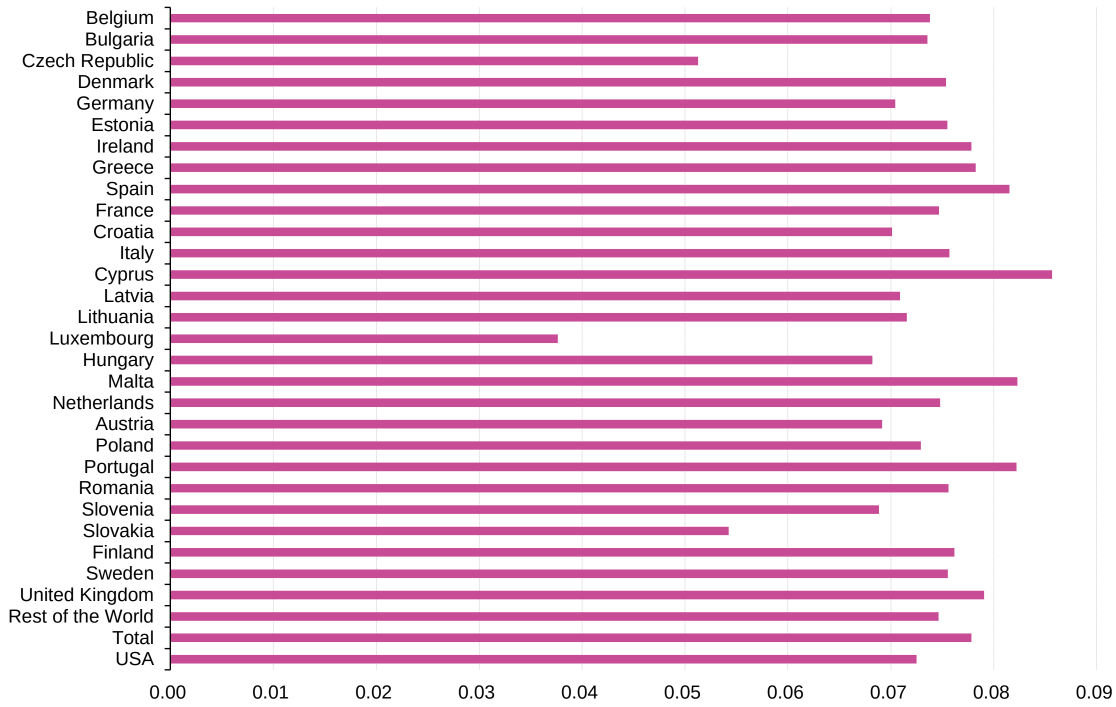
Looking at one country as the importing country and compiling the average CIF-FOB ratio for each of the partner countries, Figure 4.7 presents the spectrum of values per country.

Over the 5 years available (2010 to 2014) the average CIF-FOB ratio remains stable at 7.4 % (slightly down at 7.33 % in 2014). At product level average, CIF-FOB ratios are also very stable for the 2010-2014 period.

([57]) Refer to footnote 14.

Figure 4.5: CIF-FOB average ratio per country, year 2010

Ratio per importing country



Ratio per exporting country

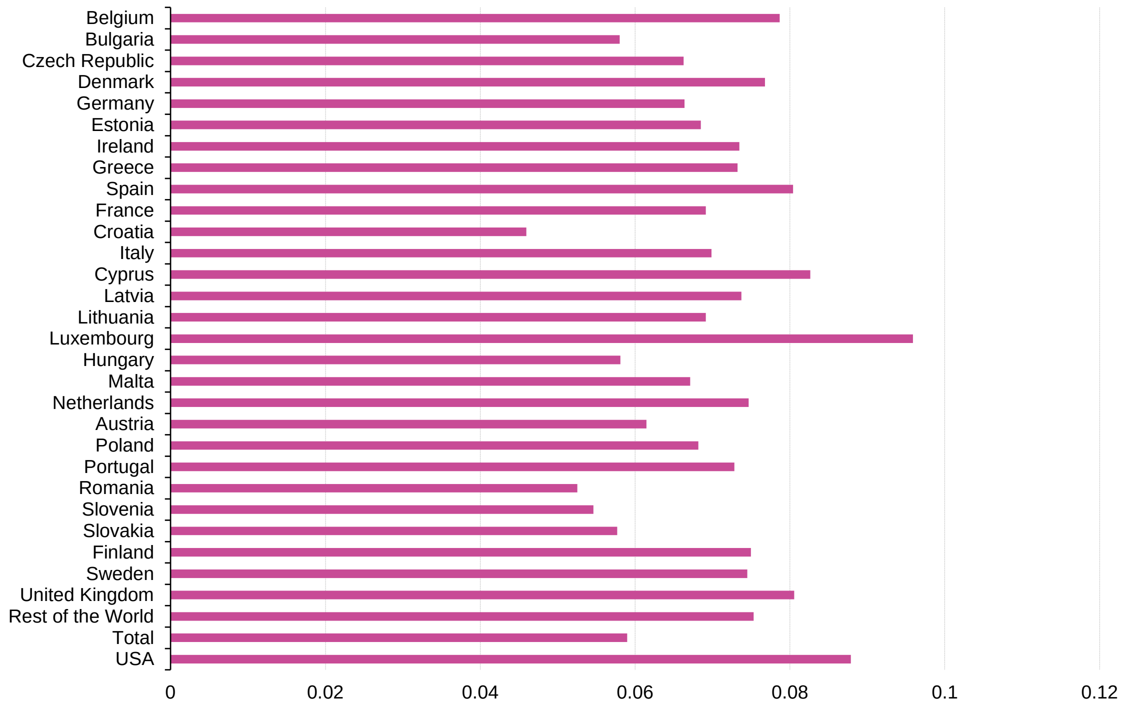
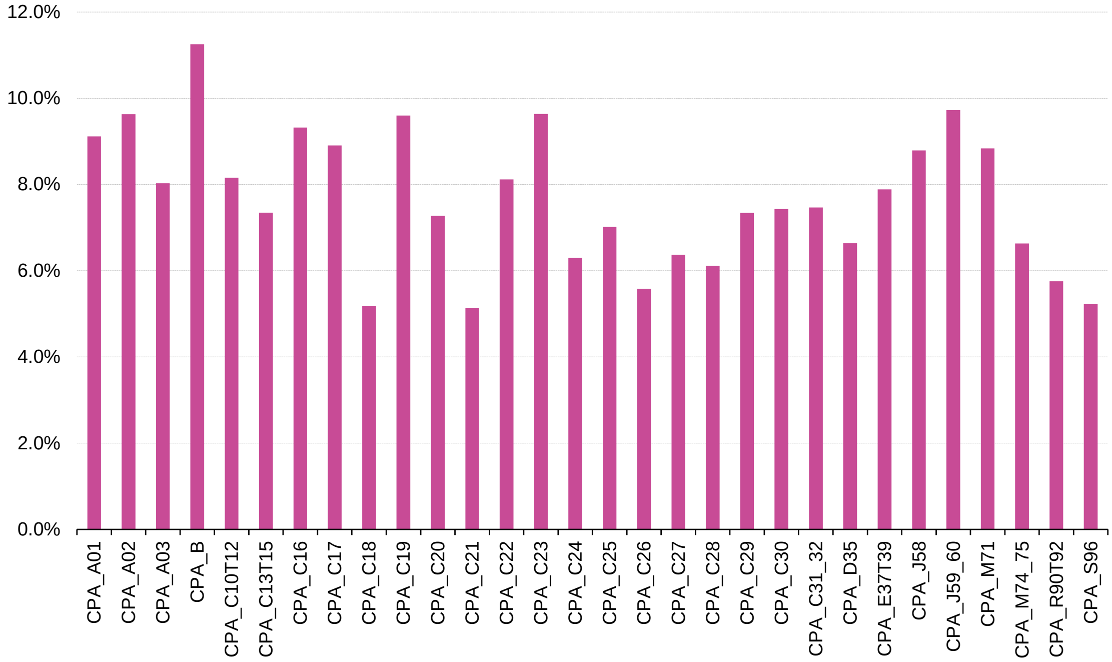
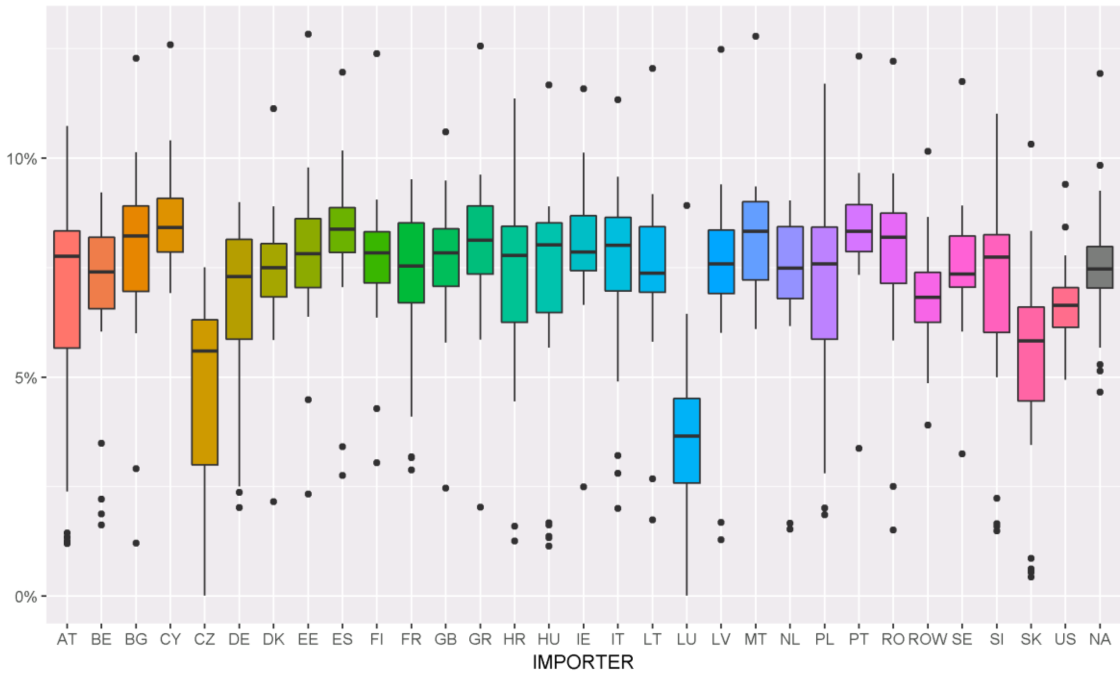


Figure 4.6: CIF-FOB average ratio per product, year 2010



Note: the CPA codes refer to the product classification.

Figure 4.7: CIF-FOB average ratio distribution over partners per importing country, year 2010



5 Estimation of missing national supply, use and valuation tables

5.1 Introduction

An inter-country supply and use framework (IC-SUT) is based on the national supply and use frameworks (SUT). In chapter 0, SUT data were presented. However, data gaps can be expected for two reasons: derogations in compulsory data transmission and voluntary transmissions. This chapter describes the strategies used to fill such gaps in national SUTs.

Use tables at basic prices – use (bp) – are often not available (Dietzenbacher et al., 2013), i.e. under the current EU regulation (in force since 2014), national statistical offices (NSOs) are obliged to submit the supply table (Sup) and the use table at purchasers' prices – use (pp) – annually. The submission of use (bp) tables is only compulsory once every 5 years. The previous regulation did not require the submission of use (bp) tables as they were considered only voluntary. This EU situation can be easily extrapolated worldwide ([58]), as many countries do not produce use (bp) tables annually, including Brazil, Israel, Switzerland, South Africa, the Former Yugoslav Republic of Macedonia, Norway and Taiwan. Besides, some countries like the US and New Zealand have only recently started producing such tables, thus making it difficult to find available time series of use (bp) tables. This chapter aims to improve this situation for the EU and recommends a set of empirically assessed methods that can also be used for non-EU countries, if needed.

The estimation of missing national use (bp) tables requires additional information that can take the form of use (bp) tables or input-output tables of previous years, wherever available, and output of industries by product, among other relevant information. Following the UN (2018) approach, we distinguish between the concepts of **compilation**, **estimation** and **projection**. The borders between these concepts may be difficult to trace but the idea of developing different methods depending on the available information (the most information in compilation; the least in projection) is useful in our view.

Projections are based on pure mathematical processes that do not use any extra information besides the row and column totals of the target tables (or none of them) or key variables (e.g. Temurshoev, Webb and Yamano, 2011 and Valderas et al., 2018, among others). The estimation process uses additional external information and/or additional external constraints on the target tables (different from those of column and row totals).

Compilation refers to instances in which conflicting/combined external data sources are used, which is the case of NSOs when building supply, use and input-output tables. Compilation methods are — generally speaking — superior to estimation methods because they are able to consider more information. Moreover, more external information means better-constrained tables, which in turn means tables that better reflect measured external data (Lenzen et al. 2006). For example, IDE-JETRO researchers include significant information in the compilation of the Asian input-output tables (AIOT) database, while the Australian IELab balances time series of multi-regional supply and use

([58]) Erumban et al. (2012) includes the detailed data situation of all countries covered in WIOD tables.

tables using state accounts, business registers, household expenditure surveys, and all kinds of other valuable sources (Lenzen et al. 2017). The IndoLab (Faturay et al. 2017), meanwhile, uses extensive labour surveys. All these developments are contributing positively and significantly to dealing with complex issues in the compilation process.

Not so long ago, national statistical offices and other similar statistical agencies attempted to use all kinds of national data sources (conflicting or not), struggling to balance the whole system almost on a manual basis. Some of them still do it like this. Now, with the IELabs, the work has somewhat been semi-automated and national statistical offices such as the Australian Bureau of Statistics are applying these methods. The same can be applied for multi-regional input-output (MRIO) systems. Nevertheless, not everyone has the time and resources to collect, treat and deal with so many varieties of data sources to compile input-output tables. Therefore, sometimes a more modest process of **estimation** takes place. This chapter provides our recommendations for EU countries, which can also be used by others, if needed.

Hence, we limit the scope of this chapter to the estimation process of use (bp) tables. We recommend some non-exhaustive but tested methods with a selection of additional information and provide guidance ([59]) in the absence of superior data, which are held by national statistical offices (i.e. the compilation process). The recommendations are based on the work carried out within the EU context (Rueda-Cantuche et al., 2018) with additional available information provided by national statistical offices, which might not necessarily be the case for most non-EU countries ([60]). However, countries are progressively moving towards publishing supply and use frameworks and the recommendations of this chapter based on empirical comparison such as that by Rueda-Cantuche (2018) might also be helpful for non-EU countries in the near future. A worldwide view of other estimation processes can be found in Gallego and Lenzen (2009), Lenzen et al. (2009), Lenzen et al. (2012) and Lenzen et al. (2013).

The selection of the methods is based as much as possible on the conceptual features of the various tables, such as the estimation of trade and transport margins using GRAS (Junius and Oosterhaven, 2003) with a fixed restriction (imposed by definition) of the column sums over the rows equal to zero or the estimation of use (bp) tables using available IOTs, provided that supply and use tables are the main source used for their construction.

Lenzen et al. (2013) states (regarding the EORA database) that it is worth setting an initial realistic set of national supply and use tables. The EXIOBASE database calculates the use (bp) tables using, for instance, available input-output tables and assuming a diagonal supply table. The valuation matrices are then made proportionally to a previous year structure or over the use (pp) table. The EXIOBASE database finally assumes a proportional approach to distribute imports in the absence of previous years' structures (Tukker et al., 2013). The GTAP database is made of individual contributions, meaning that methods vary across countries since the guidance from the Center for Global Trade Analysis mostly focuses on aggregations, types of tables, etc. (i.e. Huff et al. (2000), for example, suggest using proportionality to split total uses between imports and domestic uses wherever the split is missing). Dietzenbacher et al. (2013) indicates that the valuation matrices are estimated using average rates by product, with some adjustments to match the totals in the national accounts aggregates.

To summarise, this chapter seeks to shed light on the estimation of single national supply and use tables and valuation matrices after a comparative analysis of a set of non-exhaustive methods, mostly applied to the EU context and whenever superior data are not available. Our approach uses available SUTs and IOTs, domestic and import uses, basic and purchasers' prices, and valuation matrices. It does not use other data sources besides the tables of previous periods that have already been produced by NSOs. Evidently, more information could have been used for the same purpose

([59]) Other similar studies trying to reproduce NSO official tables are Bonfiglio and Chelli (2008) and Sargento et al, (2012).

([60]) Besides some EU Member States, it is common for countries such as Australia, Canada, Chile, Colombia, Costa Rica, Korea, Mexico and the US not to provide valuation matrices.

but that would have been more a compilation exercise than an estimation process, following the UN Handbook on Supply, Use and Input-Output Tables (2018).

The next section identifies the estimation targets and defines different scenarios. Next, the following section recommends the estimation strategies for each scenario depending on the availability of the targeted tables and auxiliary data.

5.2 Identification of estimation targets and scenarios

This section sets the estimated targets: (i) the estimation of a use table at basic prices, distinguishing between domestic and import uses; and (ii) valuation matrices (taxes less subsidies on products (TLS) and trade and transport margins (TTM).

Within the European context, Eurostat's official transmission programme (compulsory for EU Member States) for the ESA2010 (European System of Accounts 2010), compliant with the SNA2008 (System of National Accounts 2008 of the UN) classifies the tables as in Box 4.1.In particular, we will use annual tables (T1, T2) as exogenously given data and IO tables (T3 to T5) as auxiliary data that might be available. Other auxiliary data that can be used will be T6 to T10 of a previous year ([61]) or similar country ([62]). Our main targets consist of the tables included in the list as T6 to T10, i.e. the use (bp) table, which is split into domestic and imported uses and the valuation matrices (i.e. TLS and TTM).

There are five alternative scenarios depending on the *availability* of the main elements of a SUT framework (rows of Table 5.1): supply table, use tables at purchasers' prices and at basic prices, domestic and imported use tables and the taxes less subsidies on products and trade and transport margins matrices. The different scenarios are represented in columns in Table 1 in a nested format.

- Scenario 0: refers to the situation in which all tables are available.
- Scenario 1: refers to the situation in which the TTM and TLS matrices are missing but the rest of the tables are available.
- Scenario 2: refers to the scenario ([63]) in which a distinction is to be derived between domestic and import uses at basic prices ([64]).
- Scenario 3: refers to the estimation of the use table at basic prices (total uses). Next, a further distinction can be made between domestic and import uses, and lastly the valuation matrices can be estimated, as in scenarios 1 and 2.
- Scenario 4: refers to the standard situation of updating/projecting SUTs in order to use the SUTs of a previous year or SUTs of similar countries to make projections.

([61]) In times of deep economic crisis or bust, it might be recommendable to use time series data (if available) to capture structural changes rather than just using the previous year's reference table.

([62]) Only previous year tables have been used so far instead of creating a system of criteria to select similar countries in terms of production structure, economy size, etc. This would have enlarged the methodology considerably.

([63]) For this task, the availability of the valuation matrices is irrelevant.

([64]) Import matrices could also be obtained using other detailed data sources and approaches such as BEC (Broad Economic Classification) but our approach is conceived as an estimation process rather than as a compilation process, where international trade statistics are used.

Table 5.1: Scenarios according to data availability

	Availability	Estimation			Projection
		Valuation tables	Domestic vs. imported uses	Total use (bp) tables	SUTs
Target	Scenario 0	Scenario 1	Scenario 2	Scenario 3	Scenario 4
T1. Supply	Yes	Yes	Yes	Yes	No
T2. Use (pp)	Yes	Yes	Yes	Yes	No
T6. Use (bp)	Yes	Yes	Yes	No	No
T7. Usedom (bp)	Yes	-	No	No	No
T8. Useimp (bp)	Yes	-	No	No	No
T9. TTM	Yes	No	-	No	No
T10. TLS	Yes	No	-	No	No

Source: Author, based on Rueda-Cantuche et al. (2018).

The focus of the section is therefore on scenarios 1 to 3, provided that in scenario 0 (all tables are available) there is nothing to estimate and scenario 4 (no data from the targeted year SUT framework is available) is not an estimation but a projection process ([65]). Therefore, this chapter deals with situations when some data, but not all, of the SUIOT framework is available for the targeted year.

The scenarios are presented as five independent ([66]) situations (i.e. columns in Table 5.1) because they represent five alternative situations that the reader might face when estimating use (bp) tables with a split between domestic and imported uses and valuation matrices. These situations are:

- full availability of all tables;
- use (bp) tables available but not valuation matrices;
- use (bp) tables available but not split between domestic and imported uses;
- use (pp) table available without use (bp) tables, therefore, also missing the valuation matrices; and
- no available tables for the targeted year.

As a general rule for each scenario, we expect that using tables from previous years is likely to be the best option, mainly because they gather detailed country-specific information that is not expected to change drastically in the short term.

In some cases, bi-proportional adjustment methods were required. The RAS method is the most widely used in the specialist literature: it was first described by Stone (1961) and Stone and Brown (1962), and was used extensively by Bacharach (1970) to update a given input-output table to a more recent or even future period for which only the row and column totals are given (Mínguez et al., 2009). The basic idea of RAS consists of changing the structure of the known base table as little as possible so that it meets predetermined row and column sums. In this chapter, we will use the 'GRAS' method (generalised RAS: Junius and Oosterhaven, 2003; Lenzen et al., 2007; Temurshoev et al., 2013). This is an improved version of the RAS method that can deal with negative values in the row and column sums of the matrices as well as in their interior components.

([65]) There are many updating methods in the specialist literature (e.g. SUT-RAS, SUT-Euro, PATH-RAS method; see, for instance, Eurostat 2008, Chapter 14 and UN, 2018, Chapter 18) but providing a full assessment of them goes beyond the scope of this chapter; as mentioned earlier in the Introduction, we focus only on estimation processes, excluding projection and compilation activities.

([66]) The reader should not be confused by the fact that the five scenarios have been identified separately and as independent processes; the SUTs and IOTs are actually interrelated. More precisely, the inter-connection between SUTs, IOTs, TLS and TTM are used to develop the estimation strategies.

5.3 Estimation strategies for scenarios

5.3.1 Valuation tables (scenario 1)

The estimation of valuation matrices is a necessary step to construct use (bp) tables. For the construction of the IC-SUTs at basic prices, these matrices are also required to transform exports from FOB to basic prices.

For some EU countries, the valuation matrices might be missing. Besides, these matrices are rarely available for non-EU countries, such as Australia, Canada, Chile, Colombia, Costa Rica, South Korea, Mexico and the US.

The methods used to estimate valuation matrices are selected based on the assumptions that: (i) margins and taxes are mostly *ad valorem* (such as value added tax, which represents a large part of the total TLS value); and (ii) tax and margin structures across users usually change slowly over time. Bearing this in mind and based on Rueda-Cantuche et al. (2018), we have selected the two methods that fitted best the official national SUTs used by these authors in their assessment. The methods are numbered as follows([67]):

(1) TLS is proportional to the row structure of a previous year's/similar country's TLS.

(2) TLS is proportional to the row structure of the use table at purchasers' prices.

Since both use (bp) tables and use (pp) tables are available in this scenario, the difference between them will give us the correct sum of TTM and TLS matrices. Therefore, whenever TTM (or TLS) is calculated using one of the two assumptions from above, the TLS (or TTM) matrix is then calculated by difference against the correct sum of TTM and TLS matrices ([68]). This approach reduces the assumptions made and ensures the consistency of the SUT framework.

Table 5.2: **Scenario 1 — Best performing methods**

		Availability of previous year/similar country	
		None	TTM and TLS
Availability of IOTs	None	2	1
	IOT	2	1
	IOT (dom/imp)	2	1

Source: Author, based on Rueda-Cantuche et al. (2018).

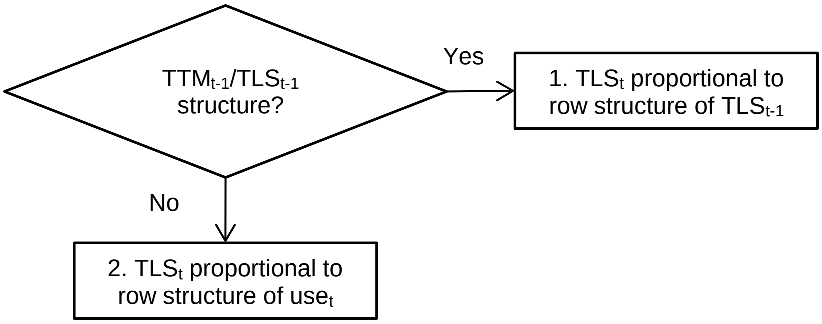
As shown in Table 5.2, the availability of input-output tables does not make a difference in the estimation of TLS/TTM ([69]). Either with or without IOTs, if we have no TTM/TLS from a previous year or similar country, we would choose method (2), i.e. to allocate the new TLS totals proportionally to the row structure of the use table at purchasers' prices and calculate the TTM matrix by difference. If we have a previous year's TTM or TLS available, then we would choose method (1), i.e. to allocate the new TLS totals proportionally to the row structure of a previous year's TLS and calculate the TTM matrix by difference. Figure 5.1 depicts the decision tree for this scenario.

([67]) More details about other alternative methods can be found in Rueda-Cantuche et al. (2018).

([68]) Whenever a target table is calculated as a residual, this is not included in the list of methods because it does not constitute an assumption itself.

([69]) Industry-by-industry IOTs might provide further information on TLS by industry, which would serve as constraints in the estimation of TLS matrices. However, in the EU context, industry-by-industry IOTs are far less common than product-by-product tables.

Figure 5.1: **Decision tree for scenario 1: estimation of valuation matrices**



Source: Author, based on Rueda-Cantuche et al. (2018).

As shown in Rueda-Cantuche et al. (2018), the resulting estimations of TTM are generally more accurate than those of TLS, especially for intermediate uses. Besides, other more refined options of bi-proportionally adjusting TTM and TLS instead of simply distributing the TTM/TLS vector proportionally can be used but they provide higher differences compared to official values. In principle, it does not seem intuitive that bi-proportional adjustments perform worse than simple proportional allocations. However, the fact that TLS tables have both positive and negative elements might be the reason behind this. The convergence problems found by Rueda-Cantuche et al. (2018) for some countries may also serve as proof of it.

In terms of errors, the results also show that it does not seem plausible to estimate TLS and TTM matrices using row structures of use tables at purchasers' prices (method (2)) but rather information on previous years (method (1)). The estimations of the TTM values of trade and transport sectors tend to suffer from less error (i.e. 4.3 % on average for intermediate uses and 2.7 % on average for final demand).

Generally speaking, all methods will lead to an increase in the number of negative elements. These elements are particularly significant in the trade and transport margins of commodities excluding trade and transport services. Therefore, these results also show evidence of a high sensitivity of the TTM and TLS estimates to the available information provided by NSOs.

5.3.2 Domestic and import uses (scenario 2)

The estimation of domestic and import use matrices are a crucial step in the building of inter-country SUIOTs. The national import use tables are split by trading partner. Meanwhile, the domestic part remains unchanged and is not subject to any balancing procedure. Therefore, inaccuracies in the determination of domestic use tables may create binding constraints for the subsequent steps in the construction of the IC-SUT. It is common to find in non-EU countries (e.g. New Zealand) use (bp) totals without a split between domestic and imported uses.

In this second scenario, the key issue ([70]) is estimating domestic and import use matrices from a use table (total) at basic prices. The column vector of imports by product provided by the supply table should be allocated row-wise to industries and final use components. The choice of the allocation rule should be based on using the same row structures as that of the IO tables of imports, current or from a previous year, if available. Alternatively, the row structures of the use table (total), either at basic ([71]) or purchasers' prices, can also be used as proxies. It is, however, evident that the assumptions using import values from the IO tables are much more appropriate than the other two

([70]) The availability of TTM/TLS is not necessary to estimate the domestic/imported split and vice versa, therefore scenarios 1 and 2 are completely independent.

([71]) The results of the method using basic prices are not commented here due to its poor performance in the assessment made by Rueda-Cantuche et al (2018).

alternatives, even though there would be some distortion caused by the treatment of secondary activities in the compilation of IO tables from original (unknown) use (bp) tables of imports.

The reason why we do not estimate first a use table of domestic uses and subsequently the use table of imports by difference (but instead the other way round) is that this method leads to a higher number of undesired negative values. Indeed, errors in the estimation of the largest part of the total use in each cell (i.e. domestic) lead to negative imports more easily than the other way round.

The methods are classified using capital letters ([72]):

A. The use table of imports at basic prices is proportional to the row structure of the IOT of imports, if available.

B. The use table of imports at basic prices is proportional to the row structure of the IOT of imports of a previous year or similar country, if available.

C. The use table of imports at basic prices is proportional to the row structure of the use table (total) at purchasers' prices.

Table 5.3 shows the methods that empirically fitted best in each situation, which greatly depends on the availability of auxiliary data. Accordingly, Figure 5.2 depicts a decision tree. Bi-proportional adjustment methods are not considered in this case because the targeted totals of import uses by industry are not generally available.

Table 5.3: Scenario2 — Best performing methods

		Availability of previous year/similar country			
		None	Use (pp) Use (bp) Supply	IOT (dom/imp)	IOT (dom/imp) Use (pp) Use (bp) Supply
Availability of IOTs	**None**	C	C	B	B
	IOT (dom/imp)	A	A	A	A

Source: author, based on Rueda-Cantuche et al. (2018).

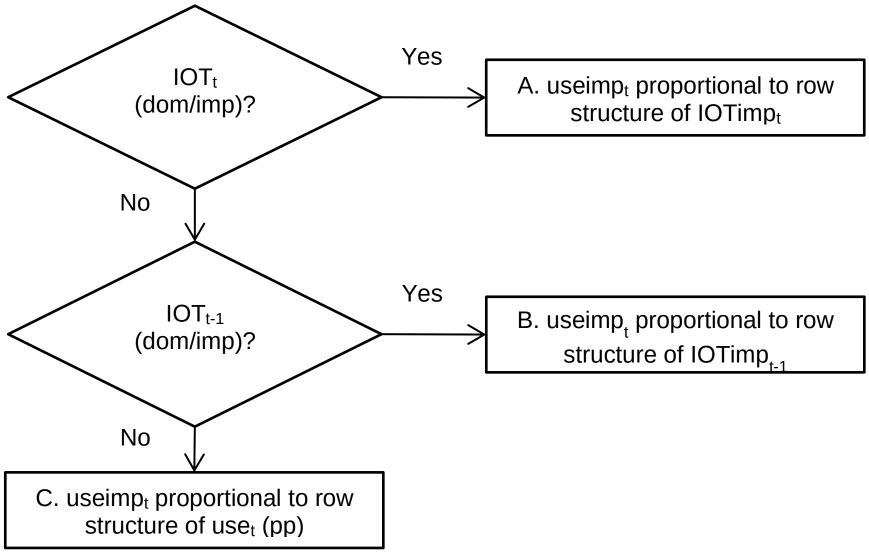
Scenario 2 requires a total use table at basic prices to be available. As shown in Table 5.1we will also assume that supply tables at basic prices and use tables at purchasers' prices are available in the current year. In addition, we could optionally have as extra information: IOTs (distinguishing between domestic and import uses) of the current year ([73]) and/or previous years' IOTs, use tables at purchasers' prices and supply tables.

As shown in Figure 5.2, the row structures of an IOT of imports, if available, seem to be the best assumption to estimate a use table of imports (method A). This conclusion is independent of the availability of a previous year's SUTs and IOTs (obviously a current IOT is better than a previous IOT). It is noteworthy that in some countries this method yields very accurate results, especially for the final uses. In general, domestic use tables are better estimated (ca. 2-9 %) than import use tables (ca. 7-15 %).

([72]) Further refinements were implemented during the calculations so that the estimated tables were eventually consistent. We did not allow non-zero values in the use dom/imp wherever there was no transaction in the use (bp). For further details, see Rueda-Cantuche et al. (2018).

([73]) We recognise that by definition it is difficult to find an IOT of imports of the current year without the corresponding use (bp) table of imports.

Figure 5.2: Decision tree for scenario 2: distinction between domestic and import uses



Source: author, based on Rueda-Cantuche et al. (2018).

Analogously, whenever there is no IOT for the current year available but there is one for a previous year, the most appropriate approach seems to be the use of the row structures of an IOT of imports of the previous year (method B). Similarly, this conclusion is again independent of the availability of SUTs of a previous year. Generally speaking, use tables of imports are not estimated so well. However, domestic use tables continue to result in low errors.

In the absence of IOTs, method B proved to be the one performing best but not with negligible errors, especially in the use table of imports.

It is noteworthy that methods A, B and C do not yield additional negative elements to the intermediate use table of imports. For the intermediate domestic use table, method B turned out to be the one with the least new (additional) negative values. On final uses, most countries also reported no additional negative elements when using method B whereas when using methods A and C there is a small increase in the number of negative values. In sum, the use of any of these methods may bring in a number of negative elements, which should be taken into account for further analyses.

5.3.3 Use tables at basic prices (scenario 3)

The estimation of use (bp) tables is a necessary step to construct the annual EU IC-SUTs due to ESA 2010 transmission programme derogations, which allow for some countries to deliver their national SUTs (bp) at a later stage. In non-EU countries, the availability is scarce. To our knowledge, countries such as Brazil, Cape Verde, Israel, Mauritius, Switzerland, South Africa, Albania, the Former Yugoslav Republic of Macedonia, Norway, Taiwan, Indonesia, Nepal, Russia and Venezuela do not report official use (bp) tables. Moreover, since some countries like the US or New Zealand have only recently started to produce these tables, they do not have a time series of use (bp) tables.

The methods used to estimate use (bp) tables are selected based on the construction process itself, i.e. either from the estimation of TTM and TLS matrices in order to subtract them from the use (pp) tables or by using the product technology assumption to reverse the IOT back to the use (bp) table originally used to compile it ([74]). We are fully aware that a pure product technology assumption is not

([74]) See Eurostat (2008, p. 296) for an illustrative flow chart of the compilation process for official IOTs.

what is applied by NSOs but it can still serve us as proxy if it is axiomatically superior to others (Kop Jansen and ten Raa, 1990; Rueda-Cantuche and ten Raa, 2009) ([75]).

The estimation of TTM and TLS can be done either separately or using the difference between use (pp) and (bp) tables of a previous year ([76]). These assumptions worked well for scenario 1. TTM and TLS can also be considered proportional to the use (pp) table with or without fixing a certain amount ([77]) of TLS allocated to final consumption of households (given the importance of VAT in TLS).

The methods proposed are as follows:

I. If we have a previous year's/similar country use tables at basic and also at purchasers' prices available, their difference would provide a matrix structure of the sum of TTM and TLS, which can be used to estimate a use (bp) table.

II. If we have a previous year's/similar country TTM and TLS matrices available, their matrix structures can be used to estimate them independently.

III. We can reverse the IOT of domestic uses and the IOT of import uses assuming the product technology assumption (product-by-product IOT) or the fixed industry sales structure assumption (industry-by-industry IOT) ([78]).

IV. We can reverse ([79]) the IOT (total uses) assuming the product technology assumption (product-by-product IOT) or the fixed industry sales structure assumption (industry-by-industry IOT).

V. We can estimate TTM and TLS assuming that both are proportional to the row structure of the use table at purchasers' prices and then subtract them from the use table at purchasers' prices ([80]).

Bi-proportional adjustment methods are not considered because the total intermediate consumption by industry and the targeted totals for the use (bp) table would not be available.

Table 5.4 shows the assumptions that perform best empirically, which will depend to a great extent on the availability of auxiliary data. Figure 5.3 depicts the decision tree for this scenario.

Whenever use (bp) and (pp) tables of a previous year are available, their difference could be used to estimate official row/column structures of joint TTM and TLS. Using those joint structures, method I proved to be the most appropriate. This result remains unchanged, independent of the availability of IOTs (with or without distinguishing between domestic and imported uses). Interestingly, method I is even preferable to using separate TTM and TLS structures of a previous year (method II), meaning that the errors of the independent estimation of TTM and TLS tend to cumulate instead of cancelling each other out. The weighted relative errors of methods I and II are around 1 %, with some exceptions (Rueda-Cantuche et al. 2018). This conclusion is also independent of the availability of IOTs.

([75]) Further refinements were implemented during the calculations so that the estimated tables were consistent. We did not allow non-zero values in the use (bp) tables wherever there was no transaction in the use (pp). For further details, see Rueda-Cantuche et al. (2018).

([76]) In scenario 3, we need to estimate both TTM and TLS separately since the sum of the two cannot be estimated as a residual against the difference of use (pp) and (bp) tables of the current year.

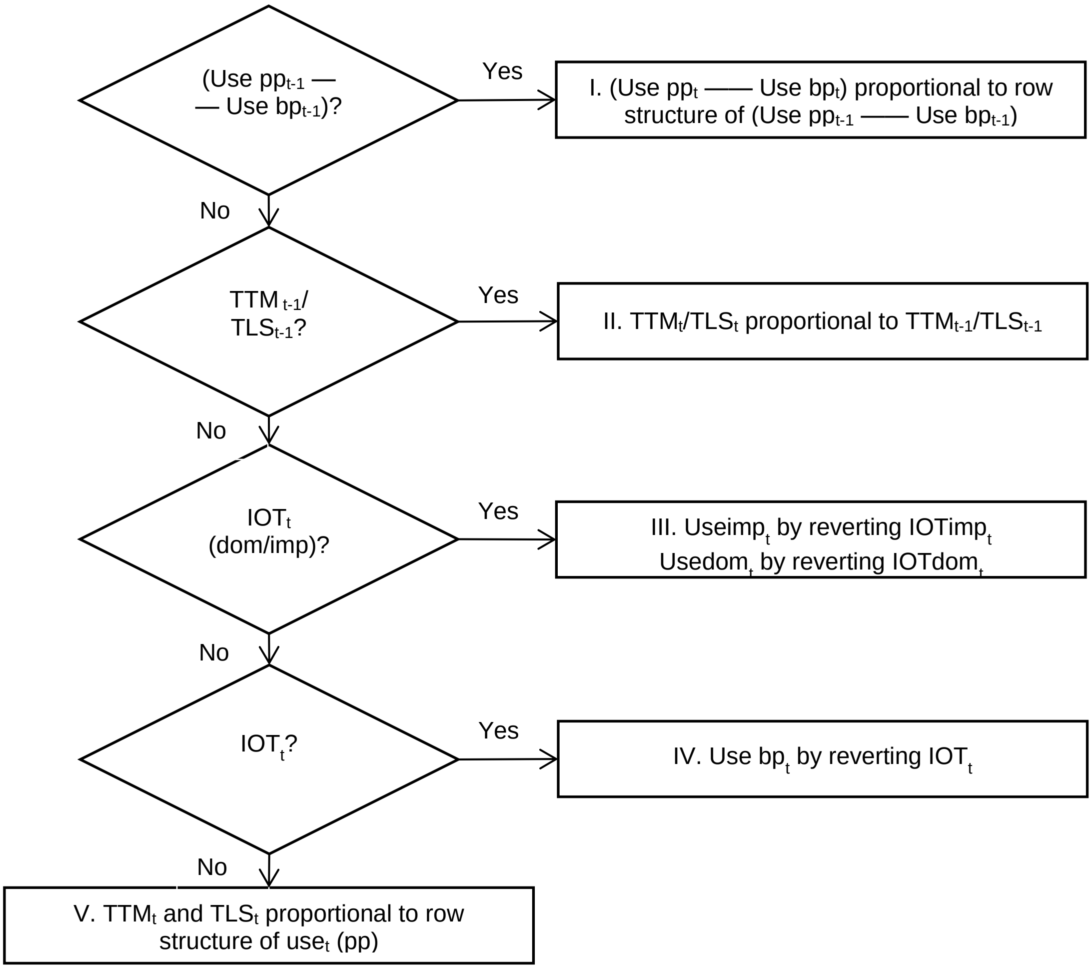
([77]) The results of the method using fixed amounts of TLS to final consumption of households are not commented here due to its poor performance in Rueda-Cantuche et al. (2018).

([78]) This method is equivalent to reversing the IOT of total uses and the IOT of imports and then calculating the domestic use table by difference, as described in scenario 2.

([79]) Input-output tables are derived from supply and use tables by using various assumptions, all of which can also be used for deriving use tables from input-output tables (see Eurostat, 2008, p. 296).

([80]) Exiobase uses this approach extensively.

Figure 5.3: **Decision tree for scenario 3: estimation of use tables at basic prices**



Source: author, based on Rueda-Cantuche et al. (2018).

Conversely, whenever no other information on valuation matrices structure is available (or can be derived) from a previous year, the availability of an IOT for the current year makes a difference in the estimation of a use (bp) table (methods III and IV) by the use of the product technology assumption (product-by-product tables) or fixed industry sales structures (industry-by-industry tables). Methods III and IV are linked to the type of IOT used (product-by-product or industry-by-industry). In the case of product-by-product IOTs the final demand must, by definition, be very well adjusted, if not the same as that of the IOT. Rueda-Cantuche et al. (2018) found that the average weighted errors were around 16 % for intermediate uses and less than 1 % for final demand, with the exception of countries producing industry-by-industry IOT instead of product-by-product IOTs.

It is noteworthy that methods III, IV and V will not lead to an increase in the number of negative elements in the intermediate domestic use table. However, methods I and II bring in a small number of negatives. Generally speaking, all recommended methods would reduce the number of negative elements in final uses, though they are very few (0.52 %).

Table 5.4: Scenario 3 Methods and results

		Availability of previous year/similar country								
		None	IOT	IOT (dom/imp)	TTM TLS	Use (pp) Use (bp) supply	IOT (dom/imp) TTM TLS	IOT (dom/imp) Use (pp) Use (bp) supply	TTM TLS Use (pp) Use (bp) supply	IOT (dom/imp) TTM TLS Use (pp) Use (bp) supply
Availability of IOTs	None	V	V	V	II	I	II	I	I	I
	IOT	IV	IV	IV	II	I	II	I	I	I
	IOT (dom/imp)	III	III	III	II	I	II	I	I	I

Finally, the use of row-wise proportional allocation of the TTM and TLS product totals in the supply table according to the row structures of the use table at purchasers' prices seems to perform well whenever no current IOT is available (method V). This conclusion is independent of the availability of a previous year IOT, with or without a distinction between domestic and import uses. However, this assumption leads to weighted errors of 12-20 %, on average.

5.4 Conclusions

This chapter recaps few non-exhaustive methods recommended for estimating valuation matrices, domestic and import use tables at basic prices and use tables (totals) at basic prices with a selection of auxiliary information in the absence of superior data, which are held by national statistical offices. The recommendations are based on Rueda-Cantuche et al. (2018), who performed an analysis within the EU context because of the availability of homogenous additional data but the analysis could also be done in non-EU countries, provided the same data are available.

The main conclusion is that the use of previous years' tables generally provides the best options in each scenario. This is mainly because they gather detailed country-specific information that is not expected to change in the short term. Our analyses offers other specific lessons with respect to valuation matrices, domestic and imported use tables at basic prices and use tables (totals) at basic prices. These are as follows:

- **Valuation matrices**: it is better to start the calculation with an estimation of matrices of taxes less subsidies on products. Next, the trade and transport margins matrix would be calculated by difference with respect to the (known) difference between use (pp) and use (bp), whenever available. This solution performs better than the other way round.
- **Domestic and imported uses**: the availability of an IOT of imports makes a difference.
- **Use tables (totals) at basic prices**: using the joint structure of the valuation matrices of a previous year is the best option, i.e. difference between the use table at purchasers' prices and the use table at basic prices from a previous year.

In the Figaro project, we have adopted Rueda-Cantuche et al.'s (2018) methodology to estimate missing national use (bp) tables, distinguishing between domestic and import uses. Moreover, given the ESA 2010 transmission programme, we plan to use this methodology more intensively to estimate annual time series of EU IC-SUIOTs in the near future.

6 Balanced view of trade in goods

6.1 Introduction

Trade asymmetry is a well-known fact and there is extensive literature and reports about the causes for those asymmetries (Eurostat, 2018a). National statistical institutes and Eurostat have been working for several years to mitigate trade asymmetries, for example, through workshops on trade asymmetries and, the production of quality reports. Notwithstanding the progress that has been made, trade asymmetries still exist which makes it hard for practitioners and researchers to build macroeconomic models or accurately assess economic relationships between countries. Some initiatives to solve trade asymmetries, from a pragmatic point of view, have been developed, as stated in the literature review presented in Miao and Fortanier (2017). These initiatives may be used to provide balanced estimates of (gross) trade between two countries.

International trade in the EU has an additional complexity compared with the standard issues that may be raised in relation to trade asymmetries, insofar as goods entering or leaving the EU may be simply dispatched or cleared to/from another Member-State. The value of this trade is recorded in the EU's official statistics but the information, while relevant to track the physical movement of goods, may be considered of limited economic interest. As such, there is a need to provide balanced trade estimates separating what is relevant in terms of physical movements and movements of goods from an economic perspective.

QDR methodology addresses this need to understand the nature of balanced trade by combining available data for trade in goods and national accounts into a global, balanced trade data set that is broken down into three categories: quasi-transit trade (Q), domestic trade (D) and re-exports (R). This approach was specifically developed for the Figaro project and will be used for producing a time series of EU-IC-SUIOTs.

QDR methodology is a crucial part of Figaro project since it provides a balanced trade view of exports originating in a reference country which is a fundamental set of information to connect use tables of domestic inputs, the core part of an inter-country input-output table.

This paper will highlight the most important aspects of the QDR methodology and specific examples will be shown for better understanding its potential, but also its limitations and assumptions.

6.2 QDR methodology overview

The QDR methodology was developed specifically to be used in the Figaro project and it is best described sequentially according to the production steps that are used within Eurostat for estimating balanced trade flows between two countries. Figure 6.1 presents a schematic overview of the five steps that compose the full production system. The first two steps do not change or estimate any data whatsoever: these steps simply re-code data and combine different data sets into a unified data structure. They ensure that all trade in goods data received are compliant with the Figaro code lists, for example, variable labels and measurement units. At the end of the first two steps, all of the data sets have been converted/harmonised so they are valued in thousands of euros, have ISO 2-digit country codes for geographical entities and use the harmonised commodity description and coding system (known as the harmonised system, or HS) developed and maintained by the World Customs Organisation.

Figure 6.1: **Trade in goods production system steps in Figaro**

The third step imputes non-allocated trade whenever this is possible. The fourth step solves trade asymmetry issues through a balancing process, while the fifth and final step breaks down these balanced trade flow into quasi-transit trade, domestic trade and re-exports. Steps 3, 4 and 5 are the core of the Figaro system and are explained in more detail in the following sections.

6.3 Non-allocated trade estimation

One reason for non-allocated trade and trade asymmetries is confidentiality: for example, when one country reports its trade with a partner as confidential while the trade partner reports a (non-confidential) value for the same transaction. An alternative reason for non-allocated trade may arise when one EU Member State fails to record its trading partner and hence pronounces the partner as 'country and territory not specified' (Eurostat, 2017a). Both of these examples are part of a more general case: whenever one of the two trade partners is unable to fully specify a transaction there will be a trade asymmetry.

Alphanumeric codes are used in intra- and extra-EU statistics to identify confidentiality or adjusted data and trade for which a breakdown of the results at a detailed level of the product classification is not possible (Eurostat, 2016). Some of these alphanumeric codes are susceptible to cause trade asymmetries as described above, in particular, codes for corrections due to reporting erroneous information (use of the wrong code, a selection of goods for which a simplified declaration applies, estimates of missing data broken down by chapter, or confidential data). The country nomenclature used for EU statistics on international trade in goods foresees miscellaneous codes when a country is not specified, for example, codes for stores and provisions, codes for countries and territories that are not specified in general, or codes for countries and territories that are not specified for commercial or military reasons (Eurostat, 2017b).

In order to mitigate trade asymmetries resulting from data only being available for one of the two trade partners, a non-allocated trade estimation procedure was developed. This procedure is applied to data on exports and imports independently prior to evaluating trade asymmetries. We start by defining **fully specified trade** as the trade for which the product code at HS 6-digit level is not alphanumeric and both the reporting country and trade partner are known. The procedure tries to find plausible HS 6-digit level products or a plausible country for the allocation of the non-specified trade.

6.3.1 Methodology

A trade flow from country *i* to country *j* (T_{ij}) is the value of goods traded between an exporting country *i* and an importing country *j*. There are, in general, two estimates for the same transaction: the exports reported by country *i* and the imports reported by country *j*; the latter are often referred to as mirror exports ([81]). Let (X_{ij}) be an estimate of the $i \rightarrow j$ trade flow based on exports (as reported by

([81]) We assume, for the moment, that both exports and imports are valued free on board (FOB). The methodology to estimate FOB-type imports is described later.

country *i*) and M_{ij} be an estimate of the $i \rightarrow j$ trade flow based on the mirror exports (as reported by country j as imports).

An asymmetry exists whenever $X_{ij} \neq M_{ij}$, in other words, whenever there are two different values for a single flow. The **asymmetry in value** of the $i \rightarrow j$ trade flow is computed by:

(1) $$\Delta_{ij} = M_{ij} - X_{ij}$$

If Δ_{ij} is significantly big and positive, it means that the import partner is declaring a much bigger value of trade than the exporting country, so it is reasonable to use this information to allocate non-specified exports. The non-allocated trade procedure is as follows:

For each HS 6-digit level product:

- Compute Δ_{ij} for each trade flow;
- Define an outlier threshold as

(2) $$\mathrm{h} = max\big(0, q_3 + 1.5(q_3 - q_1)\big)$$

where q_1 and q_3 are the first and third quartiles of Δ_{ij};

- Define significant positive asymmetry $\dot{\Delta}_{ij}$ as:

(3) $$\dot{\Delta}_{ij} = \begin{cases} \Delta_{ij} & , \quad \Delta_{ij} > \mathrm{h} \\ 0 & , \quad otherwise \end{cases}$$

- Distribute non-specified trade proportionally to $\dot{\Delta}_{ij}$ with the constraint that the new imputed value does not exceed Δ_{ij}, in other words, it does not exceed the value of the mirror data.

The imputation of non-specified trade is done sequentially, updating after each step the estimates for exports and imports with the imputed values and re-computing Δ_{ij} and $\dot{\Delta}_{ij}$. The imputation sequence is the following:

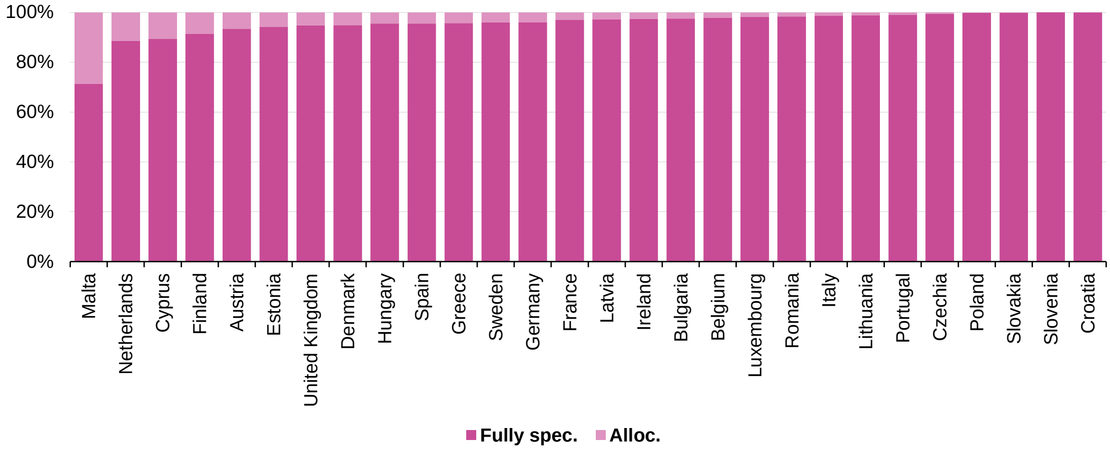
- non-specified EU partner;
- non-specified extra-EU partner;
- non-specified product in EU;
- non-specified product in extra-EU;
- non-specified partner where it is not specified if the partner belongs to the EU or is an extra-EU partner.

6.3.2 Results

The output of this imputation procedure for non-allocated trade may be added to the fully specified trade records provided by countries. The imputed records are identified (flagged) as such, which allows them to be traced back and also allows an analysis of the share of total trade that was directly reported by countries and the share that was imputed using this procedure.

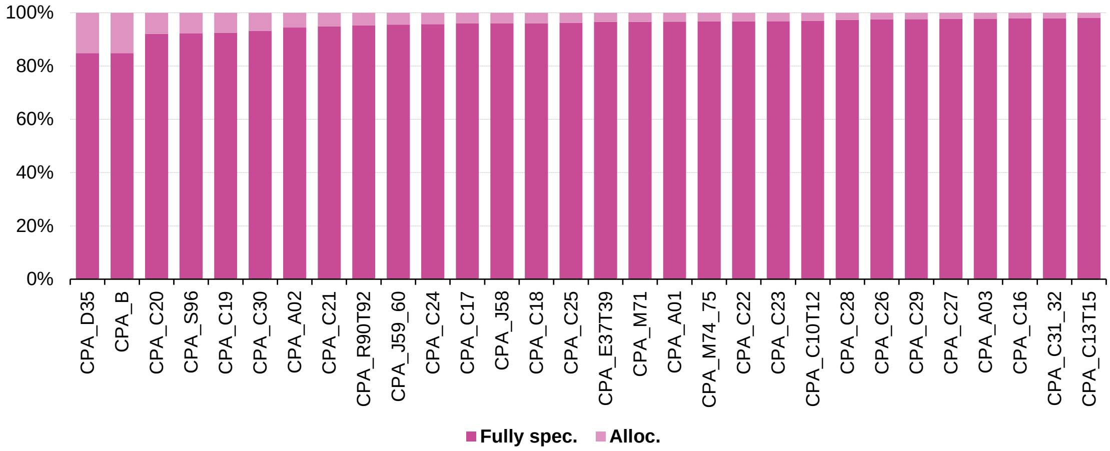
This non-allocated trade procedure was able to allocate EUR 163 billion of exports for 2010 which was equivalent to 4.4% of fully specified exports. The imputation of non-allocated exports ranged from 32 % in Malta, followed by the Netherlands with 13 %, down to 0 % in Poland, Slovenia, Slovakia and Croatia (see Figure 6.2).

Figure 6.2: Fully specified trade and allocated trade, by country



By product, the non-allocated trade procedure led to a re-allocation of exports that ranged from 18 % for electricity, gas, steam and air-conditioning (CPA Division35) and mining and quarrying (CPA Section B) down to 2 % for fish and other fishing products; aquaculture products; support services to fishing (CPA Division 03), textiles, wearing apparel and leather products (CPA Divisions 13 to 15), wood and of products of wood and cork, except furniture; articles of straw and plaiting materials (CPA Division 16), electrical equipment (CPA Division 27) and furniture; other manufactured goods (CPA Divisions 31 and 32), see Figure 6.3.

Figure 6.3: Fully specified trade and allocated trade, by product



6.4 Balanced trade flows

Fortanier (2016) presented a method developed to balance international merchandise trade statistics that built on work done by previous exercises of this kind; he also presented a literature review on the initiatives to balance international trade. This bilateral trade procedure reconciles exports and mirror exports which are supposed to be measuring the same trade flow. The general principle behind the balancing procedure is that if there are two estimates for the same phenomena, and there is no additional information that allows us to choose one over the other, use both of them but take into account how reliable they each are.

Since exports are free on board type (FOB) type values and mirror exports are cost, insurance and freight (CIF) type values, before balancing the two estimates there is a need to convert mirror exports to FOB-type values as well.

6.4.1 CIF/FOB

Exports and imports should have the same valuation before they may be used for balanced trade flows, in other words, they need to be converted so that both are denominated as FOB-type values. To transform mirror exports, which are valued as CIF, to FOB estimates, a method provided by Miao and Fortanier (2017) was adopted. The CIF/FOB data is presented as the share of costs of insurance and transport relative to import values. OECD estimates are available at HS 4-digit level. CIF/FOB estimates for each HS 4-digit heading were used for all HS 6-digit headings nested within an individual HS 4-digit heading. Whenever a specific CIF/FOB ratio was not available, it was imputed using the most detailed information available, for example, if a particular partner was missing, then the median ratio of similar partners was used, if an HS 4-digit level product was not available, then an HS 2-digit level product was used. Before balancing exports and imports, all imports were converted to FOB-type estimates.

6.4.2 Methodology

The aim of this balancing methodology is to estimate for each HS 6-digit level product a FOB-type trade flow, from country *i* to country *j*. As already mentioned, there are, in general, two estimates for each trade flow $i \rightarrow j$, exports X_{ij} as reported by country *i* and mirror exports M_{ij} as reported by country *j*.

The relative asymmetry of the $i \rightarrow j$ trade flow is computed by:

(4)
$$A_{ij} = \frac{|X_{ij} - M_{ij}|}{|X_{ij}| + |M_{ij}|}$$

Let $\mathbf{A} = [A_{ij}]$ be a matrix where each cell is the relative asymmetry of the $i \rightarrow j$ trade flow. The weighted average by row:

(5)
$$\theta_i = \frac{\sum_k A_{ik} X_{ik}}{\sum_k X_{ik}}$$

measures how close the exports reported by country *i* are to the values reported by its trade partners. Similarly, the weighted average by column:

(6)
$$\phi_j = \frac{\sum_k A_{kj} M_{kj}}{\sum_k M_{kj}}$$

measures how close the imports reported by country *j* are to the values reported by its trade partners. In the absence of any reliable information about data quality of either exports and mirror exports, it is reasonable to assume that the balanced trade flow $i \rightarrow j$ is more likely to be closer to exports if θ_i is smaller than ϕ_j, in other words, if the trade partners of country i present a smaller relative asymmetry than the trade partners of country *j*.

To guarantee some stability over time ([82]) of θ_i and ϕ_j, three-year averages are taken instead of annual values. We define **balanced trade flows** as the weighted average between exports and mirror exports, with weights $(1-\bar{\theta}_i)$ and $\left(1-\bar{\phi}_j\right)$:

(7)
$$T_{ij}=\frac{(1-\bar{\theta}_i)\cdot X_{ij}+\left(1-\bar{\phi}_j\right)M_{ij}}{(1-\bar{\theta}_i)+\left(1-\bar{\phi}_j\right)}$$

Equation (5) only applies if exports and mirror exports are both available. When there is just one estimate for a particular flow, for example, only exports are reported then the balanced trade flow equals that estimate.

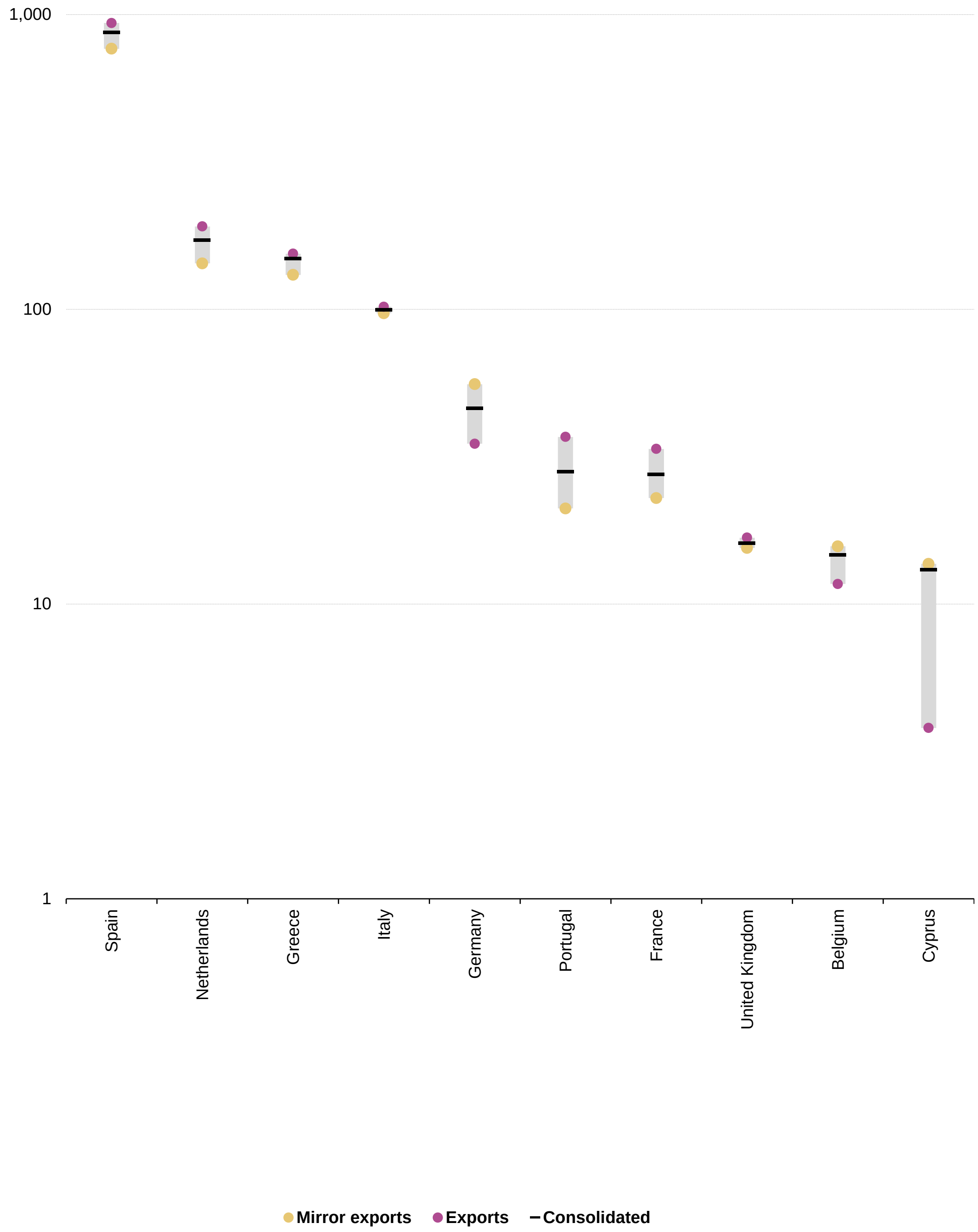
6.4.3 Results

This balancing procedure is applied both to EU international trade in goods statistics (ITGS) and to United Nations Comtrade data sets for all HS 6-digit level products. Figure 6.4 illustrates the balancing of trade for fresh or dried oranges (HS code 080510) for those EU Member States with exports above EUR 10 million (a logarithmic scale was used due to the range of trade volumes across countries).

Cyprus reported exports of fresh or dried oranges that were valued at EUR 3.8 million but its trade partners reported mirror exports valued at EUR 13.7 million (FOB). The balanced flow of EUR 13.3 million is a value that is much closer to the value of mirror exports than it is to the value of exports because the relative asymmetry of exports from Cyprus is significantly greater than the relative asymmetry of its partners' imports. A similar case can be seen for Germany, where balanced trade was closer to the value of mirror exports than it was to the value of exports. By contrast, in Greece and Italy the balanced flow was very close to the value of reported exports. The figure also shows that the higher the level of trade asymmetry the higher the risk that balanced trade deviates significantly from the reported value of exports.

([82]) Our analysis shows that, in particular for smaller values of trade, some trade flows θ_i and ϕ_j show volatility over time. To mitigate this, three-year averages are used (based on the reference year and the two previous years).

Figure 6.4: **Exports, mirror exports and balanced trade for 'fresh or dried oranges'**
(million EUR in log)



6.5 QDR

Eurostat (2018b) defines the QDR methodology as making use of the following inputs for the reference year (or the year closest to the reference year):

- the balanced view of trade derived from ITGS (which follows the community principle for EU Member States, namely to include quasi-transit trade);
- the balanced view of trade from the UN (which for EU Member States follows the national principle of trade ([83]);
- trade margins from the supply table (T1500);
- exports from domestic use tables (T1611)
- exports from import use tables (T1612).

With these inputs, the balanced view of trade according to the community principle will be broken down into how much gross trade is quasi-transit trade (Q), how much is domestic trade (D) and how much is re-exports (R); the latter may, in turn, be split into the value of the exported good (G) and the margin associated with re-exporting (M).

Quasi-transit trade is an operation when goods are imported into one EU Member State from an economy outside the EU (in other words from a non-member country) and subsequently dispatched to another Member State or when goods exported from one Member State to a non-member country are cleared for export in another Member State.

Re-export is an operation when foreign goods (goods produced in other economies and previously imported) are exported with no substantial transformation from the condition in which they were previously imported. While quasi-transit trade has no economic relevance for the construction of inter-country supply, use and input-output tables, re-exports are relevant, since there is, in general, a trade margin associated with re-exporting. Therefore it is important to distinguish quasi-transit trade from re-exports and in the case of a re-export to estimate the value of the good exported as well as the value of the associated trade margin.

6.5.1 Methodology

International trade in good statistics (ITGS) cover goods in quasi-transit, in other words, goods that are brought into or taken out of an EU Member State to be declared there as imports/exports for customs or tax purposes without that Member State having acquired the ownership of the goods (Eurostat, 2016). However, some Member States exclude quasi-transit trade when publishing their own results, to enhance the economic relevance of their national figures). In addition, some Member States exclude quasi-transit trade when sending their figures to the United Nations (UN) Comtrade database. While ITGS follows the **community principle** (to include quasi-transit trade), the UN Comtrade database follows the **national principle** (excludes quasi-transit trade).

For a particular EU Member State and HS 6-digit product, let

- X_c be (gross) exports according to the **community principle**, in other words, from ITGS;
- X_N be (gross) exports according to the **national principle**, in other words, from UN Comtrade;
- X_D be the **domestic component of gross exports**, in other words, the country of origin of that good is the exporter country;

([83]) Although the UN Comtrade guidelines specifically request use of the national principle, some EU Member States are unable to provide data according to the requested principle for some products, in particular, those Member States that are unable to provide trade data for the country of consignment and the country of origin; in such cases the data reported follow the community principle.

- X_R be the **re-exports component of gross exports**;
- X_Q be the **quasi-transit trade component of gross exports**.

Let as well M represent mirror exports of each indicator mentioned above, in other words, M_c, M_N, M_D, M_R and M_Q.

What differentiates the community principle from the national principle is the fact that the latter contains quasi-transit trade. Therefore, the estimator of X_Q is given by:

(8) $$\hat{X}_Q = X_C - X_N$$

The only information about the domestic component of trade is given by the partner country when it declares that the country of origin is the same as the country of consignment, in other words, a country reports that it has imported a good from a country which happens to be the origin for that good. The domestic component of mirror exports (M_D) is estimated by the total imports for which the country of consignment and the country of origin are the same. Then, the estimator for the domestic component of trade is given by:

(9) $$\hat{X}_D = \frac{M_D}{M_C} X_C$$

The estimator of re-exports is taken as the difference between exports according to the national principle and the domestic component of exports, in other words:

(10) $$\hat{X}_R = X_N - \hat{X}_D = X_N - \frac{M_D}{M_C} X_C$$

6.5.2 Consistency between data sources

Since there are two different data sources used to provide information for the indicators described above, there might be cases whereby both data sources provide inconsistent figures which may lead to negative estimates of trade, this may be particularly true for X_N which is taken from the UN Comtrade database (while all other indicators are sourced from ITGS). As such, the first thing to do is to identify and correct any data inconsistencies.

Inconsistent data can produce negative estimates for $\hat{X}_Q$ and $\hat{X}_R$ ($\hat{X}_D$ is always positive). Solving:

(11) $$\begin{cases} \hat{X}_Q > 0 \\ \hat{X}_R > 0 \end{cases}$$

we get the following constraint:

(12) $$\frac{M_D}{M_C} X_C \leq X_N \leq X_C$$

This means that as long as exports according to the national principle are greater than or equal to the domestic component of gross exports and less than or equal to gross exports according to the community principle, then the above estimates will be consistent. In fact, exports according to the national principle will be equal to domestic component when re-exports are 0 and they will be equal to exports according to the community principle when quasi-transit trade is 0.

Whenever an inconsistency was identified, X_N was changed to its lower or upper limit defined by equation (12).

6.5.3 Correction of bias in domestic estimates

Estimates of domestic trade are based on information relating to the country of consignment/country of origin, as provided by partner countries. Unfortunately, not all countries provide this information. Taking into account that in the absence of information on the country of origin, the most reasonable and practical estimate is to assume that the country of origin is the same as the country of consignment, then the estimate of the domestic trade component given by equation (9) is biased (upwards). To correct for this upward bias, national accounts data are used to adjust the initial estimates of the domestic trade component. Eurostat table T1611 — **use table for domestic production** — provides information on exports that were produced in a country while Eurostat table T1610 — **use tables at basic prices** — provides information for total exports (see Eurostat, 2018b). The ratio of domestically produced exports to total exports (T1611/T1610) is an estimate for the share of domestic exports in total exports.

Products in tables T1610 and T1611 are classified according to the CPA classification and at a more aggregated level than HS 6-digit level. Let d_i be estimates of domestic trade obtained from equation (9) for every i HS 6-digit level product within a CPA heading and let d be the domestic exports ratio taken from national accounts. Then, d_i were adjusted using the RAS method of data reconciliation, where the initial matrix has two columns (domestic/re-exports) and as many rows as the number of HS 6-digit level products within each CPA heading. Preliminary estimates are then changed by the RAS method so that the totals by column are consistent with d (taken from supply, use and input-output tables (SUIOT statistics) and the totals by row are equal to the estimated exports from ITGS.

6.5.4 Quasi-transit and re-export partners

Partners are taken from the distribution of original imports for which the country of origin is different to the country of consignment. Quasi-transit trade, by definition, applies only when the destination and consignment countries are in the EU and the country of origin is outside the EU. Re-exports apply more generally. When the country of origin is the same as the country of destination there is a re-import. Cases of re-imports were not taken into account due to the very small value of this particular type of trade.

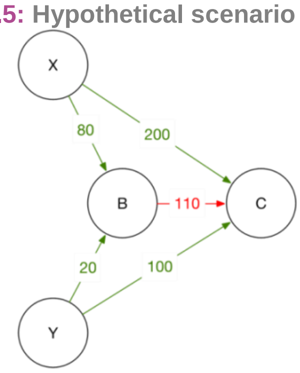
6.5.5 Triangular trade and re-export margins

The final step of the QDR methodology is to take into account the gross trade flows (X_c) that are split into quasi-transit trade (X_Q), domestic trade (X_D) and re-exports (X_R), as well as the estimated country of origin in the case of quasi-transit trade and re-exports, and to identify and correct triangular trade, in other words, when a country of origin ships a good to a country of consignment which is then shipped to a country of destination.

The best way to explain how such triangular trade was corrected is by using a small theoretical example.

Let us assume that country X and country Y export one type of good, directly, to country C, with the value of EUR 200 and EUR 100, respectively. Let us also assume that country B buys EUR 80 of the same type of good from country X and EUR 20 from country Y, adds a re-export margin of 10 % and then re-exports those goods to country C at a value of EUR 88 + EUR 22 = EUR 110.

Figure 6.5: Hypothetical scenario of triangular trade



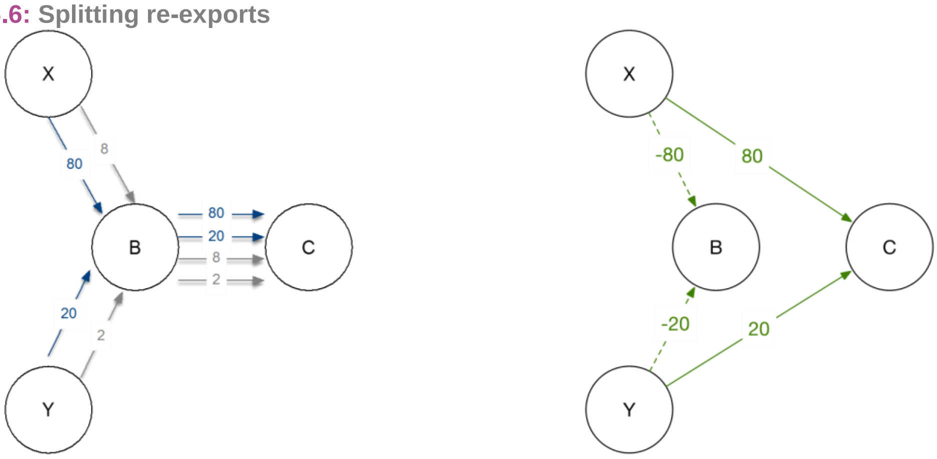
TRADE_TYPE	ORIGIN	CONSIGN	DESTIN	OBS_VALUE
?	X	X	C	200
?	Y	Y	C	100
?	X	X	B	80
?	Y	Y	C	20
?	X	B	C	88
?	Y	B	C	22
				510

The table presented in Figure 6.5 presents the information that is usually available. Re-exports are marked in red and are usually reported by the country of destination (country C) which declared importing goods from country B, whereas the goods initially came from different countries of origin (countries X and Y).

The first assumption one needs to make is that the value paid by country C to country B encapsulates the value of the good and the value of the re-export margin. Another assumption that needs to be made — due to a lack of more detailed data — is that trade margins for re-exports are similar (independent of the country of origin), in other words, in this case the same margin of 10 % applies to the re-exports from both country X and country Y.

Under these assumptions, it is possible to split the value of re-exports (EUR 110) between the two initial countries of origin and by the re-export margin: the EUR 88 from country X, becomes EUR 80 goods + EUR 8 margin and the EUR 22 from country Y, becomes EUR 20 goods + EUR 2 margin. In addition, the value of goods that country B imports from countries X and Y for the sole purpose of re-exporting can now be connected directly between the initial country of origin and their final destination. This is done by simply imputing the (additional) EUR 80 and EUR 20 values between the country of origin and destination, while removing those same values between the country of origin and the country of consignment (represented as negative flows), as shown in Figure 6.6:

Figure 6.6: Splitting re-exports



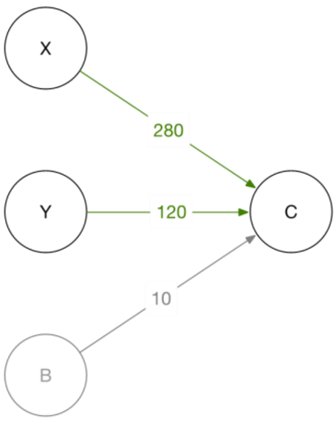
The sum of all transactions presented in Figure 6.6 makes the exact total value of the re-exports and so the re-export records presented in red in the table of Figure 6.5 can now be replaced by the transactions of Figure 6.6**.** without altering the total value of trade (see Table 6.1).

By aggregating all records in Table 6.1 we end up with the relevant information that we were looking to deduce, as presented in Figure 6.7**.**. Country X exports EUR 280 of goods that end up in country C, country Y exports EUR 120 of goods that end up in country C, and together these form the full value of goods involved. However, since country B was involved in some transactions as a re-exporting country, it is also possible to identify EUR 10 that country B has charged for the transactions it was involved in (EUR 8 with respect to re-exports from country X and EUR 2 with respect to re-exports from country Y). In addition, the triangular trade transactions and respective countries involved are kept within the table (as shown in blue), so it is also possible to reconstruct the original reported transactions. A final remark: the value of triangular trade flows plus the trade that has been of interest (as described in this paper) equals the initial value of total trade. As such, this method can also be seen as a way to remove the value of trade that was double counted due to triangular trade from the total (raw) value of trade.

Table 6.1: Complete set of transactions, in table form

TRADE_TYPE	ORIGIN	CONSIGN	DESTIN	OBS_VALUE
D	X	X	C	200
D	Y	Y	C	100
D	X	X	B	80
D	Y	Y	C	20
M	X	B	C	8
M	Y	B	C	2
R	X	B	C	80
R	Y	B	C	20
D	X	X	C	80
D	Y	Y	C	20
D	X	X	B	-80
D	Y	Y	B	-20
				510

Figure 6.7: Trade transactions of interest



TRADE_TYPE	ORIGIN	CONSIGN	DESTIN	OBS_VALUE
D	X	X	C	280
D	Y	Y	C	120
M	X	B	C	8
M	Y	B	C	2
				410

TRADE_TYPE	ORIGIN	CONSIGN	DESTIN	OBS_VALUE
R	X	B	C	80
R	Y	B	C	20
				100

6.5.6 Results

After running QDR methodology for all HS 6-digit level products, a reference data set for trade statistics was built which contains a balanced view broken down into quasi-transit trade, domestic trade and re-exports. Table 6.2 shows the first five records (out of 11.8 million) for 2010. This extensive data set contains information on trade for 176 countries and the rest of the world for about 10 thousand products.

Table 6.2: Reference trade data for Figaro at HS6 level

PROD_STAGE	TIME_PERIOD	TRADE_TYPE	HS6	ORIGIN	CONSIGN	DESTIN	OBS_VALUE	UNIT_MEASURE	UNIT_MULT	DECIMALS	OBS_STATUS	CONF_STATUS
R	2010	D	010110	ES	ES	AD	0.7	EUR	3	1	E	N
R	2010	D	010110	AR	AR	AE	30.2	EUR	3	1	E	N
R	2010	D	010110	AT	AT	AE	5.1	EUR	3	1	E	N
R	2010	D	010110	AU	AU	AE	1657.9	EUR	3	1	E	N
R	2010	D	010110	CA	CA	AE	626.1	EUR	3	1	E	N
...	...	...	...	...	...	...	...	...	...	...	...	...

The QDR methodology is able to provide information for several indicators but probably the most important is that of domestic exports, in other words, exports between a country of origin and a country of destination that originated in the economy of the exporting country. This means that QDR is able to provide a breakdown by partner of the exports vector in the use table of domestic inputs (T1611) ([84]).

([84]) Accounting for the fact that T1611 is valued here at basic prices while trade statistics are valued at purchasers' prices.

As an example, the world trade of motor vehicles, trailers and semi-trailers (CPA Division 29) in 2010 was estimated to be:

Table 6.3: Global trade of motor vehicles, trailers and semi-trailers
(billion EUR)

	EU-28	United States	FIGX
EU-28	240.3	26.7	108.7
United States	6.1	0.0	66.6
FIGX	43.7	124.1	175.9

where FIGX is the aggregate of all countries except the EU's Member States and the United States.

The two biggest exporters of motor vehicles, trailers and semi-trailers in the EU-28 are Germany and France. Table 6.4 presents their domestic exports of motor vehicles, trailers and semi-trailers by major trade partner:

Table 6.4: Domestic exports of motor vehicles, trailers and semi-trailers for Germany and France
(billion EUR)

B€	AT	BE	BG	CY	CZ	DE	DK	EE	ES	FI	FR	GB	GR	HR	HU
DE	3.0	5.1	0.1	0.1	2.4	-	1.2	0.1	6.1	0.7	10.5	14.7	0.6	0.2	1.7
FR	0.6	3.7	0.0	0.0	0.5	6.0	0.3	0.0	5.5	0.1	-	3.5	0.1	0.1	0.2

B€	IE	IT	LT	LU	LV	MT	NL	PL	PT	RO	SE	SI	SK	US	FIGX
DE	0.4	8.8	0.1	0.6	0.1	0.0	3.2	3.4	2.1	0.5	3.7	0.2	1.4	17.5	55.1
FR	0.1	3.5	0.0	0.1	0.0	0.0	0.8	0.7	0.6	0.4	0.6	0.4	0.5	0.6	9.0

As a concluding remark, QDR provides a reasonable and efficient way to break down domestic exports by partner, which is crucial for building an inter-country input-output table. In addition, there are other sorts of indicators that can be derived from this new data set of balanced trade broken down by quasi-transit trade, domestic trade and re-exports that are useful for other types of analysis, for example, analysing re-export margins by country, physical movements of trade, or estimates of quasi-transit trade.

6.6 Future work

It is very hard, if indeed possible, to find a benchmark data set to evaluate the methodology presented in this paper, so it becomes difficult to make a proper sensitivity analysis for the results of alternative methodological choices. Nevertheless, the follow up of project Figaro started in 2018 and is expected to continue until at least 2020. During this period, longer time series for international trade in goods will become available, and it is foreseen to test the robustness of the methodological choices described above across time. Furthermore, there are plans to analyse and develop a methodology to detect/correct product misclassification at HS 6-digit level. Notwithstanding the work that is still ahead, the methodology thus far is an important breakthrough in providing balanced trade estimates.

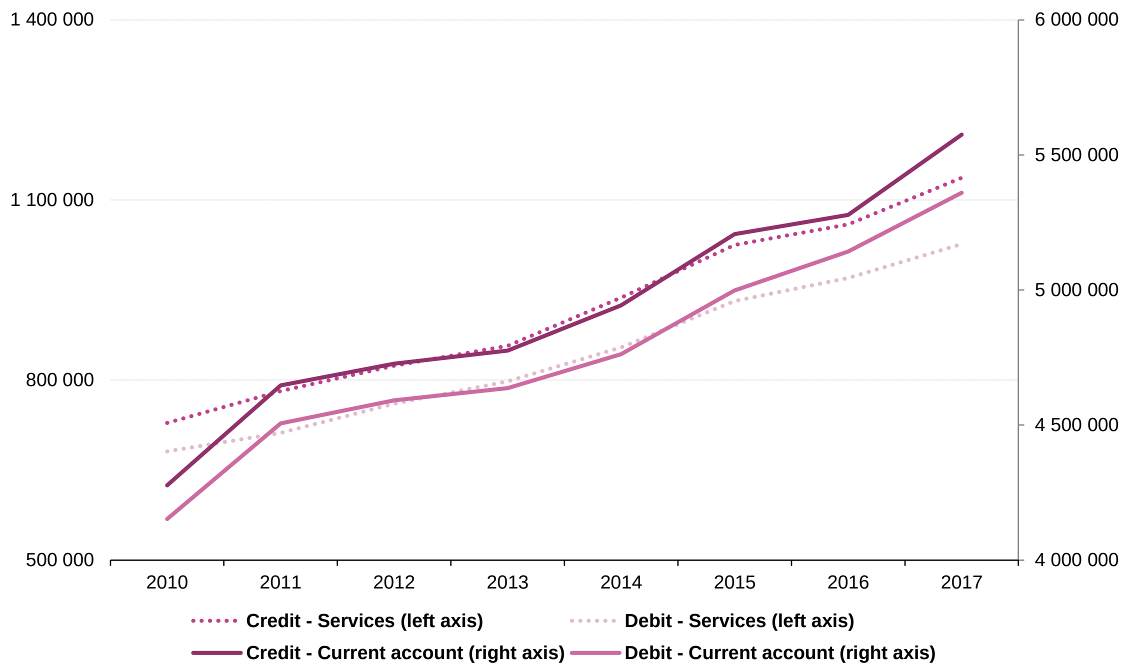
7 Balanced view of trade in services

7.1 Introduction

Trade asymmetries are also an important issue for services trade statistics. This is despite the substantial effort currently being done at international level to ensure that trade statisticians use the same concepts and definitions agreed on a set of methodological guidelines and standards. At EU level, balance of payments statisticians and services trade statisticians follow up regularly trade asymmetries and inform EU Member States accordingly.

As shown in Figure 7.1, intra-EU trade asymmetries remained relatively stable between 2010 and 2017, both for the current and the services accounts ([85]). However, the absolute asymmetry in the current account increased in 2015, reaching EUR 208 billion and 2 % of the sum of credits and debits while in the services account asymmetries reached 4.8 % in 2015, almost doubling that of 2010.

Figure 7.1: Asymmetries at EU level
(million EUR)



([85]) The current account is composed of goods and services accounts.

Source: Eurostat, bop_eu6_q

In collaboration with the Member States and partner countries, Eurostat follows up on the highest asymmetries on a regular basis ([86]). Workshops, similar to the OECD bilateral meetings, have been organised at Eurostat level to give countries the opportunity to discuss the asymmetries. The results of these meetings certainly help to reduce some of the asymmetries observed when compiling the Figaro tables.

One of the main inputs for compiling an inter-country supply, use and input-output table is a balanced view of trade across countries. This relies to a great extent on balance of payments and international trade in services statistics. The following sections describe the process of compiling a balanced view of trade in services.

The process identifies several steps to impute trade in services data and to obtain a fully consistent set of bilateral trade data before balancing the asymmetries in an automated way. The final stage converts the resulting balanced view of trade from EBOPS categories to CPA categories.

7.2 Fully consistent trade data set

Starting from the original international trade in services statistics (ITSS) dataset, different stages are necessary in order to compile a full dataset of credit/debit or export/import values. After each step, some new values are generated and/or others updated, being them part of the input data for the subsequent steps. These values also include trade between countries and geographical zones such as Asia, EU, etc. However, those are not included in the compilation of the Figaro tables to avoid double counting. The steps are listed below.

- Eliminating specific negative values
- Computing services aggregates
- Consistency imputations
- Allocation of non-allocated services trade
- Time series interpolation
- Models estimates
- Manual imputations
- Allocation of non-allocated trade partner
- Consistency imputations (for totals and sub-totals)
- Top-down benchmark
- Balance of payments consistency
- Final benchmark

7.2.1 Eliminating specific negative values

In the original ITSS dataset some transactions can seldom be recorded with negative values. For some items of the hierarchical structure of the EBOPS categories this is an admissible issue. These admissible items are:

- **SF** insurance (due to high claims) and sub-items SF1 to SF4;
- **SG** financial services and sub-items SG1 and SG2;

([86]) See the Balance of Payments working group meeting documents and asymmetry reports.

- **SK2** personal, cultural, and recreational services other than audio-visual, in particular **SK23** (e.g. recreational services include gambling);
- **SL1** embassies;
- **SJ3** technical, trade-related and other business services, in particular **SJ34** (e.g. trade-related services);
- **SA** manufacturing services.

Keeping those negative values in the process of imputation and rescaling would lead to propagating those negatives up and down the hierarchical structure. Hence, a process for purging such negative transactions is carried out in the first step with the aim to eliminate them, if they are considered non-admissible. First, it is important to mention that many of these negative observations are very small and meaningless. Moreover, we find that in 2010 and 2011 negatives are abundant mainly due to the data conversion from BPM5 to BPM6.

Our goal at this stage is not to remove all the negative values but only those that are inconsistent or meaningless. In general, all the small negative observed values (i.e. between -1 and 0) are set to zero. Besides, a comprehensive set of rules is created to identify all the unusual observations in order to decide whether they should be set to zero or maintained in the data set.

Among these rules, we consider the hierarchical structure of the dataset in EBOPS categories or items. We first evaluate the integrity of the negative values; that is, whenever there is a negative value either in the total of an item or in a sub-item and the sum of the corresponding sub-items does not match the item total value. In the former case, we set the total (negative) value to "NA (non-observable)" – it will be recalculated in a later stage – and in the latter case we set the negative value to zero. We also account for the propagation of these negatives in the upper levels of the hierarchical structure by setting them to zero as well, if necessary.

Regardless of their size, we also set other negatives to zero if: (i) they have a negligible weight in the total S category (total services) – below 5 % – and they are non-admissible; and (ii) in other unusual situations such as when negative and positive sub-items lead to a total item sum equal to zero.

For the year 2010, EUR -202 million on the credit side and EUR -291 million on the debit side were set to zero. This corresponds to a total of 2 480 transactions (see Table 7.1).

Table 7.1: Negative values set at zero

	Credit	Debit
Total amount put to zero (million euros)	-202	-291
of which input values greater than 1 (in absolute term)	-47	-181
of which input values are less than 1	-155	-111
Nb of transactions	1235	1255
of which item SN	808	798

Values corresponding to the SN category (non-allocated) are given a special treatment when their observed values are negative or not available. The value of SN is set at zero in the following cases: (i) SN accounts for less than 5 % of the total services S; (ii) the difference between total services S and the sum of SA to SL is less than 3 units in absolute value; (iii) the sum of SA to SL is a non-negative value and both S and SN are not observed; (iv) both total services S and the sum of the two-letter SA to SL is equal to 0; and (v) SN is not available, the sum of the two-letter SA to SL is larger than the observed value of total services S and the resulting negative item SN contributes for less than 10 % of the total services S.

7.2.2 Computing services aggregates

After eliminating the specific negative values as described in the previous section, all totals and subtotals are now replaced by the sum of its sub-items to ensure consistency of the dataset. The sum is done in all circumstances. This is done sequentially and bottom-up within the hierarchical classification, starting with the highest level of disaggregation (six-letter level) and summing up in ascending order.

Changes to the values are extremely small: for total services, credit and debit of the EU Member States to the partner country vary just 0.03 %. At country level, the most significant changes appear in Latvia and Slovenia (see Table 7.2).

Table 7.2: Changes with computation of item aggregates, 2010
(million EUR)

Country	Flow	input data	Compute aggregates	Change
Latvia	**Credit**	1,203	1,173	-2%
Slovenia	**Credit**	1,424	1,387	-3%
Latvia	**Debit**	514	488	-5%
Slovenia	**Debit**	982	962	-2%

7.2.3 Consistency imputations

Imputations based on the hierarchical structure of items have been done for those cases where, having the total item value available, there was only one sub-item missing (or non-available). This consistency imputation rule was done for all the categories in the hierarchical structure. The imputations were carried out using a sequential top-down approach, starting with imputations at the highest level of the hierarchy (two-letter level) and descending afterwards, to ensure the largest number of imputations. Table 7.3 illustrates the results for two examples.

Table 7.3: Imputations of services SG and SN, 2010

Services	Flow	Nb of transactions	Trade value imputed
SG2	**Debit**	3,418.0	8,850.6
SG2	**Credit**	3,203.0	14,437.9
SN	**Debit**	1,990.0	343.3
SN	**Credit**	1,745.0	222.9

7.2.4 Allocation of non-allocated services trade

The allocation of non-allocated trade (item SN) is done by comparing the sum of the services SA to SL with the total services S for each combination (reference area, partner country and type of flow — credit/debit). Mismatches generally come from item SN (unallocated trade).

The process is the following:

1. The difference between S and $\sum_{x=A}^{x=L} Sx$ is evaluated: $\Delta = S - \sum_{x=A}^{x=L} Sx$

2. If the difference is smaller than EUR 3 million ($\Delta < 3$), then the value of total services S is set to the sum of the items: $\bar{S} = \sum_{x=A}^{x=L} Sx$, and SN set to zero, $\overline{SN} = 0$

3. If the difference is equal or bigger than EUR 3 million ($\Delta \geq 3$), then each item Sx is calibrated to match total services S:

$$\forall\, x = A \text{ to } L, \qquad \overline{Sx} = Sx * \left(1 + \frac{\Delta}{\bar{S}}\right)$$

This allocation will be further analysed due to possible negative SN values needed to allocate (a negative Δ was observed for a few cases).

Table 7.4 presents an example of how the first four steps work. It presents an example of the credits for a reference area X and partner country Y. For the sake of brevity, displayed data include disaggregation up to three-letter levels when data are relevant for the example. Input data are displayed in the first column. We firstly remove some negligible negative flows in SA and SI categories that were reported. In a second step, item totals are recalculated following a bottom-up approach when all sub-items are available, thus leading to changes in S, SI, SJ and SK items. Next, the missing SG2 value can be estimated by difference with respect to the SG total value. Lastly, the amount of non-allocated services (SN) is distributed among all the categories proportionally.

Table 7.4: Example of the export trade of Country X to Country Y
(million EUR)

Code	Input data	Negative annihilation	Computing aggregates	Single Child Imputation	SN allocation
S	481.0	481.0	484.0	484.0	484.0
SA	-1.0	0.0	0.0	0.0	0.0
SB	8.0	8.0	8.0	8.0	8.1
SC	113.0	113.0	113.0	113.0	113.9
SD	32.0	32.0	32.0	32.0	32.3
SE	24.0	24.0	24.0	24.0	24.2
SF	19.0	19.0	19.0	19.0	19.2
SG	23.0	23.0	23.0	23.0	23.2
SG1	20.0	20.0	20.0	20.0	20.2
SG2	N.A.	N.A.	N.A	3.0	3.0
SH	9.0	9.0	9.0	9.0	9.1
SI	57.0	57.0	58.0	58.0	58.5
SI1	-1.0	0.0	0.0	0.0	0.0
SI2	23.0	23.0	23.0	23.0	23.2
SI3	35.0	35.0	35.0	35.0	35.3
SJ	N.A.	N.A.	189.0	189.0	190.6
SJ1	125.0	125.0	125.0	125.0	126.0
SJ2	42.0	42.0	42.0	42.0	42.4
SJ3	22.0	22.0	22.0	22.0	22.2
SK	4.0	4.0	5.0	5.0	5.0
SK1	2.0	2.0	2.0	2.0	2.0
SK2	3.0	3.0	3.0	3.0	3.0
SN	4.0	4.0	4.0	4.0	0.0

7.2.5 Time series interpolation

We found that we had to make interpolations of missing services trade data for Estonia and Germany. Data for services SA and SB were systematically missing for Estonia in 2012. Even though that year is not relevant for the 2010 Figaro tables, a linear interpolation was carried out to fill those data gaps. By using moving averages, we have followed the OECD's (2016) interpolation approach, which is used by the OECD for the estimation of a balanced view of services trade.

Countries may report only credits and debits with the partner world for some services in the initial years, providing a more detailed partner breakdown only for the latest years of the time series. This is the case of Germany for services SE and its disaggregation into SE1 and SE2, where the geographical breakdown is only provided for 2014. In this situation, a geographical interpolation for 2010-2013 has been carried out according to the existing geographical distribution of trade for 2014 in these services categories. Results from these interpolations are compared in a later step, with existing information coming from the balance of payments (BoP) statistics. If this information were available, BoP data would eventually be used instead of interpolated data. The follow-up project of Figaro ("Figaro Act I") will keep working on improving the interpolations methods used.

7.2.6 Model estimates

Some services are part of a voluntary data transmission and only a few countries report information for these categories. Since these data are needed to ensure a conversion from EBOPS categories to the CPA product classification, model-based (gravity models) estimates were computed for:

- SD1 to SD5: sub-items for travel;
- SH1 to SH3, SH41 and SH42: sub-items of charges for the use of intellectual property, not included elsewhere;
- SK11 and SK12: sub-items of audio-visual and related services.

The process closely follows the OECD's approach described in documents such as 'Towards a global matrix of trade in services statistics' ([87]) and 'The OECD-WTO balanced trade in services database' ([88]).

Estimations are made for the years 2010 to 2015, with "reference areas" including each EU Member State. In addition to the EU Member States, "counterpart areas" were available for the United States and for other countries from among the rest of the world. Based on data available, models were used to predict all the non-reported flows for all possible combinations between reporter and partner countries, and for the years 2010-2015. It would have been desirable to have higher geographical breakdown of the countries among the rest of the world by the EU countries so as to increase the size of the available sample.

The estimations include the 28 EU Member States, US and the rest of the world for both exports and imports. The rest of the world values as reporters are all estimated on a bilateral basis first, before being aggregated in a rest of the world area.

Lastly, to integrate the results of our estimations into the global database, the predicted values were transformed into shares in categories (SD, SH and SK1) and then rescaled to the reported values of these categories whenever available.

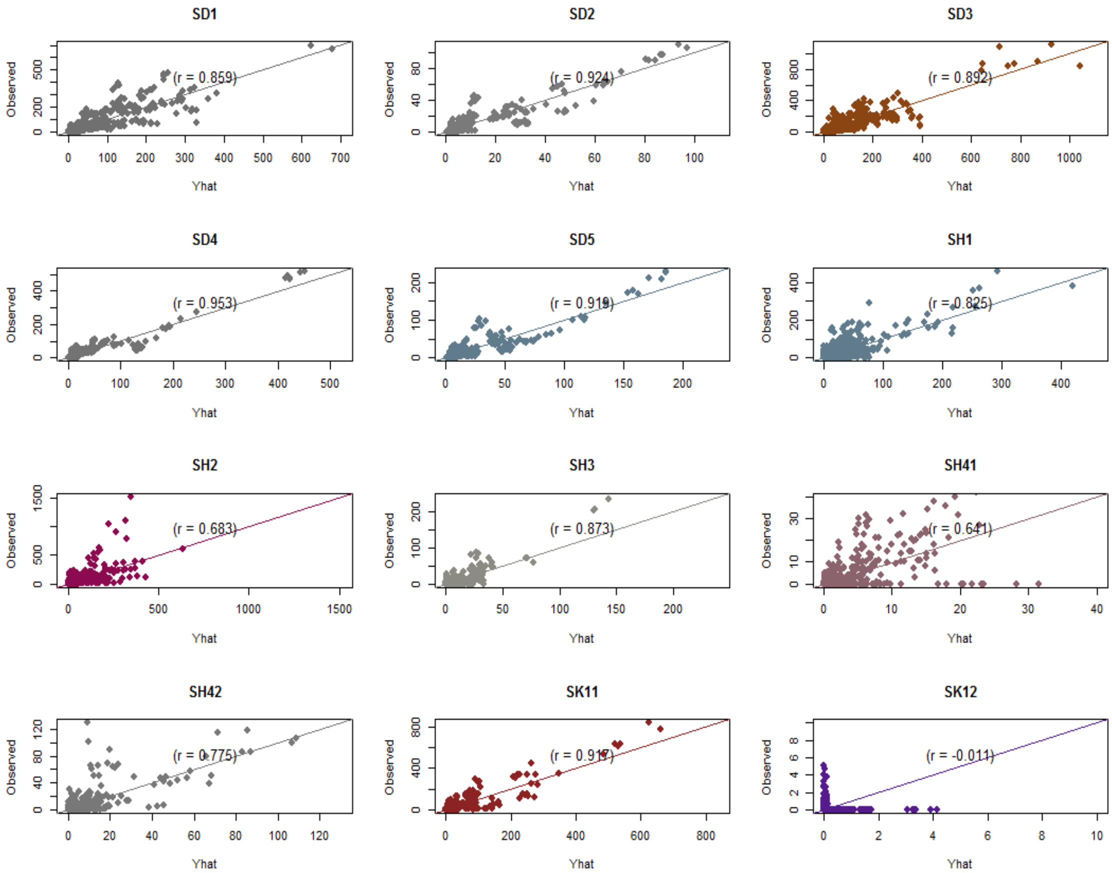
The following set of graphs (in Figure 7.2) present the relationship between (non-adjusted) predictions and observed values including coefficients of correlation. It gives some insight about how good the models used fitted the observed data.

In the next Figaro project, these models will be re-estimated using new updated information for 2010-2016. More data will be available by then. Also, we would allocate non-allocated trade by partner at an earlier stage to benefit from more data availability and/or imputations that would have been done on the geographical dimension and that were not considered here by now. This would increase the sample size, especially for the rest of the world areas, and would improve the quality of these model-based estimates.

([87]) OECD (2016) 'Towards a global matrix of trade in services statistics'. Unclassified OECD document STD/CSSP/WPTGS(2016).

([88]) OECD (2017) 'The OECD-WTO balanced trade in services database'. Unclassified OECD document STD/CSSP/WPTGS(2017)4.

Figure 7.2: Prediction and observed values for some services categories



7.2.7 Manual imputations

In 2016 and 2017 Eurostat organised three workshops on asymmetries in services and balance of payments. Countries were given the opportunity to hold bilateral meetings with Eurostat to discuss some of the biggest asymmetries. Exchange of information on the compilation of services data proved to be very useful for compilers and for Eurostat statisticians.

A hundred flows were corrected by countries to reduce the asymmetries. The flows relate to year 2014 or 2015. The same correction was applied backwards up to 2010.

However, when trade flows are manually changed at a more detailed level of the EBOPS classification (for example SC3C2 Freight transport on road) the upper categories were not examined (for example SC3C, SC3, SC). Therefore, many of the manual corrections will be modified again later on during the top-down benchmark step (explained below).

Services SC, SI21 (computer software) and SJ33 (operating leasing services) were manually corrected for eight countries. The impact is small compared to total services. However, identifying for each country the largest asymmetries is an important step towards better data quality.

Table 7.5: Manual corrections for year 2010 in services
(million EUR)

	Credit input	Manual corrections	Debit input	Manual corrections
Austria			284.0	629.0
Czechia	121.6	76.0	4.9	30.0
Estonia	87.8	270.2	36.8	20.1
Finland			109.2	130.0
Greece			69.1	45.0
Hungary	97.4	120.1	30.5	50.0
Latvia	4.0	20.0	2.0	30.0
Romania	68.8	50.0	53.4	120.0

7.2.8 Allocation of non-allocated trade partner

In services trade data, the partner country may not be allocated: it refers to code B09, which indicated EU as a partner zone, but with no further detail. The value of trade with this partner needs to be reallocated to EU Member States. For trade in services statistics, there is no possibility to have mirror flows for partners outside the European Union. Therefore the reallocation concentrates only on EU partners.

Only five countries show input trade flows with an unallocated partner country: Bulgaria, Spain, France, Cyprus and Sweden. Moreover, the corresponding values to be allocated are relative small. Table 7.6 sums up the trade amount for the three services:

Table 7.6: Trade with non-allocated EU partner, year 2010
(million EUR)

Country	Credit	Debit
Bulgaria	3.0	0.7
Spain	270.0	2,289.0
France		11.0
Cyprus	35.0	260.0
Sweden	2,549.9	7,405.8

The methodology applied here builds upon the methodology used to allocate non-allocated trade in goods statistics. It is based on the distribution of non-allocated partner trade on the basis of the information coming from mirror flows.

Consider one country's exports and imports to/from other EU countries and some non-allocated trade within the EU, too (i.e. code B09). For each country consider M as the trade flow of imports (debit) of a given country from a trading partner. Here, M refers to the imports and $\bar{M}$ to the mirror imports (i.e. credits declared by the corresponding trading partner).

The difference $\Delta = \bar{M} - M$ is computed and set to 0 if negative. This implies that we would not allocate non-allocated trade where the mirror import is lower than the reported import value. It makes no much sense to allocate trade flows to a trading partner that is reporting more exports than what the country reference reports as imports from it. Since we are dealing with imports and exports of services, no adjustment is necessary to account for valuation differences.

Δ has a matrix form: $\Delta = (\delta_{i,j}) = \begin{pmatrix} \delta_{1,,1} & \cdots & \delta_{1,,28} \\ \vdots & \ddots & \vdots \\ \delta_{n,1} & \cdots & \delta_{n,28} \end{pmatrix}$ with the row index *i* standing for two-letter level services (SA to SL), and column index *j* standing for each of the 28 EU partner countries.

For each service (i), $V(i) = \begin{pmatrix} \sum_{j=1}^{28} \delta_{1,j} \\ \dots \\ \dots \\ \sum_{j=1}^{28} \delta_{n,j} \end{pmatrix}$ is calculated.

Finally, for each service (*i*) and trading partner (*j*), the non-allocated trade flow (B09) is distributed proportionally according to the value of $\delta_{i,j}$:

$$A_{i,j} = \left(\delta_{i,j} * \frac{B09(i)}{V(i)}\right)$$

And this amount allocated is added to imports to obtain the total estimated flows of imports.

The same process is applied to exports (credits). In this case, $\Delta = \bar{X} - X$ and, again, if $\delta_{i,j} < 0$ is set to 0. This avoids allocating B09 to those flows where the reporter has declared an amount of exports larger than its mirror flow. Let us illustrate this procedure with an example:

Table 7.7: example of the allocation, services category SC, credit for one country X
(million EUR)

Partner (1)	Input data (2)	Including imputations up to this step (3)	Mirror flow (4)	Delta (5)	A (6)	Allocation included (7)
Austria	146,7	146,7	213,4	66,7	0,9	147,6
Belgium	260,1	260,1	325,3	65,1	0,9	261,0
Bulgaria	4,5	4,5	7,5	3,0	0,0	4,6
Cyprus	17,6	17,6	32,2	14,6	0,2	17,8
Spain	141,7	141,5	200,1	58,5	0,8	142,4
Finland	1 052.4	1 052.3	1 526.7	474,4	6,6	1 058.9
United Kingdom	858,6	858,5	1 518.9	660,4	9,2	867,8
Hungary	14,4	14,3	15,3	1,1	0,0	14,3
Ireland	58,0	57,9	114,8	56,9	0,8	58,7
Italy	119,8	120,0	144,1	24,2	0,3	120,3
Luxembourg	44,7	44,7	81,3	36,7	0,5	45,2
Malta	3,5	3,4	5,9	2,6	0,0	3,4
Netherlands	552,1	552,0	831,8	279,7	3,9	556,0
Portugal	33,1	33,0	61,1	28,0	0,4	33,4
Slovakia	17,1	17,0	26,7	9,7	0,1	17,1
Non-allocated	25,0	25,0		1 781.5	25,0	
Total	3 349.3	3 348.4				3 348.4

Country X has here 15 partner countries in the EU (**column 1**) for the services SC, credit. The trade value of EUR 25 million for this service could not be allocated to EU trading partners. **Column 2** presents the input data provided by the ITSS dataset. **Column 3** includes previous imputations. There are minor and correspond here all to consistency imputations. **Column 4** examines the mirror flow $\bar{M}$ of these transactions; here the debit from the 15 partner countries to Country X. **Column 5** calculates the difference $\Delta = \bar{M} - M$ and **Column 6** distributes the amount of non-allocated trade (25) proportionally to column 5. The result is the sum of column 3 and column 6. Eventually, the total trade flow for the service category SC in column 3 still equals the same total trade flow after the allocation (column 7).

7.2.9 Consistency imputations (for totals and sub-totals)

After all previous steps, new observations have been added to our dataset. Hence, at this step we again impute missing totals whenever all sub-items have become available. This is done from a bottom-up approach, as it was done in the second step.

Looking at the results of this step, we notice that the total services item S is now fully available, as well as the two-letter items SA to SL. However, we still find that some more detailed items are missing while their corresponding sub-items are available. Those sub-items were generated as a result of the model estimates calculated in a previous step. Finally, they were imputed accordingly in the database.

All countries have their trade flows affected due to these consistency imputations of remaining missing totals and subtotals. Trade data for US were imputed with model estimates for debit transactions, as well as the trade data for the World as reference area. For example, in Table 7.8 the model estimates impute data for SH41 and SH42, and then this step imputes the total of SH as the sum of SH41 and SH42.

Table 7.8: Estimation of totals with available model estimates
(million EUR)

Step	Service	Value
Model estimate	SH41	6.9
Model estimate	SH42	629.1
Non-allocated trade	SH4	0.0
Parent imputation	SH4	635.9

Table 7.9 gives the number of records imputed with a non-zero value.

Table 7.9: Number of transactions imputed, 2010

	S	SC	SD	SG	SH	SH4	SK	SK1	Total
Credit	28.0	0.0	43.0	1.0	215.0	681.0	228.0	340.0	1 536
Debit	30.0	1.0	50.0	0.0	178.0	655.0	231.0	293.0	1 438
Total	58.0	1.0	93.0	1.0	393.0	1 336	459.0	633.0	2 974

The item SH and its sub-item SH4 are the most affected categories of this step.

The significant amounts for item SH and SH4 come from the model estimates that were computed without any constraints to aggregated levels. Those amounts will be corrected in the next step where we rescale detailed item sub-totals to benchmark totals at higher levels in the hierarchy.

Table 7.10: Trade values imputed, 2010
(million EUR)

	Credit	Debit
S	715 550.7	969 614.6
SC	0.0	-1.5
SD	13 657.0	62 152.3
SG	1.0	0.0
SH	701 072.9	905 770.0
SH4	816 784.8	520 944.1
SK	2 540.6	3 052.2
SK1	2 663.7	3 094.9

7.2.10 Top-down benchmark

A proportional adjustment is carried out in this step from totals to sub-totals. In this case, a top-down approach is followed from total services (S) to two-letter services (SA to SL), and then, in a successive way, to all the disaggregation levels of the EBOPS hierarchy. This implies that more reliability is given to higher levels of the classification (i.e. sub-totals will be modified in order to match their corresponding totals).

Instead of a standard proportional benchmarking, a new method has been implemented since positive and negative values presumably co-exist in the dataset for a given category and then, pure proportional benchmarks do not work properly. In these situations, using pure proportional adjustment leads to unlimited growth of positive and negative values (in absolute terms) when the total item value is bigger than the sum of its sub-items. Therefore, we have developed a unidirectional benchmarking method that avoids this behaviour and manages to get positive values grow and negative values become less negative if the total item value is bigger than the sum of its sub-items. Otherwise, positive values decrease and negative values become more negative.

Box 7.1: Unidirectional benchmarking

Let s_i be the balanced sub-item values

Let S be the balanced item total value

Let $\sum_i s_i = U$ be the sum of the balanced values. Of course, U is not necessarily equal to S.

Let s_i^* be the benchmarked values. This implies that $\sum_i s_i^* = S$

We need to find the s_i^* (i.e. our unknowns)

Let us now define:

- $P = \sum_{\{i:s_i>0\}} s_i$, the sum of the positive values of s_i
- $N = \sum_{\{i:s_i<0\}} s_i$, the sum of the negative values of s_i
- $P^* = \sum_{\{i:s_i^*>0\}} s_i^*$, the sum of the positive values of s_i^*
- $N^* = \sum_{\{i:s_i^*<0\}} s_i^*$, the sum of the negative values of s_i^*

With these definitions, it follows that:

$$P + N = U$$
$$P^* + N^* = S$$

We need to find common variation rates for positive and negative elements, say k_1 for P and k_2 for N, so that $k_1 P + k_2 N = P^* + N^* = S$.

We want to preserve signs of the benchmarked values s_i^* with respect to s_i. This implies that k_1 and k_2 have to be positive. Also when $S > U$, elements in P must increase and elements in N must also increase (reduce their value and approach to zero). The opposite would happen if $S < U$, all the elements should be reduced.

Let us assume that $k_1 \cdot k_2 = 1$, hence $kP + \frac{1}{k} N = S$. This assumption is compliant with the conditions declared in the previous paragraph.

The solution for *k* is: $k = \frac{S \pm \sqrt{S^2 - 4PN}}{2P}$. Since we want *k* to be positive, and taking into account that $\sqrt{S^2 - 4PN}$ is always greater than S, we discard the 'minus' solution of the quadratic equation. Hence,

$$k = \frac{S + \sqrt{S^2 - 4PN}}{2P}$$

In those situations where there are no positive elements (i.e. $P = 0$) or, alternatively, there are no negative elements (i.e. *N* = 0), this method reduces to the standard proportional allocation:

1) when $N = 0$, it is easy to see that $k = \frac{S}{P} = \frac{S}{U}$

2) when $P = 0$, it can be also found that $\frac{1}{k} = \frac{S}{N} = \frac{S}{U}$

At this step, the top-down approach is not implemented when:

- Sub-items are zero or non-available but the item total value is non-zero;
- The sign of the item total value is different from the sign of the sum of the corresponding sub-items.

In these two situations the two-letter categories SA to SL are then recalculated to bring them in line with total S. The top-down benchmark is currently applied only to services categories but not to partner countries. This is planned to be done in the follow-up project "Figaro Act I".

This step does not alter the total services trade. The impact on the two-letter services is very limited: a maximum of -1.6 % for services SL in credit flows, and -0.4 % for debit flows (see Table 7.7).

Looking at the three-letter level, the most affected services were SH1 to SH4 (services related to intellectual property products). The large amount of trade in SH4 services comes from the estimation of US trade in the model estimates.

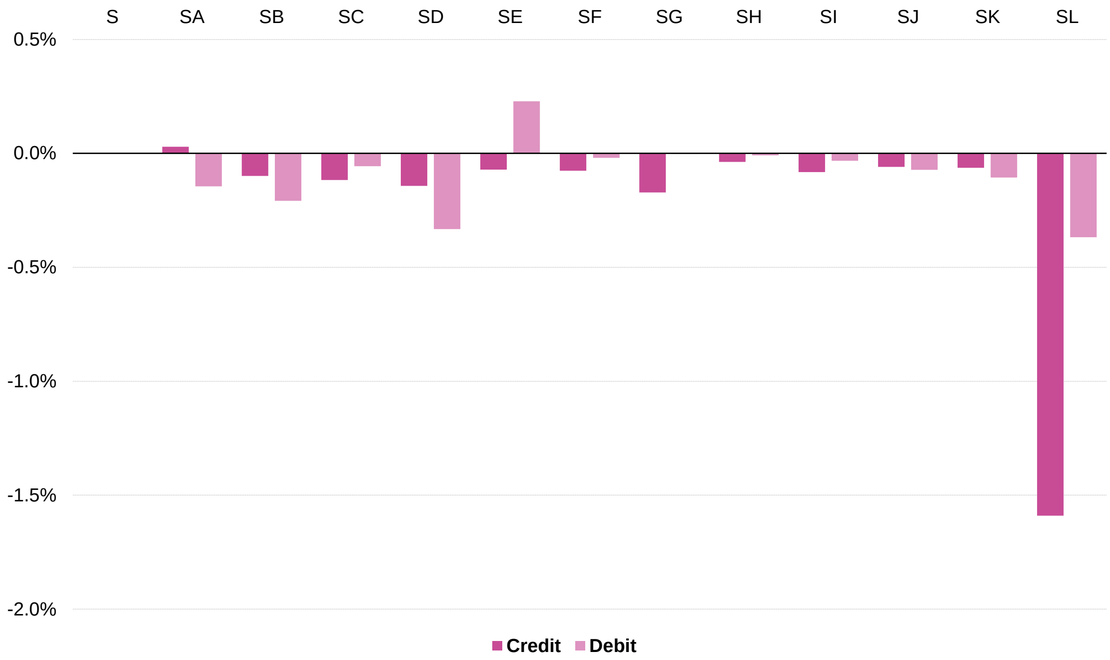
Table 7.11: example top-down benchmark for credit flows between Country X and partner Country Y
(million EUR)

	Input	Model estimates	Total item imputation	Top-down benchmark
SD	1 060.0			
SD1		3 490.2		570.5
SD2		44.1		7.2
SD3		809.3		132.3
SD4		2 082.0		340.3
SD5		59.2		9.7
SH	88.0			
SH4			13 926.1	87.3
SH41		3.0		0.0
SH42		13 923.1		87.3

Table 7.12: Trade value before and after the top-down benchmark for SH services, 2010
(million EUR)

	Credit		Debit	
	Before	After	Before	After
SH1	5 309.1	5 500.4	6 709.4	8 854.3
SH2	13 239.9	15 072.3	10 043.6	19 977.5
SH3	291.8	558.8	3 915.5	4 653.8
SH4	1 816 919.7	1 716 412.8	2 521 587.4	1 933 428.3

Figure 7.3: Change of trade value with the top-down benchmark step, year 2010, for all Figaro countries
(% change)



7.2.11 Balance of payments consistency

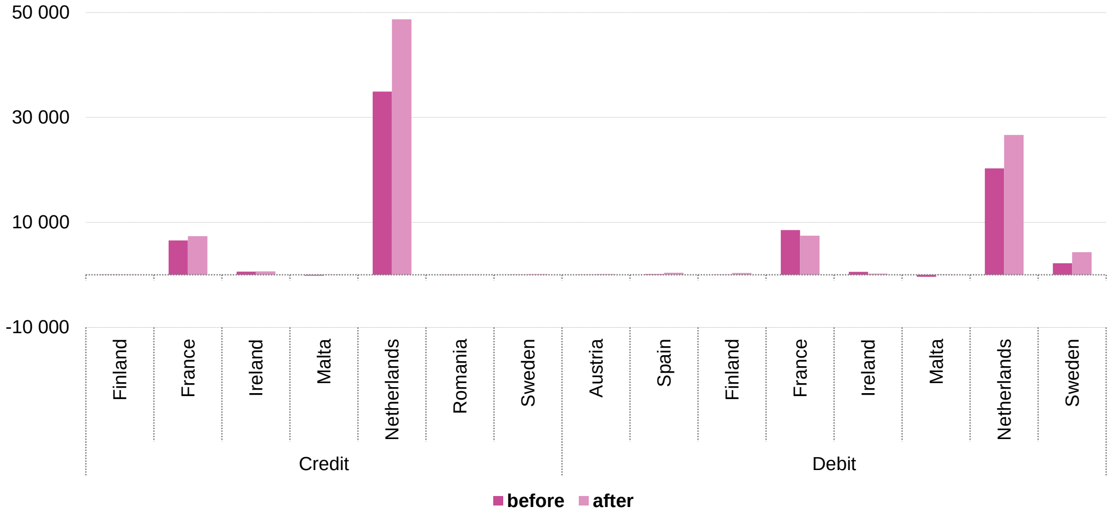
This step checks the derived ITSS based dataset with the balance of payments data at two-letter level (SA to SL). When the datasets are not consistent with one another, we generally replaced the ITSS based data with balance of payments data. However, we also try to avoid jeopardising the derived dataset with balance of payments data that we might see too different from each other.

Replacements were made in the following situations:

- Flows missing in our reference dataset of ITSS but present in the BoP database;
- Inconsistent sign of trade flows i.e. categories with a different sign in the ITSS reference dataset and in the BoP database;
- Large deviations: transactions with a relevant difference between the two datasets. We used a multiple approach to set thresholds. Initially, all the observations with a non-negligible deviation were replaced, unless the proportion of this change was not relevant (i.e. below 5 %). To do this, signs in the two datasets must be the same.

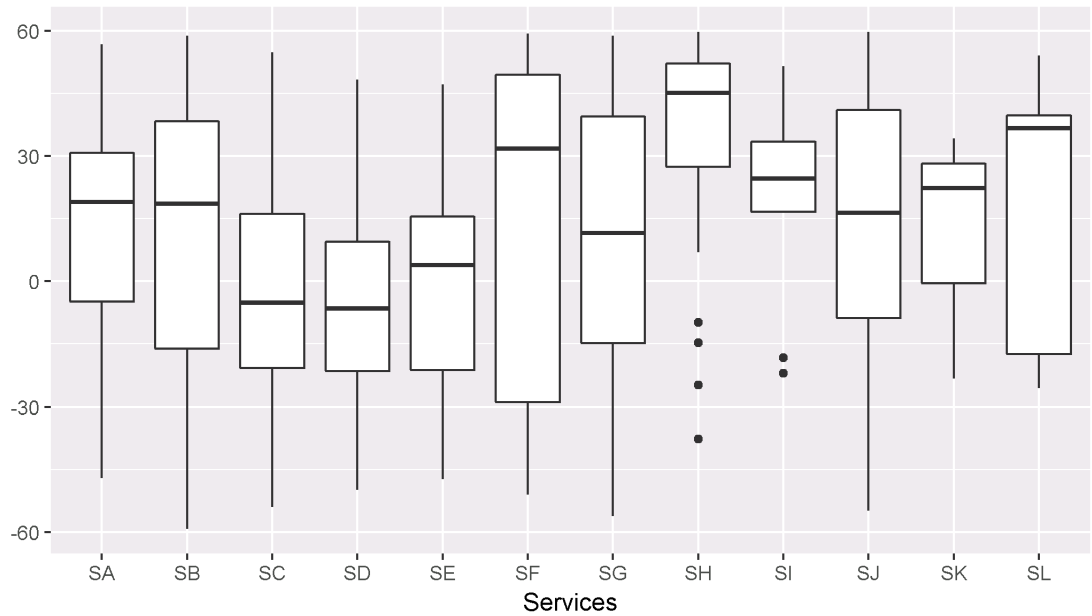
Circa 800 transactions were modified in this step. Deviations are calculated from the previous steps using this one. Statistics on the deviation indicate a median of 9 %. However, there are some large deviation values: the maximum is 200 % and the threshold to consider them outliers was set to 60% (in absolute terms). Figure 7.4 presents the values of the transactions affected by this step before and after the adjustment. The highest impact took place in the Netherlands, both on credits and debits.

Figure 7.4: **Trade value for services adjusted to balance of payments data, before and after adjustment**
(million EUR)



Besides, the main adjustments were made in the Netherlands (472 transactions), France (69), Germany (60), Sweden (37) and Ireland (33), covering already 88 % of the transactions updated with BOP data. The percentage deviations (excluding outlier values above 60%) were quite low, except for services SH and SL, among others (see Figure 7.5).

Figure 7.5: **Boxplot of the deviation of balance of payments consistency step compared to previous steps, 2010, per services**
(%)



7.2.12 Final benchmark

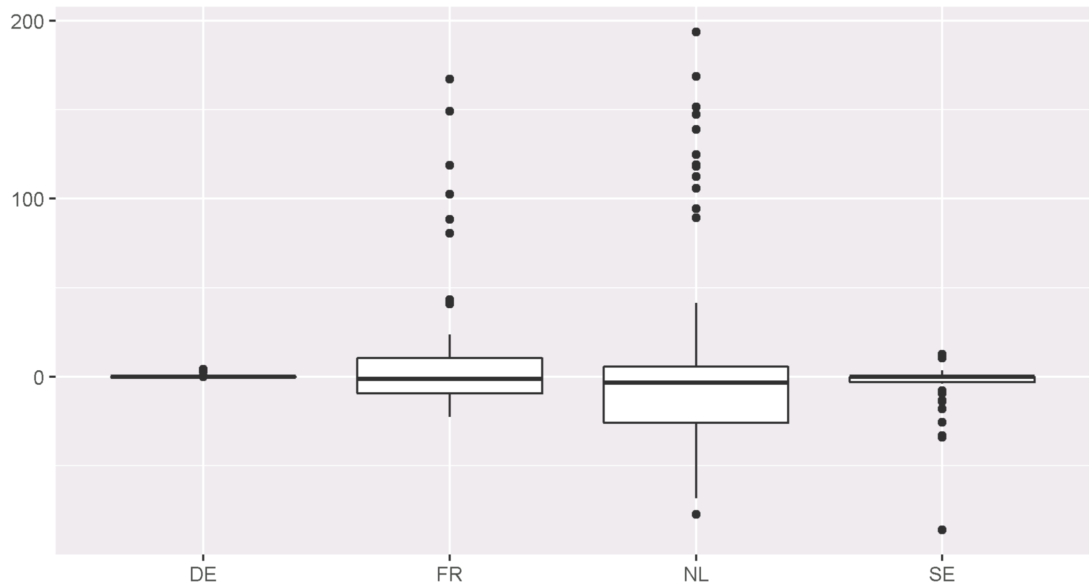
After the integration of BoP data at two-letter level, we reach the final step of the process, which is a final balancing process. Total services category (S) was recalculated as the sum of SA to SL categories. For the rest of the categories, top-down benchmarks were done using the unidirectional benchmarking process described in Box 7.1.

Table 7.13: **Example of changes with the final benchmark adjustment**
(million EUR)

	Input (1)	Top down (2)	Bop consistency (3)	Top down benchmark (4)
SH	81.3		74.0	
SH1		5.0		4.6
SH2		18.5		16.9
SH3		0.4		0.4
SH4		57.3		52.2
SH41		3.1		2.8
SH42		54.3		49.4

At the three-letter services level, the deviation (value of this adjustment compared to the latest value available) had a mean of 1.4 % with a standard error of 0.45 %. The main transactions affected by this step are in the Netherlands, France, Germany and Sweden (Figure 7.6).

Figure 7.6: **Boxplot of the value of deviation for four countries**
(%)



After all these steps, for each of the Figaro countries and their partner countries, there are two different trade flows: export and import for each of the services' detailed categories. However, the two flows are not the same and therefore present asymmetries. This is what we address in the next section.

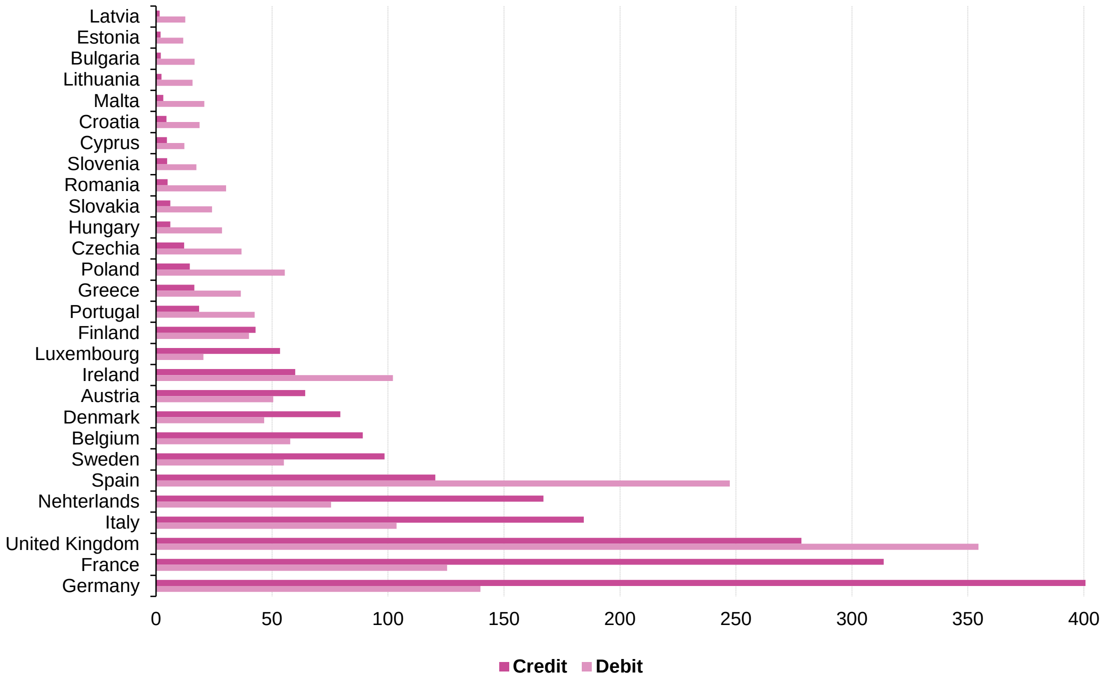
7.3 A balanced view of trade

The aim of trade balancing is to compile one single flow and therefore remove asymmetries between credit and debit (or export/import) flows. Figaro focuses on the 28 EU Member States and the US. As exporter country, some of the US services flows have been imputed in the previous steps but not all of them. On the partner side, data for each of the EU countries with partner US were available; therefore, sometimes these asymmetries might be difficult to interpret.

The balancing process is the same as for goods (see section 6.4.2). For total services, the EU countries presenting the largest asymmetries are the largest economies: Germany, France, the

United Kingdom, Italy, the Netherlands and Spain (seeFigure 7.7). For most countries, asymmetries are bigger on the debit side than on the credit side.

Figure 7.7: Asymmetries for total services category, 2010
(million EUR)



Most of the asymmetries come from the service category SH, followed by the travel item SD and the transport item SC.

Table 7.14: Trade asymmetry per two-letter services, 2010
(billion EUR)

	SA	SB	SC	SD	SE	SF	SG	SH	SI	SJ	SK	SL
Credit	21.6	8.4	108.9	106.4	12.8	29.9	67.6	1,923.5	54.7	113.4	11.9	5.5
Debit	21.2	8.0	101.9	66.9	12.6	26.5	61.8	1,702.7	52.4	122.9	12.8	6.2

Relative asymmetry is the ratio of the absolute asymmetry over the initial flow. For total services, the median relative asymmetry is 21 % for all EU countries, meaning that for half of the trade transactions the initial flow and its mirror flow are different for less than +/- 21 %. The situation varies for the total services in relation to the country. Figure 7.8 shows that for total services the relative asymmetry is largest for Luxembourg, Malta and Cyprus.

Figure 7.8: Relative asymmetry for total services, 2010

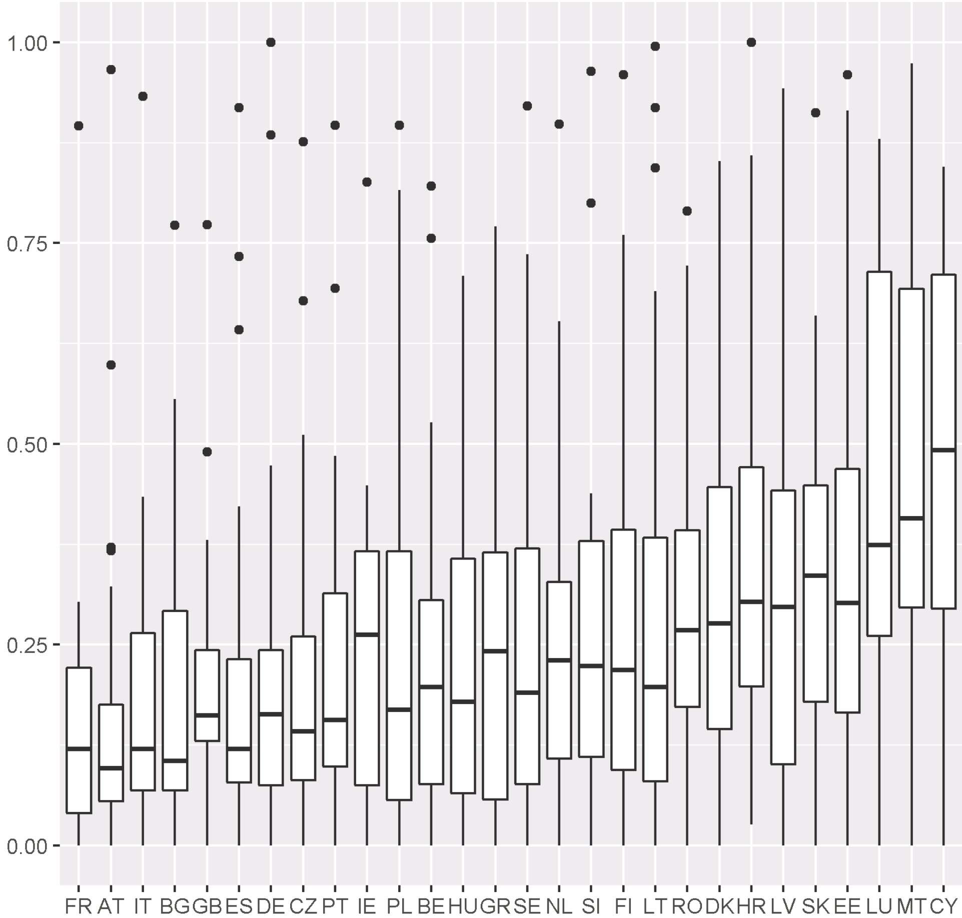


Table 7.15: Example of benchmark to total services of the balanced flows
(million EUR)

	Consolidated flow	Consolidated, benchmarked flow
S	1,205.8	1,205.8
SA	32.2	32.0
SB	14.1	14.0
SC	288.0	286.0
SD	180.5	179.2
SE	9.4	9.3
SF	18.8	18.7
SG	95.1	94.4
SH	40.1	39.8
SI	111.4	110.6
SJ	407.7	404.8
SK	9.8	9.8
SL	7.3	7.3

The balancing process is done for each service item and sub-items. Therefore, the method does not guarantee that the balanced value for a certain item matches the sum of the balanced values for the corresponding sub-items. In Table 7.15 above, balanced flows are given in the first column and the corresponding benchmarked values in the second column.

7.4 From BOP classification to CPA product classification

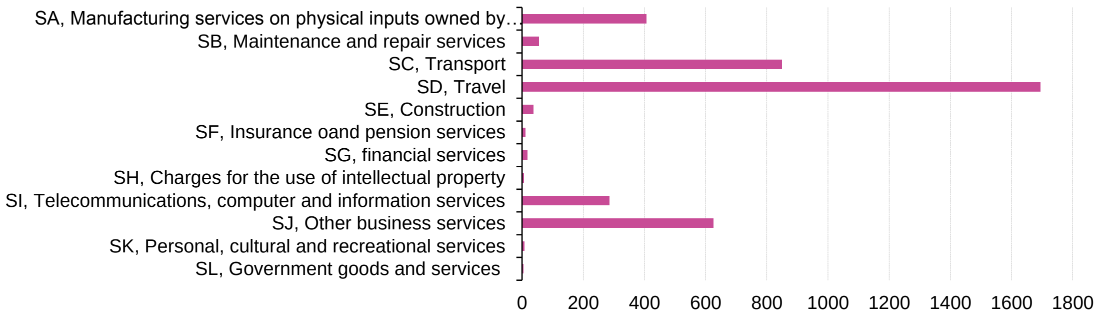
At this stage the balanced view of trade gives the trade flow between one country and its partner according to the EBOPS classification. The EU IC-SUIOTs are built on the product and industry classification. Therefore, a transformation is necessary to provide the balanced view of trade in the CPA product classification as an input for the construction of the EU IC-SUIOT. This is achieved by using bridge matrices, which are based on national information ([89]) of some countries and customised correspondence tables.

The conversion has been made at the most detailed level in terms of EBOPS categories, wherever available; otherwise, it was made at an upper level. For travel services (SD), the conversion shares from EBOPS to CPA were based on the estimation process of direct purchases abroad (see 3.2.6).

For example, items related to passenger sea transport (SC11) were allocated solely to the CPA H50 water transport, except for Austria where 80 % was allocated to CPA H50 and 20 % to CPA H52 warehousing. Another example is SF live insurance, 84 % of which would be allocated to K65 'insurance and reinsurance services' and 16% to K66 'auxiliary services to financial services and insurance services' for all countries.

Figure 7.9 and Figure 7.10 illustrate the distribution of trade from Czechia to Germany for the year 2010, in the EBOPS categories and in CPA product categories, respectively.

Figure 7.9: Trade from Czechia to Germany in EBOPS categories, 2010

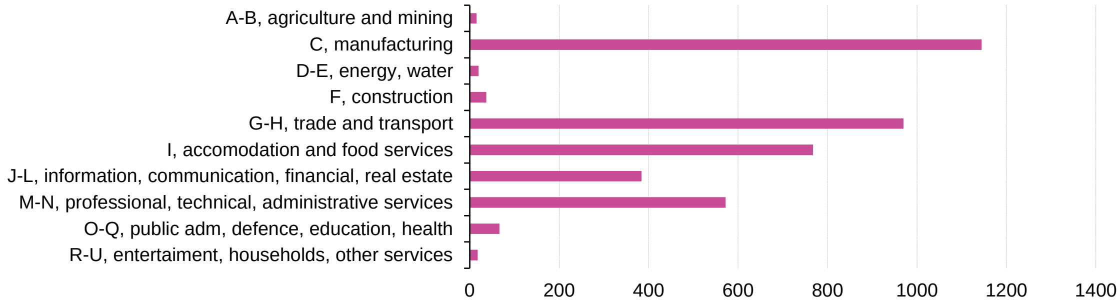


Source: Eurostat, FIGARO 2010

At this final stage a balanced view of trade in goods and services in CPA classification has been estimated for the construction of the Figaro tables. However, further adjustments to the balanced view of trade need to be done in order to match national accounts trade data. These adjustments refer to goods sent abroad for processing and merchanting, which are described in the next two chapters. Besides, further improvements to the various steps described in this chapter will be carried out in the follow-up project "Figaro Act I".

([89]) Austria, Czechia, Estonia, Germany and Slovenia.

Figure 7.10: Trade from Czechia to Germany in CPA products



Source: Eurostat, FIGARO 2010

8 Goods sent abroad for processing

8.1 Introduction

The classification of the production activity of an establishment is determined according to its main economic activity following the methodological specification of the International Standard Industrial Classification (ISIC), Revision 4. Identifying whether this establishment is providing a good or is providing a service may not be straightforward in the case of goods. For instance, when an establishment sends goods for processing to another establishment that belongs to a different institutional unit without changing ownership, then the value of the processed good may include processing services. This responds to the principles of economic ownership and legal ownership in the SNA (UN, 2008). The principle of economic ownership considers the criteria for recording the transfer of products from one unit to another. However, if the establishment that receives the goods for processing is not aware of how and where and for how much the assembled goods are sold, the economic ownership remains with the legal owner (UN, 2008). This practice has increased in many industries which outsource part or the entire production process, including those industries that operate under the globalisations of markets.

The ESA 1995 considered processing services on goods without a change in the economic ownership only within the territory of an economy, opposite to the case where those processing services were carried out outside the economy. This situation implied that the national accounts and the balance of payments statistics had to make imputations of imports and exports of goods crossing borders for being processed or after being processed. This inconsistent treatment of goods sent abroad for processing (GSA) was removed in the new ESA 2010.

The new treatment of GSA is one of the main changes introduced in the national accounts (ESA2010) and the balance of payments (BPM6). As a result, if a good is sent abroad for processing without changing ownership, then it cannot be considered as an export. The same applies to processed goods, which cannot be considered as imports. The processing services or the cost of the processing fee is considered a manufacturing service on a physical input owned by others in BPM6 (EBOPS category SA) while it is instead allocated to the category of the good in the corresponding CPA classification. Therefore, in ESA 2010 as well as in BPM6, the only flow recorded is the export of the processing service. Indeed, this record is more consistent with the financial record of the transaction, but it causes an inconsistency between international merchandise trade statistics (IMTS) and national accounts (Eurostat, 2014a).

In addition, the manual on the changes between ESA 1995 and ESA 2010 states that ‘the value of the service is not necessarily the same as the difference between the value of the goods sent for processing and the value of the goods after processing because of holding gains or losses, the inclusion of overhead and measurements errors associated with the goods movements’ (Eurostat, 2013, p. 67).

To link and reconcile national accounts with merchandise trade statistics, Eurostat (2014a) recommends that the value of the goods sent abroad and then returned back is recorded as a supplementary item. The ESA 2010 specifies that ‘the value of the exported goods can be recorded alongside that of the imported goods as supplementary items, the values being those recorded in the IMTS. This will enable the net processing service to be derived as the value of the processed goods exported less the value of the unprocessed goods which are imported. It is this service which is recorded in the national accounts' (Eurostat, 2013, p. 398). The manual suggests showing the net position in the balance of payments international accounts and the corresponding rest of the world sector account. The BPM6 manual (IMF, 2009) recommends that where it is known that imports and exports in the IMTS reflect a situation where there is no change in ownership, then the two are recorded side by side in the balance of payments figures, so that the services element can be immediately calculated. Eurostat (2013) shows an example of how imports and exports flows related to goods sent abroad for processing should be recorded in the balance of payment international accounts following the recommendation in BPM6.

In addition, it is also necessary to analyse the transportation services related to goods sent abroad for processing. Even if under ESA 2010 goods sent abroad for processing are excluded from general merchandise trade, they might generate transportation costs that have to be considered when transforming imports from CIF to FOB, and they have to be registered as an import if the transportation company is non-resident (Eurostat, 2014a).

The complexity of the treatment of goods sent abroad for processing is explained in detail in the Manual on goods sent abroad for processing (Eurostat, 2014b). The manual presents the main changes to be considered in the new ESA 2010, which relate not only to goods sent abroad for processing, but also to issues related to tradable products, quasi-transit, non-resident transit trade, goods for repair and re-export. It also explains the conceptual problems and the analysis of the impact of these new treatments by providing: (i) a compilation guide of the main sources available; and (ii) suggestions for how Member States can improve the collection of information to address the challenges of this type of measures in the national accounts, the balance of payment and trade statistics.

In the specific case of GSA, the manual provides a very detailed explanation of seven study cases as follows:

- Standard case. GSA and returned after processing
- Case I. Processing with subsequent sale to another Member State
- Case II. Processing with subsequent sale within the initial Member State
- Case IV. Processing under contract with several suppliers
- Case V. Goods with negligible value sent for processing
- Case VI. Multi-country processing
- Case VII. Return of unprocessed goods

The analysis of these cases give us a better idea of the complexity of these transactions and the challenges involved in dealing with the correct classifications and treatments in the national accounts, BoP and IMTS. These new methodological changes in these two main macroeconomic frameworks, ESA 2010 and BPM6, also raise significant considerations and trigger significant changes in the processes of gathering information. This involves introducing new statistical programs and improving the old ones, as well as improving the surveys frameworks and the administrative records international trade transactions. Despite all these limitations, a methodological procedure has been developed to estimate the GSA adjustment for each Member State by trading partner and CPA products with all the information available. The following sections provide the detail of the data sources and the estimation methods used in each case.

8.2 Overview of data sources and estimation methods

The estimation of the GSA adjustments in this chapter uses 2010 as the base year, which is the first year in which the ESA 2010 and the BPM6 started to be required for the compilation of macroeconomic statistics. It is therefore not surprising to find data limitations when estimating the necessary detailed information to produce the GSA adjustments to trade statistics for the estimation of the EU inter-country supply, use and input-output tables. Changes in the Member States' compilation structure to gather such information are currently being implemented but not all at the same speed across countries.

Besides, there is only partial information coming from BoP data and/or by combining business statistics and trade statistics data. Moreover, each Member State has its own way of implementation. In that sense, the estimation process developed in this chapter has been limited to the information available and also takes into account only the standard case according to the Manual on goods sent abroad for processing (Eurostat, 2014b). This implies not only the assumption that the goods sent abroad for processing return to the country of origin but also return to the same CPA product classification.

The following sections consider how the identification of the data sources and the methodological processes are applied to estimate the goods sent abroad for processing in 2010 by Member State, trading partner and CPA products.

8.2.1 Data sources

The data used to estimate GSA adjustments include four different sources. They come from Eurostat and reports produced by certain Member States. None of them contains a complete set of information by country, trading partner, user and CPA product. Hence, it is necessary to combine them to arrive at a complete estimation of the goods sent abroad for processing adjustments.

The first set of information considers the reports of gross national income inventories by each Member State (GNI inventories). These reports are written by the national accountants of each Member State following a common structure based on Eurostat's guidelines (Eurostat/C3/GNIC/271 - 2014). Chapter 5.13 of the GNI inventories, for 'Exports and imports of goods', contain information on the adjustments made in supply, use and foreign trade statistics, including the adjustment in GSA and merchanting for the year 2010. However, not all countries explicitly report a fully-fledged breakdown by product and trading partner of this type of adjustments.

The second source is derived from the Eurostat's report on 'Statistics on goods under merchanting and goods sent abroad for processing' presented at the third meeting of the Eurostat's Task Force on Integrated Global Accounts (Eurostat, 2017). This report describes the concepts, data recording and data sources. It also shows the gross flows connected to both inward processing and outward processing based on ITGS sent by Member States for the years 2013-2015. The identification of these flows is made by countries using nature of transaction (NoT) codes. The report suggests that these data might be more reliable when data refer to inward processing, particularly for countries such as Bulgaria, Estonia, Croatia, Cyprus, Hungary, Latvia, Lithuania, Portugal and Slovenia. The report also suggests that it is preferable to collect additional direct information from trade in services data rather than using NoT codes from ITGS, given the current framework. This recommendation will be followed in future developments of EU-IC-SUIOTs as much as such services trade data will be available. Eurostat trade in goods statisticians are considering reviewing the data collection with Member States to better record the nature of transaction and to provide balance of payments and national accounts statisticians with more suitable information.

In addition, Eurostat provides international trade in services statistics (ITSS) that include data about manufacturing services on physical inputs owned by others, split by trading partner, as well as some information sent by Member States on gross flows of goods related to GSA (Eurostat, 2017).

All the previous information can be complemented with other country specific data that are used to allocate the GSA total adjustment by product. This data come from country reports that explain how the changes in the new ESA 2010 framework have been handled, with special emphasis on the adjustments made to trade statistics in order to account for the goods sent abroad for processing. These reports point out the difficulties to produce sound estimations of such adjustments and provide other alternative country-specific sources. For example, Italy (Bracci et al., 2015) focuses on the use of 'intra-community trade in service data collected by the tax authority', while the Netherlands (Chong, 2015) and Belgium (Van den Cruyce, 2016) consider, in addition to trade statistics, the structural business surveys (SBS) and industrial services (Prodcom).

8.2.2 Process of estimation and methodology

The adjustment to ITGS for goods sent abroad for processing (GSA) is twofold: one component of the adjustment is related to processing services flows and a second component is related to the gross flows of the goods involved in the processing activity. The processing services fees are recorded in the BoP (item SA) and have to be allocated to the corresponding CPA product involved in the processing activity. Regarding the gross flows of the goods exported and imported for processing, they have to be subtracted from ITGS net of the value of the processing services.

Figure 8.1 shows the three-layer process we have designed for making the GSA adjustments. First, we estimated the overall total adjustment for the whole economy of each country. Secondly, we split the overall totals by trading partner; and then, thirdly, by CPA product. The whole estimation procedure consists of 17 steps, including input databases, estimation processes and the construction of a final database of GSA adjustments by reporting country, trading partner and CPA products.

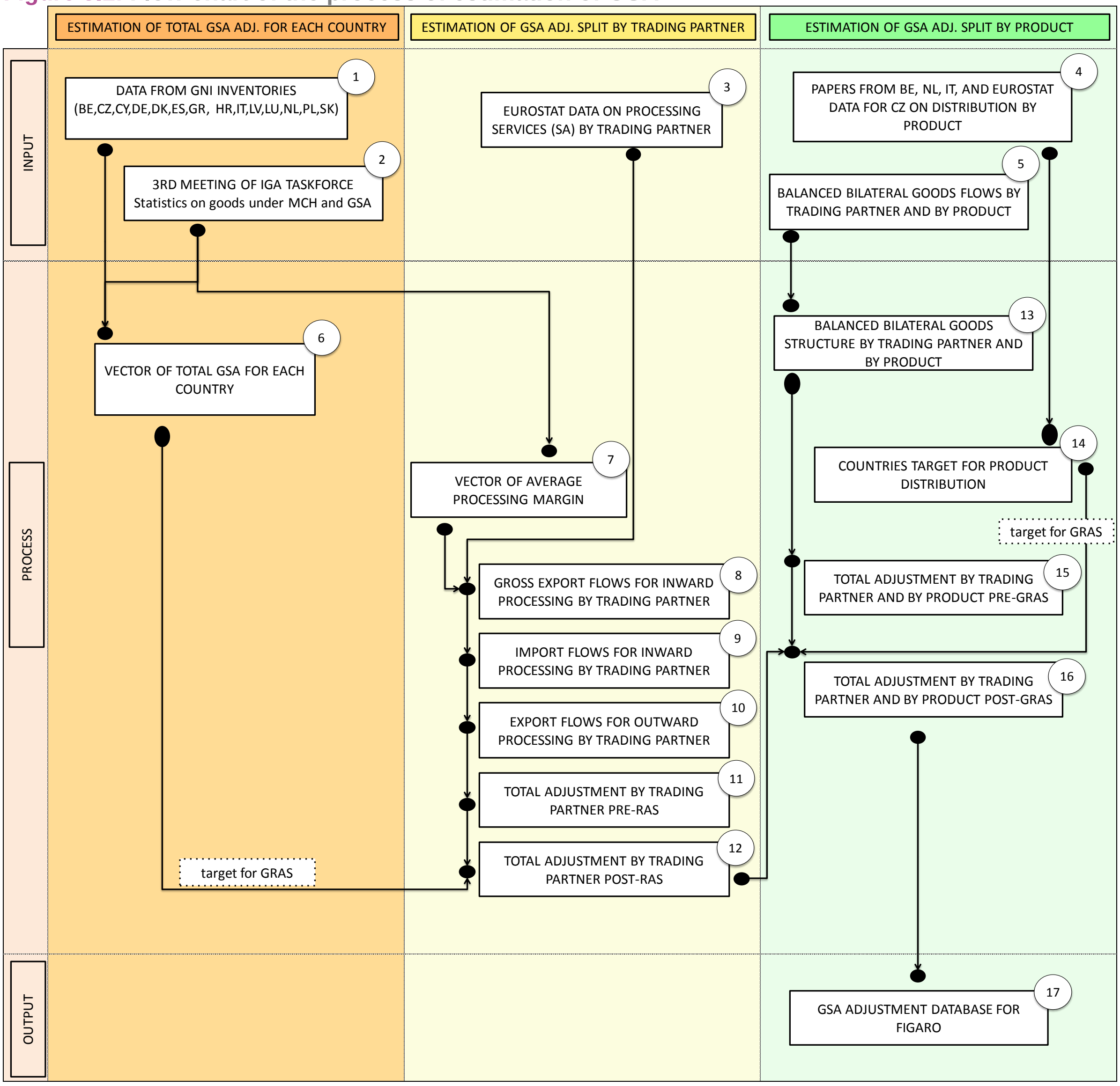
We considered the adjustment of goods sent abroad for processing (GSA) net of processing services reported by countries in the GNI inventories (see Step 1 in Figure 8.1). Eight countries reported the total GSA adjustment they applied to 2010 data (Germany, Greece, Spain, Cyprus, Latvia, Luxembourg, Slovakia and the Netherlands). For these countries, we directly used the values they provided. Another six countries reported total GSA adjustment for 2011 or 2012 (Belgium, Czechia, Denmark, Croatia, Italy, and Poland) instead of 2010. Therefore, we computed how much the GSA adjustment was as a share over their total value of exports of goods for 2011 and 2012 and we applied an average share to the total exports of goods of 2010.

For the remaining countries, which did not report any explicit value in the GNI inventories, we derived the total GSA adjustment using the information provided in the Eurostat report 'Statistics on goods under merchanting and goods sent abroad for processing' (Eurostat, 2017) on gross flows connected to inward and outward processing (see Step 2). The information was, however, for 2013, so we estimated the GSA adjustment for 2010 in the same way as explained earlier for the 2011 and 2012 values.

To derive processing margins by country we derived implicit processing fees related to inward processing as the difference between exports after processing and imports before processing, and the processing margin as the ratio between those processing fees and the exports after processing. We obtained this way sound estimates for twenty countries while for the others we just used an average of them.

So far, we have estimated a vector of total GSA adjustments by country (step 6) and a vector of the average processing margin for each country (Steps 7). These two vectors are key inputs to split the total GSA adjustments by trading partner in subsequent steps.

Figure 8.1: Flow chart of the process of estimation of GSA



Source: Own elaboration.

8.2.3 Distribution by trading partner

Subsequently, the breakdown of the country totals of GSA adjustment values across trading partners were based on the balanced view of trade of manufacturing services on physical inputs owned by others (item SA). This was the general rule in the absence of information about bilateral trade flows of goods sent abroad for processing (in gross terms), with the exception of Germany ([90]) (Step 3, matrix of processing services). Since those manufacturing processing services can be considered as a share of the gross value of the goods traded, this can be derived by dividing those manufacturing processing services by a processing margin (from Step 7) (Fortanier and Miao, 2017, p. 7). In Step 8 of Figure 8.1, a matrix of gross exports flows for inward processing by trading partner is estimated in this way. Next, by subtracting the matrix of processing services (Step 3) to the matrix of export flows

([90]) Germany specified the eight main related trading partners: Czechia, France, Poland, the Netherlands, Ireland, United Kingdom, Spain and United States.

after processing (Step 8), it yields an estimation of a matrix of imports before processing (Step 9), which in turn, by transposition, we have considered it a proxy of the matrix of export flows before (outward) processing (Step 10). In this way, we have computed a first approximation of the bilateral gross trade flows of the GSA adjustments, including both inward and outward processing.

As a result, since manufacturing services were already split by trading partner, these geographical distributions were used as a proxy to compute the GSA adjustment values by trading partner (Step 11), too. However, the resulting overall total values for each country have to be eventually benchmarked - using the GRAS method (Step 12) - against those earlier estimated on the basis of the GNI inventories and Eurostat (2017).

8.2.4 Distribution by CPA product

The breakdown of each GSA bilateral trade flow by CPA product was initially based on the CPA structures of a few countries (across all trading partners) that provided information about the type of goods traded for such purpose (see Step 4, third column of Figure 8.1, for Belgium, Czechia, Germany, Italy and the Netherlands) and an average structure of them for the missing ones. However, it turned out that these structures were very country-specific, thus leading to meaningless allocations in average structures. Therefore, in the absence of superior data, we eventually opted for assuming the structures given by the available balanced view of trade in goods (Step 5 and 13) even though we are fully aware that not all goods produced in the economy are likely to be sold abroad for processing.

However, there are exceptions. Belgium (Van den Cruyce, 2016) provided some information on exports - or imports - after inward - or outward - processing and on processing fees split by product. Czechia provided information on the exported and imported GSA processing fees distributed by product; therefore we used the structure of exported processing services to distribute the GSA adjustment across products. The Netherlands (Chong, 2015) and Italy (Bracci et al., 2015) provided information of the GSA processing fees distributed by industry. We derived the gross flows related to the processing fees and the GSA adjustment split by industry and we used the distribution obtained as a proxy of the distribution of the GSA adjustment by product. From these sources we built a vector of structures by CPA product for each country (Step 14).

Germany was the only country that provided information related to exports before outward processing and imports before inward processing split by CPA products. As said earlier, Germany also specified the eight main related trading partners, which allowed estimating specific CPA structures for each one of them. An alternative CPA structure for the remaining trading partners of Germany was estimated based on the remaining total of GSA adjustments reported by Germany and the balanced view of trade in goods statistics.

As a result, Step 15 provides an initial estimation of the GSA adjustments by CPA product using the balanced view of trade in goods statistics and other national data. However, these results also have to be benchmarked with the previous estimates of GSA adjustments by country and trading partners, using the GRAS method. Ultimately, some ad hoc adjustments had to be made in a few cases to avoid negatives whenever the resulting GSA adjustment turned out to be higher than the corresponding bilateral trade flow.

The results of this process were also used to build up the conversion matrix from EBOPS to CPA categories in relation to the item SA (Manufacturing services on physical inputs owned by others).

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8.3 Conclusions

One of the main methodological changes introduced in national accounts (ESA2010) and in the balance of payments (BPM6) is the treatment of goods sent abroad for processing. Previous to these changes, the goods sent abroad for processing were registered gross as exports and imports of merchandise trade, like any other good; being an exception of the ownership principle. Since the introduction of the ESA 2010 methodology, a good sent abroad that does not change ownership is excluded from the trade in goods. Alternatively, the processing service or the cost of processing fee is considered a manufacturing service in the physical input owned by others in BPM6 (item SA) and allocated to the corresponding CPA classification of the processed good. With these changes, the inconsistency of the ownership principle in ESA2010 and BPM6 is solved but indirectly causes another inconsistency with international merchandise trade statistics (IMTS) that is measured in gross terms (Eurostat, 2014a).

To implement these changes, countries also have to introduce changes in the specific processes to gather information about these goods. As 2010 was the first year in which the ESA2010 and BPM6 were implemented, the lack of detailed information on this topic is considerable. For the purpose of the Figaro project, despite this lack of information we used all the detailed information available for each of the European countries and developed different methodological approaches to estimate all the details necessary to produce an inter-country SUIOT. In this sense, the data used to estimate the GSA adjustments considered various different sources that were combined to achieve the estimation of goods sent abroad for processing by country, trading partner, user and CPA product. A detailed analysis of the changes done to the original data and the results of the average process margins can be found in Chapter 13.

9 Merchanting

9.1 Merchanting and different accounting principles

As described in the ESA 2010, merchanting is an arrangement where an economic unit in one country purchases goods from another county for sale in a third economy. The goods legally change ownership but do not physically enter the economy where the merchant who owns them is resident. In other words, merchanting is as a sort of re-export without the goods crossing the border of the merchanting country ([91]).

Usually, merchanting arrangements are used for activities such as global wholesaling services, some retailing services, transactions resulting from global manufacturing processes, or commodity dealing. Anyway, not all the activities of wholesaling, retailing, and commodity dealing are defined as merchanting: if the goods are present in the economy of the merchant that owns them, or if their physical form changes due to processing activities, they are considered as general merchandise (Eurostat, 2013).

Merchanting practices can be related to services too. An example is the case of subcontracting: a service provider might be paid for some specialist services and might subcontract them to another contractor.

The key characteristic of merchanting is that this practice implies a change of ownership, but without a physical movement of goods within the merchant's economy. For this reason merchanting arrangements are recorded differently in different statistical databases that are compiled under different recording principles.

On the one hand, as described in UNSD (2011), international merchandise trade statistics are compiled under the principle of recording all physical flows moving across countries. In this case, merchanting practices are not recorded as international flows of goods by the merchant's economy because they do not imply a physical movement. Let us consider a hypothetical example, for instance, a Dutch trader who sells fish from a Danish ship at the port of Helsinki in Finland, for a total value equal to EUR 1.5 million. Let us also assume that the merchanting fee corresponds to EUR 0.5 million. The IMTS register only the export of goods from Denmark to Finland, but no record appears in the international trade in goods statistics of Netherlands ([92]).

On the other hand, accounting systems such as national supply and use tables or balance of payment accounts are compiled following the ESA 2010. Under the ESA 2010, the principle of

([91]) Merchanting practices might have different forms: the merchant might sell the goods in the same country where he buys them, or several countries might be involved. For more examples of the different transactions that are classified as merchanting, see Chapter 6 of UNECE (2011).

([92]) International trade in services statistics compiled under the Services Sectoral Classification List (W/120) would include the EUR 0.5 million merchanting margin in services.

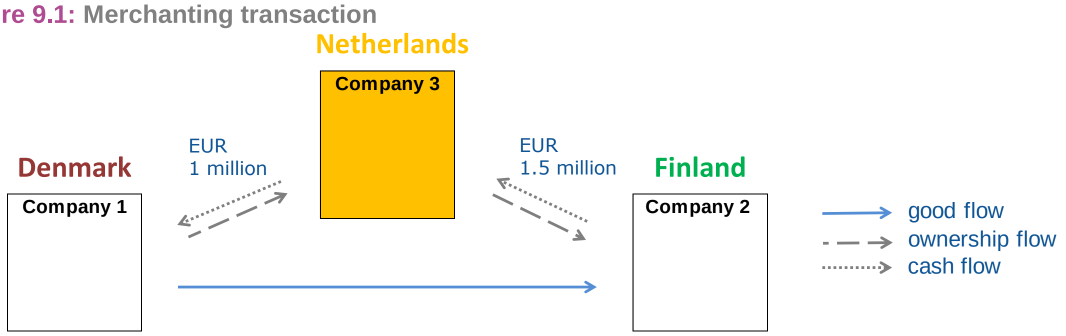
change of ownership is applied without exceptions: 'Imports and exports of goods occur when economic ownership of goods changes between residents and non-residents. This applies irrespective of corresponding physical movements of goods across frontiers' (Eurostat, 2013, p. 80). Under this principle, merchanting should be specifically recorded also in the international trade in goods statistics of the economy of the merchant, in the following way: goods acquired by merchants are registered as a negative export of the economy of the merchant; goods sold by merchants are registered as a positive export; the difference between sales and purchases is the 'net exports of goods under merchanting'.

Considering the previous example, the Dutch trader's acquisitions and sales should appear in the Dutch export of fishing products ([93]), acquisitions (EUR 1 million) as negative export, and sales (EUR 1.5 million) as positive export. The net export under merchanting corresponds to the merchant's trade margin (EUR 0.5 million) ([94]).This accounting system was introduced with ESA 2010 to avoid some critical issues implicit in the previous system, including a global imbalance in the goods account (UNECE, 2011).

Contrary to what might be expected, net export under merchanting does not necessarily have to be positive. In fact, besides the merchant's margin, it includes also possible losses and gains, and changes in the merchant's inventories. So, if for a given transaction the trader registers some losses, or if he decides to buy goods in a period but sell them in subsequent periods, the resulting net export under merchanting might be negative.

Figure 9.1 provides a simplified example of how merchanting is recorded in a SUTs framework under the ESA 2010 accounting system. The countries involved are Denmark, Finland and the Netherlands. Company 1 in Denmark is producing the good (fishing products). Company 2 in Finland buys this product, but not directly. In fact, company 3 in the Netherlands acts as a merchant: it buys the product from Denmark, paying EUR 1 million, and sells it to company 2 in Finland for a value equal to EUR 1.5 million, without the good entering the Netherlands. Company 3 is therefore carrying out a merchanting activity. The blue line in the figure shows the physical movement of the product from Denmark to Finland, while the grey lines describe the flow of cash and ownership that involves also the merchant's economy, the Netherlands.

Figure 9.1: Merchanting transaction



Source: author.

([93]) For the purposes of balance of payments statistics, trade flows are broken down into general merchandise and goods under merchanting.

([94]) Merchanting entries are valued at transaction prices as agreed by the parties, not necessarily at fob prices.

Figure 9.2: Merchanting recorded in SUTs under ESA 2010.

Denmark (producer)

SUPPLY (basic and purchasers' prices, EUR million)	Output	Import	Total basic prices	Trade margins	Total purchasers' prices
Fishing and acquaculture	1,0				1,0
Wholesale services					
Total	1,0				1,0

USE (purchasers' prices, EUR million)	Intermediate consumption	Export	Total
Fishing and acquaculture		1,0	1,0
Wholesale services			
Total		1,0	1,0

Finland (final purchaser)

SUPPLY (basic and purchasers' prices, EUR million)	Output	Import	Total basic prices	Trade margins	Total purchasers' prices
Fishing and acquaculture		1,5			1,5
Wholesale services					
Total		1,5			1,5

USE (purchasers' prices, EUR million)	Intermediate consumption	Export	Total
Fishing and acquaculture	1,5		1,5
Wholesale services			
Total	1,5		1,5

The Netherlands (merchant)

SUPPLY (basic and purchasers' prices, EUR million)	Output	Import	Total basic prices	Trade margins	Total purchasers' prices
Fishing and acquaculture				0,5	0,5
Wholesale services	0,5		0,5	- 0,5	
Total	0,5		0,5		0,5

USE (purchasers' prices, EUR million)	Intermediate consumption	Export	Total
Fishing and acquaculture		0,5	0,5
Wholesale services			
Total		0,5	0,5

Source: author.

Figure 9.2 shows how these flows are recorded in a SUTs scheme under ESA 2010 ([95]). Denmark records its production of fishing products (EUR 1 million) as output in the supply table and as an export in the use table. Finland records in both tables a value equal to EUR 1.5 million, classified as an import of agricultural products in the supply table, and as intermediate consumption in the use table. Figure 9.2**.** shows the Netherlands' SUTs. While in the supply table at basic prices the value of merchanting is recorded as a service, it is then adjusted and assigned to fishing products in the supply value expressed in purchasers' prices. In the same way, in the use table (expressed in purchasers' prices) the merchanting activity is recorded as an export of fishing products. In this way the three countries' accounts are balanced at global level, recording a global export of fishing products (EUR 1.5 million) equal to the global import of the same product.

9.1.1 Information required for estimating merchanting

Since the goods subject to merchanting do not physically cross the merchant's borders, detecting merchanting activities for the purposes of recording them is a challenging task. UNECE's 2011 report suggests that even if the value of merchanting globally reported is strongly increasing over time, there might be important under-reporting and underestimations of these practices.

Two main sources are usually addressed when estimating merchanting activities (see UNECE, 2015 for more details).

A first source is business surveys, which should include some specific and supplementary questions in order to provide information on the merchanting portion of trade-related purchases and sales of different companies. To be able to measure merchanting margin, information on changes in inventories should also be collected. Surveys for the wholesale industry are particularly relevant for detecting merchanting activities.

([95]) For more details on the changes between the ESA 1995 and the ESA 2010 accounting systems, see Eurostat (2014a, 2014b).

A second source is international trade in services statistics (ITSS). In fact, even if ITSS are compiled under the principle of change of ownership established in ESA 2010 — which requires that merchanting be excluded from services — the manual on statistics of international trade in services 2010 suggests that 'given the interest in such information, compilers may wish to provide estimates of distribution services, including those related to the merchanting of goods […] as a complementary grouping' (UNSD, 2012, p. 38).

In the absence of explicit information available, a method for finding and estimating merchanting practices is to compare data of individual companies in different sources, for instance business surveys and customs data. This is particularly relevant for companies that carry out international transactions.

9.2 Estimation of merchanting in Figaro

In Figaro, two main databases are used to construct the inter-country use table for 2010. On the one hand, the 2010 national SUTs are the main source for the domestic part of the tables and for the total use for each country. As explained before, these tables are compiled following the principles of ESA 2010. On the other hand, data on 2010 international trade in goods are used to split the international trade data recorded in SUTs across trading partners and users. This second source is compiled based on the physical flows moving across countries. Therefore, it is necessary to estimate net export of merchanting for 2010, which has to be added to international trade in goods statistics in order to align the two databases to the same accounting principle used in the national SUTs — the principle of change of ownership.

As mentioned before, the best option when estimating merchanting flows is to have access to very detailed information from business surveys as well as from customs data for each single country. However, this was not possible in the Figaro project. A second option is to obtain information on merchanting flows from each country's statistical office. In fact, in order to compile national SUTs the main source on international trade transactions that countries use is IMTS; therefore, to compile national SUTs for 2010, they need to estimate merchanting flows as well and to adjust IMTS data.

The following subsections describe the information on merchanting available for the Figaro project and the method and assumptions applied to estimate the merchanting adjustment whenever the information currently available is not complete.

9.2.1 Information used to estimate merchanting

To estimate merchanting flows in Figaro, six data sources are used.

First, the Eurostat data on the balance of payment account contain the item 'net export under merchanting', which corresponds to the total amount of merchanting activities of any country in a given year. For some countries this information is available for 2010: Bulgaria, Czechia, Cyprus, Denmark, Germany, Greece, Italy, Lithuania, Luxembourg, Malta, the Netherlands, Poland, Slovenia and Sweden. Other countries provide this information but for years after 2010: Austria, Belgium, Estonia, Finland, France, Hungary, Ireland, Latvia, Portugal, Romania and Slovakia. For Croatia, Spain and the United Kingdom the information is missing.

As a second source of information, Eurostat has another database not publicly available on net export under merchanting. This database contains additional information for Croatia (starting from 2011) and the United Kingdom. Moreover, besides the total merchanting flow of each country, the database breaks down the merchanting activities into three geographical areas: euro area, non-euro area and non-EU countries.

Third, many countries report information on total merchanting in their gross national income (GNI) inventories. Some of them reported for 2010 (Germany, Estonia, Greece, Spain, Cyprus, Latvia, Lithuania, Luxembourg, the Netherlands, Slovakia, and the United Kingdom), while others reported for subsequent years (Belgium, Czechia, Denmark, Croatia, Italy, Hungary and Sweden).

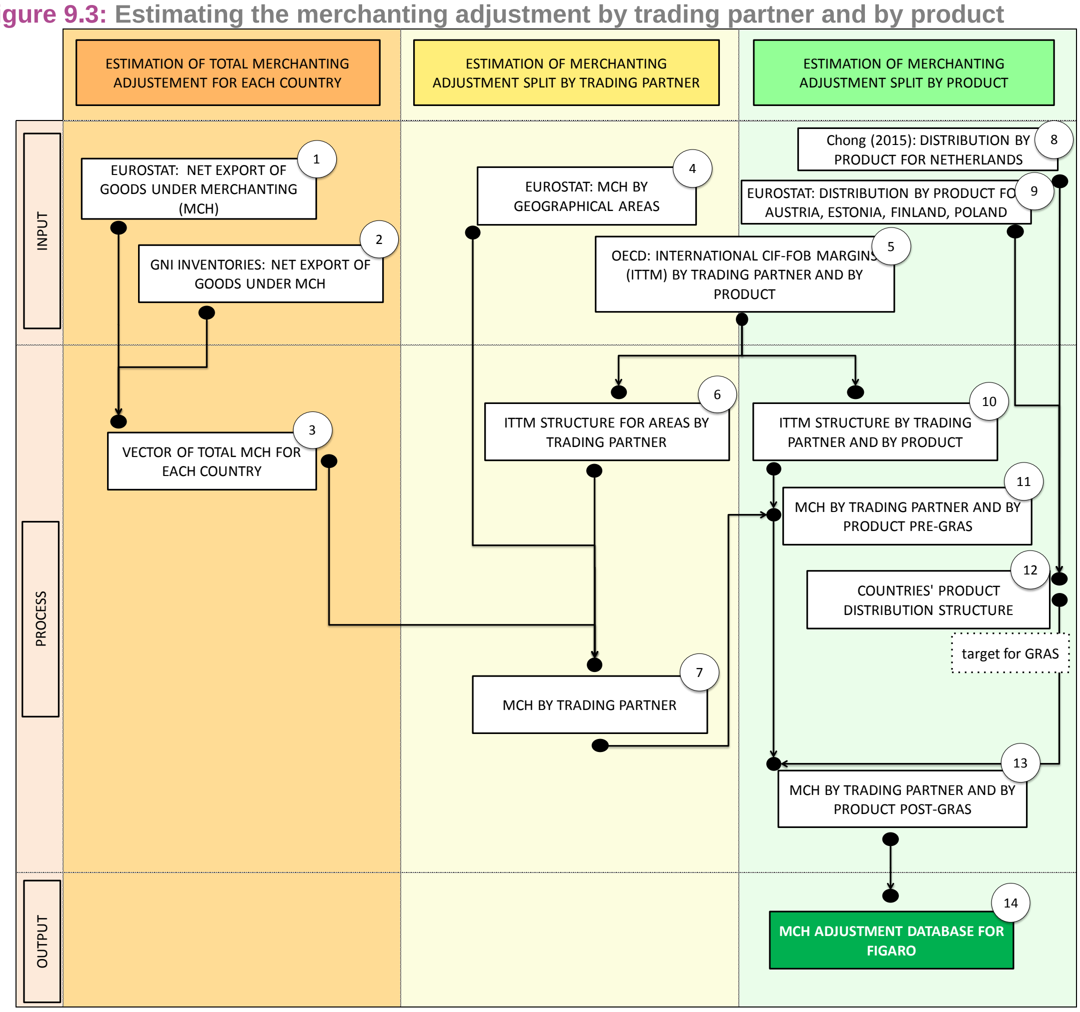
Next, two other sources are used for information on merchanting broken down by product. Eurostat directly collected information for Austria, Estonia, Finland and Poland. Chong (2015) provides some useful information for the Netherlands, too.

Finally, whenever the information available is not enough to estimate the merchanting activities with the required level of disaggregation, we use the OECD database on international transport and insurance costs margins ([96]).

9.2.2 Method and assumptions for estimating merchanting flows

Estimating the flows of merchanting activities for each country is necessary in the Figaro project to align IMTS data with national SUTs data.

Figure 9.3: Estimating the merchanting adjustment by trading partner and by product



*Source:*thor.

Since exports in IMTS for each country are split by trading partner and by product, the merchanting adjustment also has to be estimated with the same breakdown. As a result, our estimation process

([96]) Refer to footnote 14.

has three main layers. First we estimate the total 2010 merchanting adjustment for each country whenever this is not available. Second, we estimate the bilateral flows of merchanting, i.e. how the total merchanting is broken down across the different trading partners. Finally, we estimate for each country and each trading partner what products are involved in merchanting activities.

Figure 9.3 provides a visual description of the estimation flow, describing the inputs and process in each layer, up to the merchanting adjustment, split by trading partner and by product. The following three subsections explain each layer. Any layer involves different steps, numbered in Figure 9.3 and then cited in the text to ease the reading

9.2.3 Total merchanting adjustment for each country

As described in Figure 9.3, the first layer (the orange area of the Figure) is to estimate the total merchanting adjustment for each country.

For 16 countries the total merchanting adjustment applied in Figaro is the values directly recorded in the Eurostat databases for 2010 ([97]). The countries concerned are: Bulgaria, Cyprus, Czechia, Denmark, Germany, Greece, Croatia, Italy, Lithuania, Luxembourg, Malta, the Netherlands, Poland, Slovenia, Sweden and the United Kingdom (step 1).

Among the countries whose information on 2010 merchanting adjustment is not available in Eurostat data, four countries (Estonia, Latvia, Spain, and Slovakia) provide information on the 2010 merchanting adjustment in their GNI inventories (step 2).

Finally, for the remaining countries (Austria, Belgium, Finland, France, Hungary, Ireland, Portugal, and Romania) there is no direct information on 2010 merchanting activities. For these countries, we estimate the 2010 adjustment based on the average growth rate of merchanting in the following years (2011-2016, depending on data availability).

In this way we obtain, for each country, the total value of merchanting adjustment that we need to add to exports flows in IMTS (step 3).

9.2.4 Merchanting adjustment split by trading partner

The second layer (the yellow area of Figure 9.3) is to split the total value of merchanting adjustment across the different trading partners. For this part of the process, we first use the Eurostat database that provides the merchanting adjustment, split into three geographical areas (step 4):

- euro area (Austria, Belgium, Cyprus, Estonia, Finland, France, Germany, Greece, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Portugal, Slovakia, Slovenia and Spain);
- non-euro area (Bulgaria, Czechia, Denmark, Croatia, Hungary, Poland, Romania, Sweden and the United Kingdom);
- non-EU countries (the United States, and the rest of the world region).

As with the previous step, the split in different geographical areas is available for the year 2010 for 16 countries. For the other countries we extrapolated the geographical disaggregation starting from information about subsequent years.

After obtaining this first disaggregation in three areas, we need to further split each of them into the countries belonging to each respective area. As data at this level of geographical breakdown are not currently available, we consider two possible options to estimate them.

A first option is to use the structure of the balanced view of international trade in goods data. This involves assuming that the geographical distribution of merchanting by trading partner is similar to

([97]) Balance of payments by country, quarterly data (bop_c6_q).

the geographical distribution of general merchandise trade. The limit to this approach is that usually these types of processes, such as goods processed abroad or merchanting seem to be linked to specific productive processes or specific multinational companies acting globally with relevant trade flows, so their distribution across countries might be less spread than general merchandise trade.

A second option is to use data on services related to international CIF-FOB margins (step 5) and apply their geographical distribution (step 6). This distribution might be a reasonable proxy: the underlying assumption is that we would consider merchanting distributed in a similar way to other trade-related services. It is, however, important to keep in mind that under the ESA 2010 system the category of services related to international CIF-FOB margins does not include merchanting.

We assessed both structures and picked up the one that better fitted the purpose of our estimation, namely to align IMTS with national SUTs data. Based on these checks, the best option — the one that minimizes the absolute value of the discrepancy between trade data and national SUTs data — is to use the geographical breakdown of services related to CIF-FOB margins to obtain the values of merchanting adjustments split across the different trading partners (step 7).

9.2.5 Merchanting adjustment split by trading partner and by product

After obtaining a estimation for the merchanting adjustment split by trading partner, or, in other words, the bilateral flows of merchanting activities, the third layer is to further disaggregate them considering the different products exchanged under merchanting agreements (the green area of Figure 9.3).

Five countries provide information on merchanting activities available at product or industry level.

Chong (2015) describes the methods applied by Statistics Netherlands to measure merchanting in order to compile the national accounts under the ESA 2010 principles using data from IMTS (step 8). The main source for measuring merchanting is structural business surveys, which contain data on merchanting for the wholesale trade industry. Using this information Statistics Netherlands estimates merchanting activities of other industries, too. We use the composition of merchanting activities by industry as a proxy of the composition by product, assuming in this way that industries perform merchanting practices for trading their main productions. Moreover, since the wholesale trade sector has a predominant share in merchanting activity by sector, we consider only the sectors producing goods (from NACE activity A01 to NACE activity D35).

Eurostat has information on merchanting split by product for four other countries: Austria, Estonia, Finland and Poland (step 9).

Figure 9.3 shows the structure implemented in Figaro for countries with information available to disaggregate the merchanting adjustment by product. For countries where information on merchanting disaggregated by product is not available, we evaluate three main options.

- A first option is to use the data structure from international trade flows, implicitly assuming in this way that all goods exported are also traded through merchanting in the same proportion as the total exported goods.
- A second option is to use the product composition of services related to international CIF-FOB margins: in some ways, this structure might better capture the composition by product of merchanting services if large companies establishing global manufacturing agreements prevail in these services.
- A third option is to use the information made available by five countries in order to calculate an average structure of merchanting activities by product and to apply it to all the countries with no information.

Table 9.1: Composition of merchanting activities by product.
(Percentage)

Product\country	Austria	Estonia	Finland	Poland	Netherlands
Products of agriculture hunting	4.0	2.0	0.0	0.0	0.0
Products of forestry	0.0	0.0	0.0	0.0	0.0
Fish and other fishing products	0.0	0.0	0.0	0.0	0.0
Mining and quarrying	19.0	0.0	0.0	0.0	0.0
Food beverages and tobacco	3.0	6.0	0.0	18.0	10.0
Textiles wearing apparel leather	1.0	4.0	0.0	1.0	0.0
Wood, wood and cork products	1.0	7.0	2.0	0.0	0.0
Paper and paper products	8.0	4.0	72.0	0.0	1.0
Printing and recording services	0.0	0.0	0.0	0.0	0.0
Coke and refined petroleum products	9.0	38.0	0.0	12.0	0.0
Chemicals and chemical products	3.0	6.0	3.0	2.0	13.0
Basic pharmaceutical products	1.0	2.0	0.0	1.0	16.0
Rubber and plastic products	0.0	2.0	20.0	1.0	0.0
Other non-metallic mineral products	1.0	5.0	0.0	0.0	1.0
Basic metals	11.0	0.0	0.0	2.0	0.0
Fabricated metal products	2.0	2.0	0.0	0.0	0.0
Computer electronic, optical products	9.0	3.0	0.0	44.0	29.0
Electrical equipment	1.0	0.0	3.0	4.0	13.0
Machinery and equipment nec	8.0	10.0	0.0	6.0	8.0
Motor vehicles trailers, semi-trailers	2.0	2.0	0.0	4.0	9.0
Other transport equipment	0.0	2.0	0.0	0.0	0.0
Furniture, other manufactured goods	1.0	0.0	0.0	5.0	0.0
Repair services of machinery	0.0	0.0	0.0	0.0	0.0
Electricity gas steam, air conditioning	15.0	0.0	0.0	0.0	0.0
Natural water supply	0.0	0.0	0.0	0.0	0.0
Sewerage services sewage sludge	0.0	3.0	0.0	0.0	0.0
Constructions and construction works	0.0	0.0	0.0	0.0	0.0
Total	100.0	100.0	100.0	100.0	100.0

Source: author, based on Eurostat data and Chong (2015).

We applied the three options carrying out an assessment on the results that concluded that the first option was the preferred one (step 10). So, for the countries without information on the breakdown by product we split the bilateral flows of merchanting activities using the structure of international CIF-FOB margins. Instead, for the countries that provide information on merchanting adjustment by product, we applied a two-step procedure. We first use the structure of international CIF-FOB margins (step 10) to split each bilateral trade flow and obtain an initial structure by product that is different for each trading partner (step 11). Next, we compute the corresponding weighted average structure by product that in a second step is benchmarked using the GRAS method against the product distribution provided by the countries (step 12) to obtain merchanting adjustments split by trading partner and by product (step 13).

A final adjustment is applied to the merchanting estimation obtained so far to obtain the merchanting adjustment database for Figaro (step 14). Even if the merchanting adjustment is usually a positive value representing the merchanting margins that have to be added to the export flows, merchanting might also be negative due to losses and gains, or due to different recording periods between merchants' purchases and sales. For this reason, and due to the fact that the distribution we apply is not proportional to international trade flows, we apply a final correction to avoid creating negative values in international trade flows. There are some cases where the value in international trade flow is close to zero, and we assign a negative adjustment, one that is small but bigger than the initial value. This creates a negative value in international trade flows. For these cases, we assign a final value for the bilateral trade flow equal to zero and we reassign the negative adjustment to the other trading partners and the other products, proportionally to the trade flows ([98]).

Table 9.1 shows the distribution of the merchanting activities across different products for Austria, Estonia, Finland, Poland and the Netherlands. From these data it seems possible to identify two main characteristics of the breakdown of merchanting by product.

First, in all countries these practices tend to be focused on a few products. The exceptions are Austria and Estonia, where more products are involved. In these two countries, seven and eight

([98]) An alternative solution, whenever the merchanting estimation method generates some negatives, is to keep the initial trade value and to reassign the whole value of the adjustment to other trading partners and other products.

product categories respectively account for 80 % of the total merchanting. In Finland, Poland and the Netherlands two, four and five products respectively account for 80 % of total merchanting.

The second characteristic relates to the type of products involved in merchanting. Some products are subject to merchanting in at least three out of the five countries. The products concerned are: food, beverage, and tobacco products; paper and paper products; coke and refined petroleum products; computer, electronic and optical products; and machinery and equipment. This might suggest that some product categories are more likely involved in merchanting practices. Moreover, in some cases these products represent very large shares of total merchanting, such as chemical products in the case of Estonia (38 %), paper products in Finland (72 %), and electronic products in Poland (44 %),

On the other hand, many of the products exchanged under merchanting seem to be very country-specific, and are probably the result of large companies or industrial clusters making use of merchanting agreements. For instance, this is the case of mining and quarrying for Austria, which accounts for 19 % of total merchanting, plastic products for Finland (20 % of total merchanting), and chemicals products and pharmaceutical products for the Netherlands (13 % and 16 %, respectively).

9.3 Conclusions

Under the ESA 2010 accounting system, the principle of ownership must prevail when registering the international trade in goods across different countries. For this reason, in national SUTs tables compiled following the ESA 2010 principles, merchanting agreements — the buying and selling of a product by a country without the product crossing the borders of the country itself — appear as net exports of the products. In the IMTS these exchanges do not appear as they do not involve physical flows of merchandise trade.

Since the two different data — national SUTs and IMTS — are used for the Figaro project, it was necessary to adjust the IMTS data to align the two sources with the same principle of ownership. To adjust the IMTS data we estimated the value of merchanting activities for each country, broken down across the different bilateral trade flows and across the different products involved in merchanting transactions. To estimate the merchanting adjustment we used the information made available by Eurostat as well as the information made available by the Member States. Whenever the available information was not complete, we estimated merchanting adjustments using the OECD data on international CIF-FOB margins.

As a first conclusion, the information made available by countries reveals the importance of getting that information from as many countries as possible. As described above, when we look at the data made available by Eurostat and by a few countries, we find that merchanting activities seem to be related to specific bilateral exchanges and to specific products. Whenever this information is not currently available we estimated merchanting by trading partner and by product, based on the structure of international CIF-FOB margins which turned out to be the one performing best in order to align IMTS data with national SUTs. A detailed analysis of the changes done to the original data can be found in Chapter 13. In any case, future editions of the project should prioritise obtaining more detailed and complete information from the Member States.

Secondly, to compile and apply the merchanting adjustment, the ESA 2010 accounts system sets criteria that are the same for all countries. In practice, however, the difficulty of collecting data on this type of transactions could lead to estimates by the different countries not entirely consistent with each other. Future versions of the Figaro project will need to examine, whenever countries provide more information, whether the merchanting adjustment required to compute the inter-country use tables must somehow adjust to the asymmetries in merchanting estimations across countries, or if it must be in line with the own estimates of the countries, thus leaving differences to be captured in the statistical discrepancy calculated in the Figaro inter-country statistical use table (see Chapter 11).

For the estimation of time series (2011-2016) of Figaro tables in the near future, it is crucial to collect as much information as possible on the split of the merchanting activities in terms of goods traded and trading partners involved. As shown by the available data for a few countries, merchanting activities has a country specific character and therefore, it is not desirable to assume average structures based on all types of goods involved in a country's bilateral flows. The consequences in the analysis done with the Figaro inter-country input-output tables can be very important for some specific sectors such as the food industry in the Netherlands. It is expected that in the follow-up project "Figaro Act I", more country specific data will be used/available and less assumptions made.

10 Direct purchases abroad

10.1 Domestic and national concepts

According to ESA2010 (p. 3.176), direct purchases abroad by residents cover all purchases of goods and services made by residents while travelling abroad for business or personal purposes. The mirror concept to direct purchases abroad is the expenditure by non-resident tourists and business travellers introduced in p. 3.173 (i) and (j) of ESA2010, covering also purchases by non-residents on health and education services; this includes the provision of these services on the domestic territory as well as abroad.

SUTs are valued under the domestic concept, which includes household expenditure by residents and purchases of non-residents in the domestic territory, excluding direct purchases abroad by residents. In contrast, the national concept includes household expenditure by residents both in the domestic territory and abroad but excluding purchases of non-residents in the domestic territory,

The conversion of the total household expenditure from domestic to national concept in the SUTs is made through two additional rows accounting for direct purchases of residents abroad and purchases of non-residents in the domestic territory. The former adds positive values to the household consumption column of the use table and to the column of imports in the supply table, while the latter basically shifts a positive amount from household consumption to exports in the use table, leaving the supply table unchanged.

According to ESA 2010, expenditure carried out by non-resident tourists and business travellers is considered as an export of services and, for the purposes of the supply and use and input-output tables, a breakdown by component products is necessary.

The mirroring expenditure carried out by residents of an economy while travelling abroad for business or personal purposes is an import of services. However, ESA2010 makes a distinction ([99]) between:

- all business-related expenditure by business travellers, classified as intermediate consumption;
- all other expenditure, whether by business travellers or other travellers, classified as household final consumption expenditure.

Hence, households' final consumption expenditure is not the only magnitude affected by these concepts. According to ESA, direct purchases abroad have to be split between intermediate consumption (for business-related expenditure by business travellers) and must be accounted as: (i) intermediate consumption of the branches of activity to which the travellers belong (Eurostat Manual, p. 112); and (ii) household final consumption expenditure (for non-business travellers and non-

([99]) ESA 2010 p. 3.176. This idea is also present in SNA08 p. 8.99. Previously, this distinction was also accounted for in ESA95 p. 3.145 and SNA93 p. 14.111.

related to business expenditure). Of course, this has to be done on the basis of the survey information available for these purposes.

10.2 From national to inter-country supply and use frameworks

Generally, in a national SUT framework, direct purchases abroad and non-resident purchases on the domestic territory are typically included as a lump-sum total without a product breakdown.

Regarding direct purchases abroad by residents, according to the transmission programme for ESA2010, are not included in the column of imports by products and, consequently, they have to be included as a lump-sum total in the bottom part of the supply table to obtain the total value of imports. In the use table, for the sake of balance, a coherent approach is followed and they are also included as a lump-sum total in the column of household final consumption expenditure so that it becomes possible to compute this aggregate in national terms.

As for non-resident purchases on the domestic territory, and according to the transmission programme for ESA 2010, households' final consumption expenditure product includes purchases on the domestic territory by non-residents for the sake of balance of supply and demand. In contrast In contrast, exports do not include them. This is logical since products are bought and often consumed directly in the destination country without crossing borders. As with direct purchases abroad, non-resident purchases on the domestic territory have to be included as a lump-sum total in the bottom part of the use table. This is done by subtracting this value in the column of household final consumption expenditure and adding the same amount in the exports column.

As mentioned above, it is important to note that ESA 2010 recommends that expenditure incurred outside the economic territory be broken down by product. This is necessary to obtain a balance between supply and use by products in national terms and for analysis purposes. However, this breakdown has to be estimated as a special exercise in the statistical compilation process, and it is seldom provided by statistical offices. As far as we know, only the UK statistical office provides this information publicly each year in their input-output SUT framework ([100]).

Considering the available information, the Figaro project produced a bilateral matrix containing all flows by product, country of origin of the product and country of the purchaser, as presented in Table 10.1. This table shows all the information required for the necessary adjustments from national to domestic concepts and vice versa.

Each row of Table 10.1 gives the purchases of every product by country of origin of the purchaser. Since we only have to account for purchases abroad, elements in the country-wise main diagonal are set to 0, meaning that purchases of nationals in their own countries are not included here. Hence, only elements in the off-diagonal of this table are informative.

Every element of Table 10.1 can be interpreted in two ways. Consider the cell highlighted in light grey inside the table. This represents the amount of product 1 consumed by a resident of country 4 in the economic territory of country 3. This element constitutes a non-resident purchase for country 3 and also a direct purchase abroad for country 4.

The total by rows provides the non-resident purchases of a product on the domestic territory of a country. The total by columns provides direct purchases abroad of a country.

([100]) https://www.ons.gov.uk/economy/nationalaccounts/supplyandusetables/datasets/inputoutputsupplyandusetables.

Table 10.1: Bilateral matrix for direct purchases abroad

		Origin of the purchaser				Non-resident purchases on the domestic territory	
Place of purchase	Product classification	Country 1	Country 2	Country 3	Country 4	Σ	Country total
Country 1	Product 1	0					E
	Product 2	0					
	…	0					
	Product n	0					
Country 2	Product 1		0				F
	Product 2		0				
	…		0				
	Product n		0				
Country 3	Product 1			0			G
	Product 2			0			
	…			0			
	Product n			0			
Country 4	Product 1				0		H
	Product 2				0		
	…				0		
	Product n				0		
Direct purchases abroad	Σ	A	B	C	D		

Hence, elements A, B, C and D in Table 10.2 are direct purchases abroad of countries 1, 2, 3 and 4, respectively, and elements E, F, G and H are non-resident purchases on the domestic territory of countries 1, 2, 3 and 4. These total figures are used in national SUTs for national/domestic concept adjustments while the main body of the table provides the product breakdown.

In the Figaro project, direct purchases abroad by residents and purchases of non-residents on the domestic territory are valued at purchasers' prices. This implies that trade flows include non-deductible Value Added Tax (VAT) payments by the corresponding purchasers, particularly those from non-EU countries. Ideally, information about the VAT refunds by country of origin of the visitors and product could be used to refine the geographical distribution of direct purchases abroad and purchases of non-residents on the domestic territory but these are not usually available. In the follow-up project "Figaro Act I", this issue will be addressed as long as more information becomes available.

10.3 Methodology for the estimation of direct purchases abroad

Table 10.1 was fully estimated in two steps. We first balanced bilateral trade flows against their corresponding national accounts values per country and secondly, those were subsequently split by product.

10.3.1 Step 1: National bilateral flows for direct purchases abroad

The first step consists of building a simplified version of Table 10.1 with only national totals for direct purchases abroad (Table 10.2).

Table 10.2: Bilateral matrix for national totals of direct purchases abroad

Place of purchase \ Origin of the purchaser	Country 1	Country 2	...	Country k	Non-resident purchases on the domestic territory
Country 1	0				E
Country 2		0			F
...			0		G
Country k				0	H
Direct purchases abroad	A	B	C	D	

Direct purchases abroad are mostly included in the item 'Travel' in EBOPS 2010 categories. These are goods and services consumed *in situ* or purchased for return to the place of origin of the purchaser. These are mostly travel expenditures by tourists as well. However, not all direct purchases abroad come from the item "Travel" but also from other goods items reported in the balance of payments.

Besides balance of payments, there are other official data sources that can be used to estimate direct purchases abroad, such as tourism satellite accounts, short-term business statistics, transport statistics, the Labour Force Survey (for the estimation of cross-border workers) and structural business statistics. Additionally, specific national surveys (border surveys, accommodation surveys …) carried out to compile tourism satellite accounts can potentially be used to estimate these expenditures.

Additionally, there are other types of direct purchases abroad that are less common and more difficult to quantify such as the imputed rents of non-resident owned dwellings. According to ESA 2010 (par. 4.60) the rental value of owner-occupied dwellings abroad should not be recorded as part of domestic production, but as imports of services. For owner-occupied dwellings owned by non-residents, analogous entries are made, and the rental value of owner-occupied dwellings belonging to non-residents is registered as exports of services. As a result of this, these imputed rents are transactions between residents and non-residents and are part of the direct purchases abroad. Taking into consideration that these are intrinsically secondary dwellings, the valuation of these imputed rents must take into account the same principles applied to the principal dwellings and the valuation of this imputed production should account for the average time of occupation. In the Figaro project, we could not find reliable information to take these imputed rents into account for refining the geographical distribution of the total value of direct purchases abroad per country.

Hence, given the limited data availability of the Figaro project for this purpose, the balanced view of trade in travel services was used as a first estimation of Table 10.2, which was subsequently balanced against the total figures by country provided in the SUTs. For United States, the total values were taken from the OECD inter-country input-output (ICIO) table (edition 2016). The rest of the world figures are calculated as a residual assuming the total value of direct purchases abroad coming from the OECD ICIO tables as fixed, subtracting from this figure the Figaro values of the 28 EU Member States plus the US. For non-resident purchases on the domestic territory, having in mind that at a global level the overall total of direct purchases abroad and purchases by non-residents on the domestic territory must coincide, then we apply an analogous procedure.

10.3.2 Step 2: Splitting by product

After having estimated a bilateral table for national totals that is fully consistent with the world table total figures and with the EU 28 national SUTs, the next step is to split it by product.

For this purpose, only the UK provided information for direct purchases abroad and non-resident purchases on the domestic territory by product. In the absence of further information, we used this information to split UK figures and other EU countries' figures. Although it is true that differences exist in the spending patterns for different countries, depending on the country of origin of the purchaser and other personal circumstances, we also had to assume the same consumption pattern across purchasers given that this information was not available at this level of detail. This implies that every purchaser buys the same basket of goods and services for every EUR 1 spent, regardless of their country of origin or the country of destination.

Hence, total direct purchases abroad by EU countries were split using the UK distribution by product; needless to say that this is a very strong assumption since British people do not buy abroad the same type of goods and services than Austrians or Germans, for instance. Therefore, in order to make the derived product distributions more country–specific, we benchmarked the resulting values to the corresponding shares of the five sub-items of travel services: goods, local transport, accommodation, food-serving, and other services, all given per each country by the balanced view of international trade in services.

In addition, other information about expenditures on tourist trips coming from the annual survey on trips of EU residents (Eurostat) could also be used to further refine the split of direct purchases abroad by product. Indeed, the use of such information together with the tourism satellite accounts will be part of the follow-up project "Figaro Act I".

10.4 Summary and conclusions

Estimating a bilateral matrix for direct purchases abroad is not an easy task. Going from a lump-sum total to a fully-fledged bilateral matrix split by product and country requires many assumptions. It also involves dealing with fragmented information from different sources in a comprehensive approach so that each and every piece of information fits in into the global jigsaw.

As described above, the process can be briefly summarised in two steps:

- Construction of a bilateral trade matrix with overall totals by country;
- Subsequently break down the estimated bilateral trade matrix by product.

In the Figaro approach, we benchmarked the international balanced view of travel services to the national totals of direct purchases abroad and purchases of non-residents in the domestic territory using the GRAS method. Subsequently, using as benchmark the shares (by country) of each of the five travel sub-items according to EBOPS 2010 classification, we split each resulting amount using the UK breakdown by product. This method resulted in a set of bilateral flows split by CPA categories that are fully consistent with the national figures for direct purchases abroad and preserves the balanced view of trade structure across the different sub-items of the travel services for each reporting country.

As a side product from this approach, we also derived country-specific conversion shares of the travel services item from EBOPS 2010 classification to the CPA classification (64 products). And last but not least, the follow-up project "Figaro Act I" will extend this approach in several directions:

- Use tourism statistics such as the annual survey data on trips of EU residents to increase granularity in the breakdown of travel services.
- Use more official data about the product breakdown of direct purchases abroad and non-resident purchases on the domestic territory from national statistical offices.
- Explore the feasibility to make a distinction between business-related and personal travel expenditures. This issue is initially less important since it does not affect the household final consumption expenditure but rather imported intermediate consumption. However, a better fine-tuning of those business-related expenditures (mostly concentrated on accommodation, transport and food-serving services) would lead to a better estimation of personal services. Again the survey on annual data on trips of EU residents may provide good background information to make such distinction, which is seldom found in ITSS.

11 Inter-country supply and use tables

11.1 Introduction

The supply and use tables form a core part of the input-output framework. The **supply table** offers a picture of the supply of goods and services by domestic production and imports. The **use table** describes the use of goods and services for intermediate consumption and final use. In this chapter we describe how the inter-country SUTs were compiled.

Inter-country supply and use tables are mostly based on national SUTs. However, there are some differences between national and inter-country SUTs, for instance, in the valuation of international trade flows and in their components. These differences are summarised below to present the challenges to be faced for the compilation of inter-country SUTs.

Looking at national supply tables, output is valued at basic prices. They also include valuation layers (columns) for taxes less subsidies on products and trade and transport margins. These valuation layers allow for the transformation of total supply at basic prices into total supply at purchasers' prices. The total supply at purchasers' prices is also shown in the supply table. Imports in the supply table are compiled as a single column that shows the total imports of a country broken down by product, and valued in CIF prices, including international freight and insurance costs of international transportation.

Looking at national use tables, these are compiled at purchasers' prices and at basic prices, distinguishing between domestic and import (CIF) intermediate and final uses. As part of the final uses, exports by product are valued in FOB in the use table at purchasers' prices and at basic prices in the use table at basic prices. The use table of domestic production contains exports, while the use table of imports contains re-exports.

By definition, the inter-country SUTs are valued at basic prices. While in the inter-country supply table imports have the same disaggregation and the same valuation as in the national tables, in the inter-country use tables exports — valued in basic prices — are broken down into two additional dimensions compared to the national export data, namely by trading partner and by user.

This chapter describes how the inter-country supply and use tables (11 and 12) are compiled, using the national SUTs and all necessary information to obtain the valuation and the disaggregation required.

11.2 The inter-country supply table

Starting from national supply tables, the compilation of the inter-country supply table is straightforward. In fact, the inter-country supply table is simply the combination of the national tables, one next to the other ([101]). As Figure 11.1 shows, almost all components of the inter-country supply table come directly from the national supply tables; this is true for:

- the matrix of inter-industry output by product in basic prices;
- the rows of CIF/FOB adjustment and direct purchases abroad by residents (labelled in Figure 11.1 as C01 and C02, respectively);
- the rows of market output, output for own final use and non-market output (labelled as P11, P12, and P13, respectively);
- the column of total imports by product in CIF prices (labelled P7);
- the columns of taxes less subsidies and of transport and trade margins (labelled D21x31 and OTTM, respectively).
- the total supply in basic prices (TS_BP) — i.e. the sum of domestic output and imports — and in purchasers' prices (TS_PP) — which includes TTM and TLS.

The additional new element introduced in the inter-country supply table is the column of international insurance costs, trade and transport margins (ITTM), described in 11.3.3. This new column depicts the corresponding sum of import related CIF-FOB margins across all trading partners.

Figure 11.1: Inter-country supply table

	COL_PI (=INDUSE) →	A01	A02	...	U	P1_TC	P7	TS_BP	D21X31	OTTM	TS_PP	ITTM
	COUNTERPART_AREA →	W2	W2	...	W2	W2	W1	W2	W2	W2	W2	W1
REF_AREA (=GEO)	ROW_PI (= PROD_NA) ↓											
AT	CPA_A01			...								
AT	CPA_A02			...								
AT	...	...	...	...	...	...	...	...	...	...	...	...
AT	CPA_U			...								
AT	**P1_TR (=TOTAL)**			...								
AT	C01 (=ADJ_P7)											
AT	C02 (=OP_RES)											
AT	**C03 (=TOTADJ)**			...								
AT	P11			...								
AT	P12	...	...	...	...							
AT	P13											
BE	CPA_A01			...								
BE	CPA_A02			...								
BE	...	...	...	...	...	...	...	...	...	...	...	...
BE	CPA_U			...								
BE	**P1_TR (=TOTAL)**			...								
BE	C01 (=ADJ_P7)											
BE	C02 (=OP_RES)											
BE	**C03 (=TOTADJ)**			...								
BE	P11			...								
BE	P12	...	...	...	...							
BE	P13											
...	...	...	...	...	...	...	...	...	...	...	...	...
US	CPA_A01			...								
US	CPA_A02			...								
US	...	...	...	...	...	...	...	...	...	...	...	...
US	CPA_U			...								
US	**P1_TR (=TOTAL)**			...								
US	C01 (=ADJ_P7)											
US	C02 (=OP_RES)											
US	**C03 (=TOTADJ)**			...								
US	P11			...								
US	P12	...	...	...	...							
US	P13											

Source: Own elaboration.

Note: The yellow areas represent totals; the grey areas represent areas filled with zeros; W1 refers to the rest of the world region; and W2 refers to national totals.

([101]) As explained in chapter 0, an exception is made for the six countries with confidentiality constraints, namely Ireland, Lithuania, Luxembourg, Malta, Poland and Sweden. Their supply tables are shown separately.

11.3 The inter-country statistical use table

11.3.1 Introduction

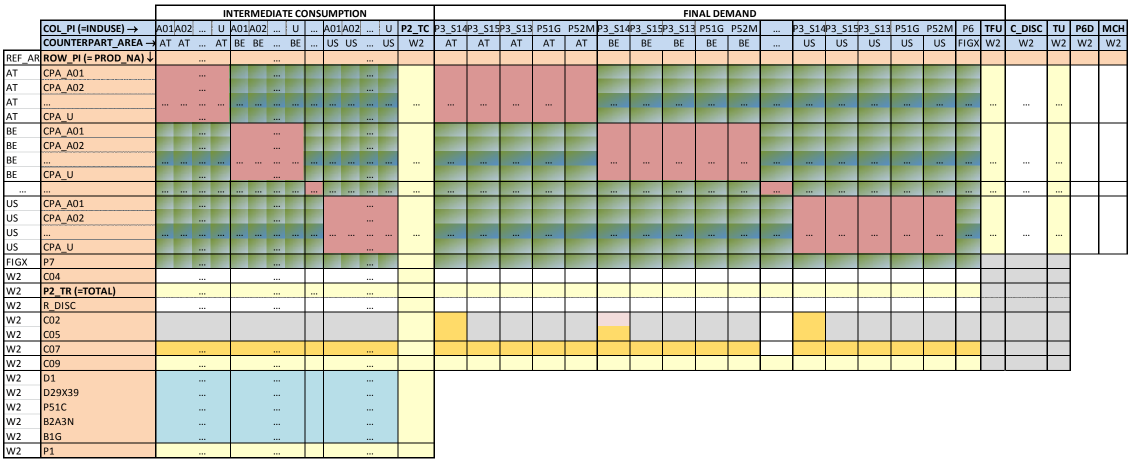
The Figaro project provides a preliminary version of the inter-country use table, which is denoted as "inter-country statistical use table". This table shows explicitly by country and product/industry the discrepancy between trade statistics (adjusted for GSA and MCH) and the trade values reported by national SUTs. Next, the inter-country use table is derived from the inter-country statistical use table by reallocating discrepancies across the corresponding export and import trade values.

To compile the inter-country statistical use table, the main source for domestic uses is the national use tables (described in chapter 0), while the main source for international trade flows is the balanced view of trade in goods (described in chapter 6) and trade in services (described in chapter 7). Since data on international trade flows used to compile the national SUTs tables are different from those of the balanced view of trade, a final column and a final row of discrepancies is added in the inter-country statistical use table to show the differences between the total output/use arising from using the balanced view of trade and the total output/use given by the national use tables. However, there might be other reasons for these discrepancies, such as the adjustments made to align trade statistics to the ESA 2010 economic ownership principle (e.g. GSA and MCH).

The inter-country statistical use table is then transformed into the inter-country use table, which is better suited for analytical purposes since by definition it does not contain the statistical discrepancies described above.

The statistical inter-country use table is represented in Figure 11.2.

Figure 11.2: Inter-country statistical use table



Source: Own elaboration.

Note: the yellow areas represent totals while the red areas represent the intermediate and final use of domestic products. Green blocks seen vertically represent the intermediate and final use of imports by countries of origin. Green blocks seen horizontally represent exports broken down by user and by trading partner. W2 refers to national totals.

As previously outlined, to populate the inter-country statistical use table there are two main data sources that have to be combined:

- data from national SUTs;
- the balanced view of trade in goods and services.

The parts of the table that contain information on the use of domestically produced goods and services (coloured in red in Figure 11.2) are the blocks situated in the main diagonal of the intermediate use and the final use parts. These parts are directly filled in with the national domestic intermediate and final uses reported in the national use tables. These data, broken down by user and product, are valued at basic prices.

Also the blue and orange parts of Figure 11.2 are directly filled in with the information of national use tables. The blue area represents the value added (B1G) and its components: compensation of employees (D1), other taxes less subsidies on production (D29x39), consumption of fixed capital (P51C), and net operating surplus and mixed income (B2A3N). The orange part represents direct purchases abroad by residents (C02), purchases on the domestic territory by non-residents (C05), and taxes less subsidies on products (C07).

The green areas of Figure 11.2 represent, vertically, the intermediate and final use of goods and services produced abroad. In contrast, when presented horizontally they represent exports broken down by user and by trading partner. The main source used to populate these areas is the balanced view of trade in goods and services. As previously described, these data show the balanced bilateral trade flows between the Figaro countries and also with the rest of the world as derived from chapters 6 and 7. This implies that trade asymmetries are removed and exports/imports and mirror exports/imports coincide, being they expressed in FOB. Moreover, as described in Chapters 6 and 7, trade flows have been adjusted to align international merchandise trade statistics with national accounts principles, taking into account goods sent abroad for processing and merchanting activities.

Once the (adjusted) balanced view of trade in goods and services is estimated, the next step is to identify who the import users are or, in other words, the destination users of the country's exports. Subsequently, the resulting inter-country statistical use table has to be converted from FOB to basic prices before compiling the discrepancies and the inter-country use table.

11.3.2 Breaking down trade statistics by user

Figure 11.3 sketches the balanced view of trade in goods and services by product and trading partner.

Figure 11.3: Balanced view of trade statistics

		TOTAL EXPORTS				
	COL_PI (=INDUSE) →	TRADE	TRADE	...	TRADE	TRADE
	COUNTERPART_AREA →	AT	BE	...	US	FIGX
REF_AREA	ROW_PI (= PROD_NA) ↓					
AT	CPA_A01			...		
AT	CPA_A02			...		
AT	...		...	...	...	...
AT	CPA_U			...		
BE	CPA_A01			...		
BE	CPA_A02			...		
BE	...	...		...	...	...
BE	CPA_U			...		
...	...	...	...	...	...	...
US	CPA_A01			...		
US	CPA_A02			...		
US	...	...	...	...		...
US	CPA_U			...		
FIGX						

Source: Own elaboration

Note: the main diagonal blocks represent areas filled with zeros; FIGX represents non-Figaro countries.

Looking at the national SUTs framework, the only matrix that provides a breakdown of international trade flows across users is the national use table of imports, which shows how much intermediate or final users consume of any imported product. In other terms, each row distributes total imports of a given product across all users, and can be used as an average row structure across countries of origin to split such bilateral trade flows.

The national use table of imports is valued CIF, while international trade statistics are valued FOB. Therefore, national use tables of imports have to be previously converted to FOB before using their row structures to distribute total exports by destination users. With this purpose, we estimated a matrix of CIF-FOB margins related to imports by country, product and user on the basis of the OECD database on CIF-FOB margins. Notice that the OECD database did not report such breakdown by user; for which we used the row structures of the national use table of imports in CIF ([102]). Once the CIF-FOB margins matrix is complete for every country, we subtract this matrix from the national use table of imports in CIF to produce the corresponding national use table of imports in FOB.

Next, we compute the row structures of the use table of imports in FOB ([103]), as shown in Figure 11.4 for one specific country *s* and subsequently distribute the balanced bilateral exports by product according to such row structures.

Figure 11.4: **Row structure of the use table of imports**

		INTERMEDIATE CONSUMPTION				FINAL DEMAND						
	COL_PI (=INDUSE) →	A01	A02	...	U	P3_S14	P3_S15	P3_S13	P51G	P52M	**TFU**	**TU**
	COUNTERPART_AREA →	W1	W1	...	W1	W1	W1	W1	W1	W1	W2	W2
REF_AREA	**ROW_PI (= PROD_NA) ↓**			...								
s	CPA_A01			%								100
s	CPA_A02			%								100
s	...	%	%	%	%	%	%	%	%	%	...	100
s	CPA_U			%								100
s	**P2_TR (=TOTAL)**	%	%	%	%	%	%	%	%	%	...	100

Source: author

Note: W1 refers to the rest of the world region; and W2 refers to national totals

In the absence of more specific information, we apply the same distribution by user to all trading partners (countries of origin) of the importing country s. For instance, to distribute by user Austrian imports from Belgium, we apply the row structure of the Austrian use table of imports. The same structure is also used to distribute by user the products that Austria imports from Germany, Italy or any other trading partner.

The exports of Figaro countries to the rest of the world (i.e. the FIGX column in Figure 11.3) are not broken down by user, so these data are directly taken from the international trade. In contrast, the imports of the Figaro countries from the rest of the world (i.e. the FIGX row in Figure 11.3) are broken down by user but not by product. In this case, we have used the total row structure of the national use table of imports in FOB, summed up over products, to distribute country's imports from the rest of the world by users.

In this way we can populate all the trade flows of the inter-country use table. Trade data are in any case still valued FOB. Next, to achieve consistency between the domestic uses and the corresponding trade flows we need to convert them from FOB to basic prices.

11.3.3 From FOB prices to basic prices

The difference between FOB and basic prices consists of the domestic trade and transport margins paid from where the good is produced to the exporting country's border. The information required to transform trade flows from FOB to basic prices are therefore the domestic TTM associated to domestic exports, broken down by user and trading partner. Unfortunately, this information is not readily available. Instead, the national SUTs provide for every country:

- a TTM matrix showing domestic TTM broken down by product and user;
- a column vector of TTM associated with total exports split by product but not by user or trading partner.

These two pieces of information are combined to transform the exports of the inter-country statistical use table from FOB to basic prices as described below.

([102]) Except for gross fixed capital formation and changes in inventories and acquisitions, whenever the national use tables for imports contained negative values we set them to zero.

([103]) Excluding exports, which in the national use table of imports are country's re-exports by definition.

We consider separately two groups of products. The first group — 'the group of goods' — is composed of those products for which the consumer pays transportation and trade margins when buying them. The second group — 'the group of TTM services' — is composed of the services of trade and transport: wholesale and retail trade (corresponding to the NACE classification codes CPA_G45, CPA_G46, and CPA_G47), land, water, and air transport (CPA_G49, CPA_G50, and CPA_G51), warehousing (CPA_H52) and insurance services (CPA_K65). In the national TTM matrix the first group of products has always positive values (i.e. these are TTM paid) while the second group has always negative values (i.e. TTM received by supplying services industries). Besides, it must be verified that for every user (or column of the TTM matrix) the sum of all positive values must coincide with the sum of all negative values since the transformation from basic to purchasers' prices is nothing else than a reallocation of TTM from supplying services industries to goods.

For every country, the conversion process from FOB to basic prices starts with the cell-wise calculation of a share of the values of the TTM matrix over the values reported by the national use table at purchasers' prices. For instance, we compute how much is the share of TTM paid by the Austrian agricultural sector for buying agricultural products. This share might even be different from that of households, for instance, or from any other user. However, in the absence of more specific information, these shares were applied to all exports irrespective of the trading partner. The underlying assumption is that the share of TTM paid over the total value of a product is different across users but it is the same across trading partners. Continuing with the example above, Austrian households and Austrian economic sectors can pay different TTM shares on the same products, but these shares are the same independently of where the exports go.

Once a fully-fledged matrix of TTM paid on exports is split by user and trading partner as described above, then the matrix is rescaled having as benchmark the TTM values by product associated to the exports of goods from the national TTM matrix of the exporting country.

For supplying trade, transport and insurance service industries, the total estimated amount of TTM paid (per user) has to be allocated to domestic trade, transport and insurance services of the exporting country. This assumes implicitly that such services are always done by domestic carriers/traders/insurers, which also implies that CIF-FOB adjustment ([104]) values are set to zero.

Once we have obtained all export-related TTM paid and received broken down by user and trading partner, we transform the inter-country statistical use table from FOB to basic prices.

11.4 The inter-country use table

11.4.1 Introduction

The inter-country use table is compiled on the basis of the inter-country statistical use table by removing its row and column discrepancies. The discrepancy column measures how far a balanced view of trade statistics adjusted for GSA and MCH is from the SUTs trade values for exports in basic prices. The discrepancy row measures how far the resulting total output (mainly driven by the balanced trade values of the imported intermediate inputs) is from the total output in the national SUTs. By doing it this way, we guarantee that GDP and the current account balance of the inter-country use table remain unchanged.

The availability of an inter-country statistical use table is mainly useful for national statistical offices ([105]). Discrepancies provide insight on where international trade in goods and services statistics differ most from national accounts trade figures and where data improvements may be required. Instead, the inter-country use table is mainly thought for analysts, who typically require balanced use tables

([104]) Actually, most of the countries do not report any value for the CIF-FOB adjustment in the national SUTs.

([105]) See http://ec.europa.eu/eurostat/web/links/national_statistical_offices and balanced input-output tables without discrepancies. For the sake of transparency, the Figaro project therefore publishes two different use tables to satisfy both producers and users of SUTs.

Probably the simplest way to achieve a balanced inter-country use table is to use a standard optimisation model or a balancing algorithm such as GRAS (Huang, Kobayashi and Tanji, 2008). We describe below how the Figaro project has produced the inter-country use table, where all discrepancies have been absorbed by the off-diagonal (national) blocs of the inter-country statistical use table, and the steps followed for such a purpose.

11.4.2 Construction of the inter-country use table

The inter-country statistical use table includes one row and one column of discrepancies. Since domestic intermediate and domestic final uses in the inter-country statistical use table are equal to the domestic values declared in the national use tables, the discrepancies just account for the difference between the estimated trade (import and export) values and the trade values reported by the national use tables. This also implies that the corrections made to remove discrepancies have been done only on the import-export side leaving the domestic parts unchanged, although sometimes with exceptions to guarantee the convergence of the GRAS solution (see Figure 11.5).

Among other reasons, Ahmad (2017) suggests that discrepancies may be due to some misclassification of products during the conversion of trade statistics by product to the corresponding products in SUTs or during the balancing of the trade asymmetries in trade in goods and services statistics. Hence, Ahmad (2017) proposes to reduce discrepancies by product by re-classifying bilateral trade flows of products while preserving import (by trading partner) totals in each country. In this way, due to the imposed preservation of imports by trading partner, discrepancies can be reduced but not completely eliminated. The main aim is to allocate differences across products in a way that preserves each country’s recorded imports by industry and the geographical allocation of the balanced view of trade. Ahmad (2017) also suggests doing this correction before splitting the balanced bilateral trade flows of goods and services by user (e.g. intermediate and final uses).

For the Figaro project, we have developed an improved version of the Ahmad's (2017) method that:

- prevents obtaining negative values as a result;
- makes de correction once the split by user has been made on the balanced view of trade adjusted for GSA and MCH in basic prices.

As mentioned above, the main advantages of this improved method are:

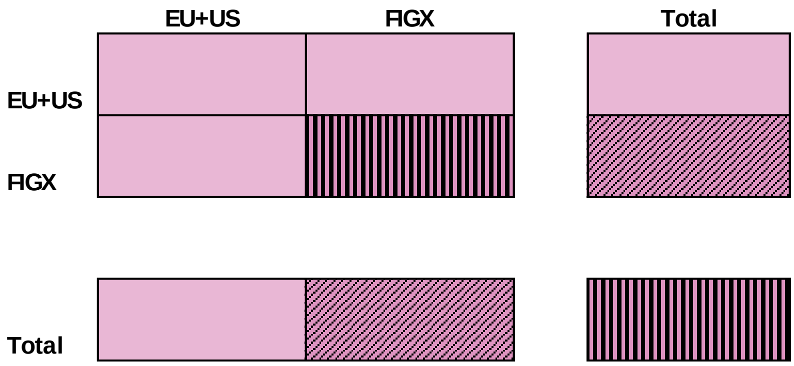
- transparency;
- economic soundness (provided that we are trying to reclassify products into close products according to the size of observed discrepancies);
- preservation of trade flows by trading partner.

Nevertheless, this method would only reduce discrepancies at the product level while remaining the overall total of discrepancies unchanged. This improved version is described in detail in chapter 16 although its practical implementation had to be postponed for the follow-up project Figaro Act I. For the Figaro project, the row and column discrepancies were eventually removed by means of the GRAS method without making any previous corrections for possible misclassification of products.

11.4.3 Setting up targets for removing discrepancies

The GRAS method for balancing matrices needs a prior matrix and row and column targets. Figure 11.5 shows schematically the different blocs involved in the construction of an inter-country use table on the basis of an inter-country statistical use table (prior).

Figure 11.5: Prior and targets



The full pink blocs stand for the elements of the Figaro inter-country statistical use table (leaving aside all domestic parts). They show the estimated bilateral exports and imports within the Figaro countries (28 EU Member States and US) and their estimated exports and imports to/from the rest of the world (FIGX). Besides, national SUTs values give us the target totals of each Figaro country's exports and imports. Evidently, such trade figures do not match each other and consequently there are discrepancies (not shown in Figure 11.5) between the estimations and the target totals.

The blocs with vertical black lines refer to the world total trade value and the bilateral trade within the countries of the rest of the world regions. In view to further integrate the Figaro tables with the OECD global ICIO tables ([106]), we have taken their values for populating these blocs and building up the prior matrix represented by Figure 11.5.

And last but not least, the blocs with thin diagonal stripes represent the total exports and imports of the countries of the rest of the world, which were calculated as the difference between the OECD world trade figure and the estimated Figaro countries' total imports (row target) and as the difference between the world trade figure and the estimated Figaro countries' total exports (column target). As a result, a new row and column of discrepancy has been created for the countries of the rest of the world (FIGX) since the Figaro and the OECD databases are not evidently consistent.

11.4.4 Removing discrepancies, qualitative checks and ad hoc interventions

Since the inter-country statistical use table may contain negative values we used the GRAS method (Huang, Kobayashi and Tanji, 2008) to balance it against the corresponding national SUTs row and column totals. However, the GRAS method may suffer from infeasibilities or can produce meaningless results in the following cases:

- rows and/or columns have all elements equal to zero in the prior matrix and non-zero target values;
- rows and/or columns have zero target but some elements of the prior matrix are different from 0 (regardless the sign of these elements);
- row and/or column sums portray a different sign from their respective target value.

([106]) Since we are only interested in totals, it does not matter that we take the aggregations of an IO table and match them to the equivalent aggregations in a use table.

So therefore, some of the discrepancies have been resolved manually with ad-hoc adjustments to improve the feasibility of the GRAS method. In the first case, having a row full of zeroes and non-zero target values means that no country has reported imports of a given product while the corresponding national SUTs are instead reporting exports of the same product. In this situation, we have allocated the full value of the discrepancy to the exports to the rest of the world (P6-FIGX). It is rather unusual that this situation happens column-wise. That would mean that all imported intermediate inputs are equal to zero with a non-zero value as a target. An analogous solution would be to allocate the discrepancy to imports from the rest of the world (P7-FIGX); however, if there are no domestic uses either then it would be advisable to make the corresponding changes to primary inputs instead.

In the second case, the target values are zero but some of the estimated trade flows in the inter-country statistical use table (by row/column) are non-zero. In this situation, we set all these elements to zero in order to facilitate economic interpretation. This would have been the case anyway if the GRAS method had been applied to a row/column with all positive or all negative values. However, it can also be that positive and negative values may compensate across one row/column leading to a target value equal to zero. If that were the case, we have also set them to zero given the low reliability of such result.

In the third case, if the target value (for a row/column) has a different sign from that of the sum of its corresponding elements in the prior matrix, then the GRAS method may have problems of convergence or produce meaningless solutions (in economic terms). This is particularly the case, for instance, when all the elements in the prior are positive and the target is negative. There are many cases where this situation cannot occur by definition, such as for household consumption and intermediate uses, but in other cases, such as in gross capital formation, the full discrepancy may be allocated to changes in inventories, if feasible. However, this is not always possible for all cases. Ideally, these unusual cases must be studied carefully and should they be found with economic sense other parts of the inter-country statistical use table must be changed instead (e.g. domestic uses, primary inputs – net operating surplus). This is precisely what we had to do in very few cases.

Once the manual adjustments have been made, the GRAS method is implemented to remove the remaining discrepancies and provide the user with a balanced and complete inter-country use table at basic prices. The final rounding balance has been done either on the row of taxes less subsidies on products or on the row of net operating surplus in order to match exactly national SUTs column totals. These changes are typically very small and negligible.

Finally, the resulting inter-country supply and use tables should be benchmarked to the latest national accounts figures (e.g. GDP) given the fact that the SUTs values are not usually updated whenever national accounts revisions take place. However, for the sake of transparency, we have not done this benchmark in the Figaro project yet. By doing so, we hope that EU national statistical offices can understand this way better how their national SUTs were integrated into the resulting EU inter-country supply and use tables. Nevertheless, with a view to the future integration of the Figaro tables with the OECD ICIO tables, the follow-up project "Figaro Act I" will consider benchmarking the resulting inter-country supply and use tables against the latest national accounts figures.

At this point, it is remarkable the huge achievement made by Eurostat and the European Commission's Joint Research Centre in producing the first (experimental) EU inter-country supply and use tables and in setting up a regular process for producing this type of tables on a permanent basis.

12 Inter-country input-output tables

12.1 Introduction

Inter-country input-output tables can be compiled on the basis of inter-country supply and use tables or directly from a collection of national IOTs. However, the data sources required to construct inter-country tables are more aligned with the compilation of inter-country SUTs than with inter-country IOTs.

Indeed, the only comparable and available information for compiling directly inter-country IOTs are national IOTs. Hence, a complete set of homogeneous national IOTs of the same typology (i.e. product-by-product, or industry-by-industry tables) would be required, which is not presently the case for the countries included in the Figaro project ([107]). Moreover, trade statistics are reported by product, which means that industry-by-industry IOTs could only be done with standard assumptions.

Generally speaking, SUTs are closer to statistical data sources since they are the ones describing supply and use of products by groups of firms or industries. IOTs are therefore artificial constructs created for analysts using standard assumptions and providing results that are not observable at all. Hence, in the Figaro project, we have opted for constructing the inter-country input-output tables on the basis of the estimated inter-country supply and use tables instead of building up a similar process as for the use table (see chapter 11) but on the basis of national IOTs.

From inter-country supply and use tables, there are two ways to compile inter-country input-output tables. Either these are compiled using only the standard assumptions ([108]) or combining them with the national input-output tables published by NSOs. In the Figaro project, we have used only standard assumptions (leaving aside available national IOTs) for homogeneity and transparency reasons. Presently, the construction method for IOTs in the NSOs of the EU countries is far from being homogenous. Some of them use extensively the product technology assumption (with different ways to treat the inherent problem of negatives) and others hybrid technology assumptions, for the construction of product by product IOTs. Alternatively, using one single assumption for all the Figaro countries would increase homogeneity in the treatment of the secondary outputs across all countries involved. And last but not least, using one single assumption for all countries also helps identifying the changes made to the original inter-country supply and use tables.

([107]) According to the ESA2010 transmission programme this could be true in the near future, when current derogations expire, at least for product-by-product input-output tables every 5 years.

([108]) For product by product IO tables, these are the product technology assumption (Model A) and the industry technology assumption (Model B); and for industry by industry IO tables, these are the fixed industry sales structure assumption (Model C) and the fixed product sales structure assumption (Model D). See Eurostat (2008) for more details.

12.2 The inter-country input-output table

The standard models for building national IOTs from national supply and the use tables are described in Eurostat (2008) pp. 347-369. Interestingly, the essentials (i.e. the algebra) of these models remain valid for inter-country IOTs. In the end, inter-country supply and use tables can be seen as nothing else than national supply and use tables with a larger number of products and industries broken down by their country of origin (for imports) and their country of destination (for exports).

Table 12.1 shows the inter-country integrated SUT framework of the Figaro project. The number of industries and products is 64 ([109]) and five different components of final uses are distinguished (household consumption; government consumption; consumption of non-profit organisations; gross fixed capital formation and changes in valuables and inventories). Exports to the rest of the world are collapsed into one single column by product and exporting country (FIGX-P6) and imports from the rest of the world, into one single row by user and importing country (FIGX-P7).

The Figaro countries include national supply and use tables for the 28 EU Member States and the US. However, there is no supply and use table for the rest of the world region but rather only information on exports/imports to/from the rest of the world, which ensures the consistency of the system and that balance is achieved in supply and demand for both, total output by products and total output by industries.

Table 12.1: Detailed inter-country integrated SUT framework of the Figaro project

		AT				BE				…	US				AT				BE				…	US				AT				BE				…	US				FIGX			
		CPA_A01	CPA_A02	…	CPA_U	CPA_A01	CPA_A02	…	CPA_U	…	CPA_A01	CPA_A02	…	CPA_U	Industry A01	Industry A02	…	Industry U	Industry A01	Industry A02	…	Industry U	…	Industry A01	Industry A02	…	Industry U	P3_S14	P3_S15	…	P5M	P3_S14	P3_S15	…	P5M	…	P3_S14	P3_S15	…	P5M	P6	Total Intermediate Use	Total Final Use	Total
AT	CPA_A01									…													…													…								
	CPA_A02									…													…													…								
	…									…													…													…								
	CPA_U									…													…													…								
BE	CPA_A01									…													…													…								
	CPA_A02									…													…													…								
	…									…													…													…								
	CPA_U									…													…													…								
…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…
US	CPA_A01									…													…													…								
	CPA_A02									…													…													…								
	…									…													…													…								
	CPA_U									…													…													…								
FIGX	P7									…													…													…								
AT	Industry A01									…													…													…								
	Industry A02									…													…													…								
	…									…													…													…								
	Industry U									…													…													…								
BE	Industry A01									…													…													…								
	Industry A02									…													…													…								
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…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…
US	Industry A01									…													…													…								
	Industry A02									…													…													…								
	…									…													…													…								
	Industry U									…													…													…								
CIF-FOB adjustment										…													…													…								
Direct Purchases Abroad										…													…													…								
Non-resident purchases in the territory										…													…													…								
Taxes less subsidies										…													…													…								
Gross Value Added components	D1									…													…													…								
	D29X39									…													…													…								
	B2A3G									…													…													…								
GVA	B1G									…													…													…								
Total										…													…													…								

As shown in Table 12.1, the national supply tables of the Figaro countries are placed on a bloc-wise diagonal matrix with industries in rows and products in columns (make matrix). This implies that the construction of the inter-country input-output table can be done using the fully-fledged inter-country supply and use matrices, which would also be equivalent to construct the national IOTs separately and then, placing them together into the inter-country IO framework.

([109]) In the published version some products and industries have been aggregated at the request of several Member States due to confidentiality reasons. In any case, the inter-country integrated SUT framework has the same total number of products and industries.

In the Figaro project, we have estimated inter-country product by product and inter-country industry-by-industry input-output tables so that users can decide which type of table to use. The published tables are eventually derived aggregating properly the inter-country input-output tables resulting from the use of confidential and non-confidential data. This last aggregation is absolutely necessary to avoid disclosures of confidential data provided by countries.

Table 12.2: Integrated single-country SUT framework with domestic output and imports

	Domestic products	Imported products	Industries	Final demand	Total
Domestic products			U_d	Y_d	*q-m*
Imported products			U_m	Y_m	*m*
Industries	*V*				*g*
CIF-FOB adj				*C*	*c*
DPA and NRPT				*D*	*d*
TLS			top_u	top_y	*t*
Value Added			*W*		*w*
Total	*(q-m)'*	*m'*	*g'*	*y*	

Models B (industry technology assumption) and D (fixed product sales structure assumption) were applied for the construction of the product-by-product and the industry-by-industry inter-country input-output tables, respectively. The main advantage of these two models (Eurostat, 2008) is that they do not yield negative values in the construction of the inter-country input-output tables.

In Eurostat (2008) pp. 347-357, we can find the description of the analytical transformation processes for deriving the input-output tables with models B and D for a single country SUTs with domestic and imported uses. However, there are differences in an inter-country input-output framework. For instance, exports and imports are not treated equally; while some of them are split by user and trading partner, others are collapsed in one single column/row.

Table 12.3: Integrated inter-country SUT of the Figaro project

	28 EU-MS + US products	28 EU-MS + US industries	28 EU-MS + US final demand	FIGX-P6 Exports	Total
28 EU-MS + US products		U_d	Y_d	*X*	*q-m*
FIGX-P7 imports		U_m	Y_m		*m*
28 EU-MS + US industries	*V*				*g*
CIF-FOB adj		C_u	C_y		*c*
DPA and NRPT			*D*		*d*
TLS		top_u	top_y		*t*
Value Added		*W*			*w*
Total	*(q-m)'*	*g'*	*y*	*x*	

As can be seen in Table 12.2 and Table 12.3 the main difference stems from the different meaning of the "domestic" concept. In national SUTs, the domestic concept is the country itself. Trade outside the country is considered as exports or imports. However, within the inter-country input-output framework, this will depend on the number of countries shown explicitly within the intermediate use matrix and the final use columns. In the Figaro project, the "domestic" concept includes the 28 EU Member States, although the inter-country SUTs also have US as a separate region. Under this "domestic" concept, only extra-EU exports and extra-EU imports are considered as real exports and imports in the same sense as in national SUTs. This applies both for intermediate and final uses.

Another difference between single country and inter-country SUTs has to do with the CIF-FOB adjustment value. Differently from CIF-FOB margins, this value is recorded in national SUTs as a lump sum total to account for the import related transport services done by domestic carriers. The CIF-FOB adjustment is done on the exports column of the national use table. In inter-country SUTs, the same figure reported by the national SUTs is distributed by trading partner and user across one single row.

For inter-country product-by-product IOTs, we used model B (industry technology). The transformation matrix for this model is $\boldsymbol{T} = (\hat{\boldsymbol{g}})^{-1} \cdot \boldsymbol{V}$ and the transformation concerns all intermediate uses in the inter-country use table. By doing this, industry columns are converted into homogenous branches of production (or simply products) according to Table 12.4. The formulas are applied to the fully fledged intermediate use matrix, as explained earlier.

Table 12.4: Transformations in Model B (Eurostat, 2008)

	MODEL B Industry technology Product-by-product Input-Output table
Transformation matrix	$T = (\hat{g})^{-1} \cdot V$
28 EU-MS + US intermediates	$S_d = U_d \cdot T$
FIGX-P7 intermediate imports	$S_m = U_m \cdot T$
CIF-FOB adj	$H_u = C_u \cdot T$
TLS	$trt_u = top_u \cdot T$
Value Added	$E = W \cdot T$

The resulting product-by-product inter-country IOT is described in Table 12.5. Besides, all remaining elements of the inter-country use table not included in Table 12.4 did not change.

Table 12.5: Product by product inter-country input-output table

	28 EU-MS + US products	28 EU-MS + US final demand	FIGX-P6 Exports	Total
28 EU-MS + US products	S_d	Y_d	X	$q-m$
FIGX-P7 imports	S_m	Y_m		m
CIF-FOB adj	H_u	C_y		c
DPA and NRPT		D		d
TLS	trt_u	top_y		t
Value Added	E			w
Total	$(q-m)'$	y	x	

For industry-by-industry inter-country IOTs, we used Model D (fixed product sales structure), whose transformation matrix is $T = V \cdot (\widehat{q-m})^{-1}$.

Table 12.6: Transformations in Model D (Eurostat, 2008)

	MODEL D Fixed product sales structure Industry-by-industry Input-Output table
Transformation matrix	$T = V \cdot (\widehat{q-m})^{-1}$
28 EU-MS + US intermediates	$B_d = T \cdot U_d$
28 EU-MS + US final demand	$F_d = T \cdot Y_d$
FIGX-P6 exports	$N = T \cdot X$

In this case, the product rows from the inter-country use table are transformed into an industry dimension. Expressions are included in Table 12.6 and the resulting inter-country industry-by-industry IOT is given by Table 12.7.

Table 12.7: Industry by industry inter-country input-output table

	28 EU-MS + US industries	28 EU-MS + US final demand	FIGX-P6 Exports	Total
28 EU-MS + US industries	B_d	F_d	N	g
FIGX-P7 imports	U_m	Y_m		m
CIF-FOB adj	C_i	C_f		c
DPA and NRPT		D		d
TLS	J_i	top_u		t
Value Added	E			w
Total	g'	y	x	

It is important to note that the FIGX-P7 imports row remains unchanged because imports are aggregated altogether in a single row and does not distinguish across products.

Finally, a note on confidentiality is in order. Even though the original inter-country input-output tables are derived with both confidential and non-confidential data, there is a last step of aggregation to avoid disclosure of confidential cells in the published inter-country IOTs. Nevertheless, the number of industries and products in the published inter-country IOTs remains being equal to each other in order to facilitate the use of input-output analysis to users.

13 Assessment of the results

13.1 Introduction

The modular approach adopted in the Figaro project to map the different adjustments and imputations to the original data allows each adjustment/imputation to be measured at each stage of the compilation process. These consist of three types of statistics based on:

- the comparison between the international merchandise and services trade data and the trade values in the SUTs, including adjustments for goods sent abroad for processing and merchanting activities;
- the analysis of the row and column total discrepancies by countries, users and products;
- the analysis of the balancing adjustments made to estimate the final inter-country use table without discrepancies, by countries, users and products.

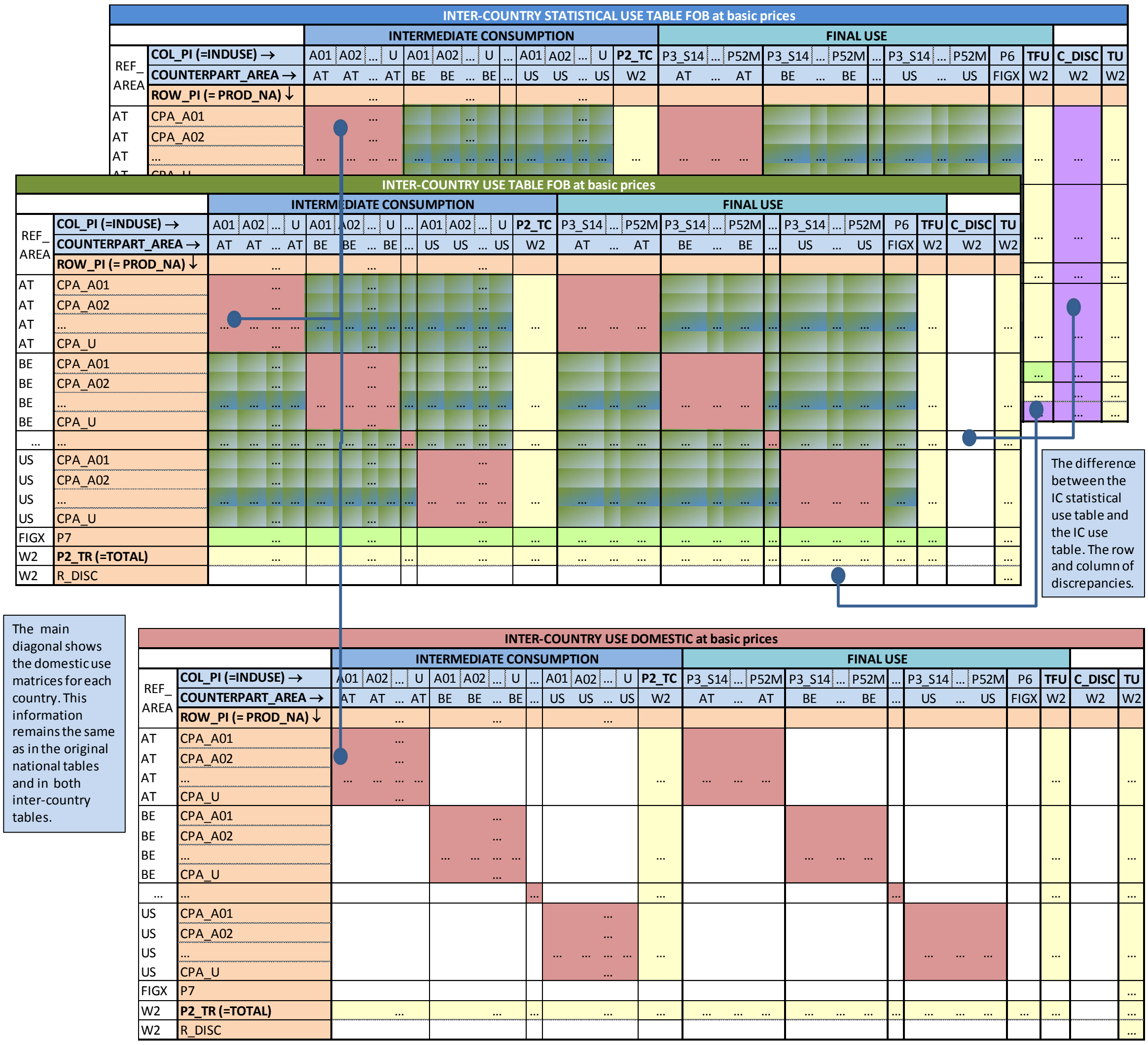
Figure 13.1 provides an overview of the inter-country statistical use table, the inter-country use table and their domestic parts. As can be seen, the main differences between the inter-country statistical use table and the inter-country use table are the total row and column discrepancies. These show the difference between international merchandise and services trade data and the trade values in the SUTs, including adjustments for goods sent abroad for processing and merchanting activities. The main diagonal (domestic) blocs of both use tables come from the original national use tables (T1611) and remain unchanged during the whole process.

Figure 13.2 shows instead the inter-country statistical use table and the inter-country use table, but excluding their respective domestic parts. By difference, we construct a discrepancy matrix, whose row and column sums coincide with those of the inter-country statistical use table.

The total column discrepancy in the inter-country statistical use table is the result of subtracting the estimated sum (across users and trading partners) of the balanced international merchandise and services trade data, adjusted for goods sent abroad for processing and merchanting activities to the total exports column by product from the national use tables (T1611).

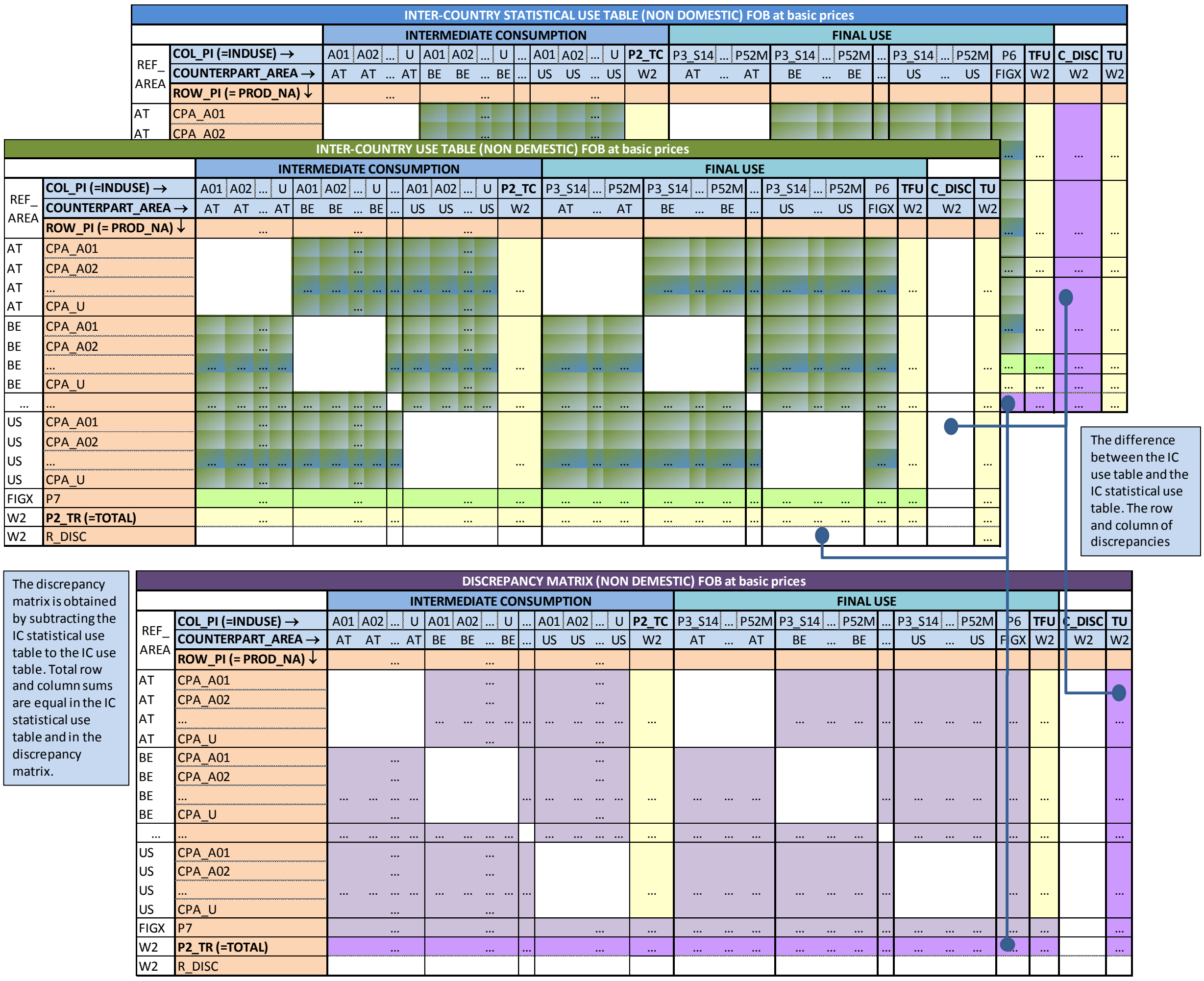
The total row discrepancy in the inter-country statistical use table is the result of subtracting the estimated sum (across products and trading partners) of the balanced international merchandise and services trade data, adjusted for goods sent abroad for processing and merchanting activities to the total imports row by (intermediate and final) user from the national use tables (T1612).

Figure 13.1: The inter-country statistical use table and its components



The GRAS method is used to balance the international merchandise and services trade data with the trade values in the SUTs, including adjustments for goods sent abroad for processing and merchanting activities; or in other words, to set all discrepancies to zero and allocate them throughout the (non-domestic part of the) inter-country statistical use table (see in Figure 13.2 the discrepancy matrix to be used in the GRAS method).

Figure 13.2: **The inter-country statistical use table and its components, excluding domestic parts; and the discrepancy matrix**



13.2 Assessment of the results

13.2.1 International trade data and national SUTs

Bilateral trade asymmetries are one of the main reasons for discrepancies. Ideally, the sum of all EU reported exports to non-EU countries should match their respective reported imports from EU countries, but they actually do not. Indeed, when NSOs compile their national SUTs, they do not have a complete picture of international trade and consequently they cannot make any attempt to balance the existent trade asymmetries. Therefore, our balancing method to remove asymmetries and construct the inter-country SUTs unavoidably makes their exports/imports values deviate from those estimated by NSOs in the national SUTs.

Table 13.1 shows that, in 2010, EU countries reported 3.1% more exports to other EU countries than their respective imports from other EU countries.

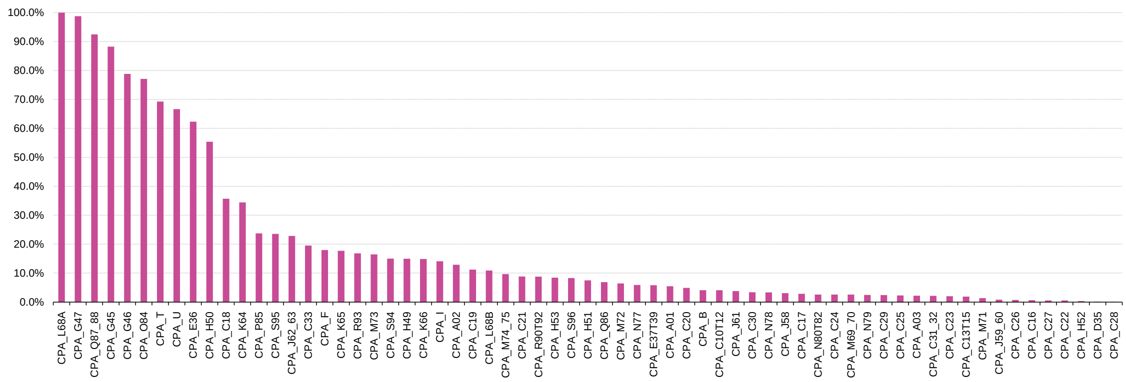
Table 13.1: **Trade asymmetries at EU level, 2010**
(million euros)

EU exports to EU countries	EU imports from EU countries	Asymmetry (million euros)	Asymmetry (%)
2 905 251.4	2 727 591.1	177 660.3	3.1 %

Source: Eurostat (nama_10_exi) and own calculations

At EU level, trade asymmetries however vary very much depending on the product: while their median by product for the EU total is 7.5 %, it ranges from 0.6 % for rubber and plastic products (C22), for example, to 55 % for water transport services or around 90 % for trade services (see Figure 13.3).

Figure 13.3: **Trade asymmetry at EU level, 2010, by product**
(in %)



The following analysis focuses on the comparison between the exports reported by national SUTs and the balanced view of trade, adjusted for GSA and MCH, used to populate the inter-country SUTs. The analysis is made aggregating by country and by product.

A. ANALYSIS BY COUNTRY

On the one hand, we use domestic exports by product from the national use tables of domestic uses. They are valued in basic prices and do not include re-exports. On the other hand, we use export values coming from the balanced view of trade in goods and services, adjusted for GSA and MCH and in FOB values. Such balanced view of trade is constructed following some adjustments made in three stages to the original data. These are:

- Balancing trade asymmetries and estimation of domestic exports and re-exports;
- Adjusting the balanced view of trade with GSA adjustments;
- Adjusting the previous balanced view of trade for MCH activities.

Once these adjustments are made, we compare the resulting balanced and adjusted export values against those coming from the national SUTs. In a comparison across countries, the different valuations (FOB – in each stage – and basic prices) should not affect the results since exports are summed over products in both cases. Nevertheless, this holds only if we assume that only domestic carriers bear the costs of transportation from the border to the domestic purchaser.

Table 13.2: **Exports in national data and in international trade data, and percentage differences, country level**
(million euros)

Country	A National exports data	B Figaro domestic exports	C Figaro exports adjusted for GSA	D Figaro export value, with MCH	E (B-A)/A	F (C-A)/A	G (D-A)/A
Croatia	7 921	15 037	14 325	14 351	90 %	81 %	81 %
Cyprus	6 370	9 963	9 959	10 534	56 %	56 %	65 %
United States	968 665	1 348 730	1 348 730	1 348 730	39 %	39 %	39 %
Belgium	194 306	264 485	260 419	262 665	36 %	34 %	35 %
Portugal	34 213	43 524	42 896	43 265	27 %	25 %	26 %
Greece	39 260	48 766	47 844	47 840	24 %	22 %	22 %
Netherlands	271 445	343 887	322 133	328 202	27 %	19 %	21 %
Denmark	97 595	112 893	112 820	116 537	16 %	16 %	19 %
Finland	69 117	81 901	81 669	81 721	18 %	18 %	18 %
Austria	118 684	141 144	137 520	139 423	19 %	16 %	17 %
France	460 991	539 190	528 246	540 892	17 %	15 %	17 %
Spain	233 661	273 899	268 537	269 440	17 %	15 %	15 %
Estonia	9 181	11 105	10 472	10 564	21 %	14 %	15 %
Slovenia	19 305	22 447	22 003	22 159	16 %	14 %	15 %
Latvia	7 257	8 294	8 183	8 188	14 %	13 %	13 %
Luxembourg	52 229	56 296	56 010	58 695	8 %	7 %	12 %
Sweden	151 010	164 916	163 843	169 578	9 %	8 %	12 %
Czechia	90 837	104 228	101 284	101 508	15 %	12 %	12 %
Malta	8 550	8 099	7 546	7 547	-5 %	-12 %	-12 %
Lithuania	13 577	15 373	14 995	15 036	13 %	10 %	11 %
Italia	375 713	419 430	408 817	410 841	12 %	9 %	9 %
Slovakia	44 692	49 303	48 036	48 038	10 %	7 %	7 %
Bulgaria	16 672	18 685	17 654	17 663	12 %	6 %	6 %
United Kingdom	475 687	527 466	500 801	503 219	11 %	5 %	6 %
Germany	904 335	988 385	939 806	952 526	9 %	4 %	5 %
Hungary	70 595	77 975	72 568	73 717	10 %	3 %	4 %
Ireland	157 810	162 629	161 357	163 614	3 %	2 %	4 %
Poland	133 810	134 143	129 216	129 224	0 %	-3 %	-3 %
Romania	39 445	42 598	38 038	38 099	8 %	-4 %	-3 %
Total	5 072 934	6 034 791	5 875 726	5 933 818	19 %	16 %	17 %

Source: author.

The last row of Table 13.2 shows the total difference summing up all Figaro countries together. In Table 13.2 shows the comparison between the export data coming from the national use tables (column A) and the export values in each of the three stages mentioned above: balanced domestic exports, exports adjusted for GSA and exports adjusted for MCH (or the resulting export values after both adjustments) (columns B, C and D, respectively). Table 13.2 looks at the impact at country level. Countries are sorted in descending order based on the size of the absolute value of the difference between the export value recorded in Figaro and the export value recorded in the national use table (column G). The remaining columns, E and F, show the difference between the export values at each stage and the trade data coming from the national use table.

Table 13.3: Relevance of GSA and MCH adjustments

Country	GSA adjustment	MCH adjustment	GSA share of domestic exports FOB	MCH share of domestic exports FOB	GSA share of GDP	MCH share of GDP
Belgium	-4 066	2 246	-1.5%	0.8%	-1.1%	0.6%
Bulgaria	-1 031	9.0	-5.5%	0.0%	-2.7%	0.0%
Czech Republic	-2 944	224.0	-2.8%	0.2%	-1.9%	0.1%
Denmark	-73.0	3 717	-0.1%	3.3%	0.0%	1.5%
Germany	-48 579	12 720	-4.9%	1.3%	-1.9%	0.5%
Estonia	-633.0	92.0	-5.7%	0.8%	-4.3%	0.6%
Ireland	-1 272	2 257	-0.8%	1.4%	-0.8%	1.3%
Greece	-922.0	-4.0	-1.9%	0.0%	-0.4%	0.0%
Spain	-5 362	903.0	-2.0%	0.3%	-0.5%	0.1%
France	-10 944	12 646	-2.0%	2.3%	-0.5%	0.6%
Croatia	-712.0	26.0	-4.7%	0.2%	-1.6%	0.1%
Italy	-10 613	2 024	-2.5%	0.5%	-0.7%	0.1%
Cyprus	-4.0	575.0	0.0%	5.8%	0.0%	3.0%
Latvia	-111.0	5.0	-1.3%	0.1%	-0.6%	0.0%
Lithuania	-378.0	41.0	-2.5%	0.3%	-1.3%	0.1%
Luxembourg	-286.0	2 685	-0.5%	4.8%	-0.7%	6.7%
Hungary	-5 407	1 149	-6.9%	1.5%	-5.5%	1.2%
Malta	-553.0	1.0	-6.8%	0.0%	-8.4%	0.0%
Netherlands	-21 754	6 069	-6.3%	1.8%	-3.4%	0.9%
Austria	-3 624	1 903	-2.6%	1.3%	-1.2%	0.6%
Poland	-4 927	8.0	-3.7%	0.0%	-1.4%	0.0%
Portugal	-628.0	369.0	-1.4%	0.8%	-0.3%	0.2%
Romania	-4 560	61.0	-10.7%	0.1%	-3.6%	0.0%
Slovenia	-444.0	156.0	-2.0%	0.7%	-1.2%	0.4%
Slovakia	-1 267	2.0	-2.6%	0.0%	-1.9%	0.0%
Finland	-232.0	52.0	-0.3%	0.1%	-0.1%	0.0%
Sweden	-1 073	5 735	-0.7%	3.5%	-0.3%	1.6%
United Kingdom	-26 665	2 418	-5.1%	0.5%	-1.4%	0.1%
United States	-	-	-	-	-	-
Total	- 159 064	58 089	-2.6%	1.0%	-1.2%	0.5%

Source: Author and Eurostat (t_nama_10_ma)

For 20 countries the percentage difference between the Figaro data and the national SUT data is more than 10 %. In particular, two countries record differences higher than 50 %: Croatia (81 %) and Cyprus (65 %). For another 5 countries the difference is also higher than 20 %: the US (39 %), Belgium (35 %), Portugal (26 %), Greece (22 %) and the Netherlands (21 %).

In total, the difference between the estimated data used in Figaro and the data in the national tables is around 17 %. The initial difference between the two sources used is 19 %. The adjustment that considers GSA seems to actually align the two sources more, reducing the gap about 3 percentage points, but the third adjustment adds one percentage point more to the difference, because of MCH.

As expected, most of the variation between international trade statistics used in the Figaro project and national SUT data is largely due to the balancing of trade asymmetries (column E). This result highlights a very marked impact of eliminating asymmetries that would deserve further analysis in the near future.

Table 13.3 shows the relevance of the GSA and MCH adjustments over the GDP and estimated balanced domestic exports of EU countries. In terms of GDP, the top-5 countries where the GSA adjustments are bigger are: Malta (8.4%), Hungary (5.5%), Estonia (4.3%), Romania (3.6%) and the Netherlands (3.4%). The same five countries (but with slightly different order) reported the biggest GSA adjustments also in terms of balanced domestic exports. Adjustments for merchanting activities represent in Luxembourg 6.7% of its GDP while 4.8% in terms of its domestic exports. Other countries such as Cyprus (3%), Sweden (1.6%), Denmark (1.5%) and Ireland (1.3%) also reported large shares of MCH adjustments in terms of their respective GDP.

B. ANALYSIS BY PRODUCTS

For the analysis by products we compare only the national data coming from SUTs (column A in Table 13.4) with the balanced domestic exports given by the inter-country statistical use table (column B in Table 13.4), both in basic prices. We cannot compare national SUT export values with the Figaro trade estimates at each of the three stages mentioned above simply because they are valued in FOB and therefore, it would be difficult to isolate how much of the difference is obviously due to the different valuation or due to other reasons. This is particularly relevant for products involved in the transformation from FOB to basic prices, such as wholesale and retail trade (corresponding to the NACE classification codes CPA_G45, CPA_G46, and CPA_G47), land, water, and air transport (CPA_G49, CPA_G50, and CPA_G51), warehousing (CPA_H52) and insurance (CPA_K65).

In Table 13.4, rows are products sorted by size in percentage terms (column C) of the absolute value of the differences between the balanced domestic exports of the Figaro tables and the national SUT export values. Column D shows the cumulative weight of each product on the total difference between the Figaro data and the national SUT data.

Although CPA_T (activities of households as employer) and CPA_Q87_88 (social work activities) turned out to be the products that had the biggest relative difference between the two data sources, their relative weight on the total difference is negligible. Instead, for the product N_77 (rental and leasing activities) there is a very high difference between the Figaro tables and the national data, and this alone explains 33 % of the total difference, of which more than a half comes from US and almost 40 % from the United Kingdom (9 %), Germany (7 %), France (5 %), Italy (4 %), the Netherlands, Spain and Denmark (3 % respectively).

Other relevant products affecting greatly the total difference are CPA_I (accommodation, food and beverage service activities), CPA_J58 (publishing activities), CPA_K64 (financial service activities, except insurance and pension funding), CPA_C26 (manufacture of computer, electronic and optical products), and CPA_G46 (wholesale). In particular, US have the biggest differences in CPA_K64 and CPA_C26, with 50 % and 74 % of the total difference, respectively. For the remaining products (CPA_I, CPA_J58 and CPA_G46), the difference is spread across countries, mostly affecting Germany, France, Italy, Ireland, the Netherlands, Spain and the United Kingdom.

Table 13.4: Export in national data and in international trade data, and percentage differences, product level
(million euros)

Product	A Exports National Data	B FIGARO Final Export	C (B-A)/A	D Cumulative weight on total difference	Product	A Exports National Data	B FIGARO Final Export	C (B-A)/A	D Cumulative weight on total difference
CPA_T	16	3,218	20462%	0%	CPA_J59_60	24,179	17,516	-28%	78%
CPA_Q87_88	25	288	1056%	0%	CPA_M69_70	104,940	76,159	-27%	80%
CPA_N77	54,615	630,026	1054%	33%	CPA_B	63,234	80,126	27%	81%
CPA_I	30,614	119,063	289%	38%	CPA_D35	16,531	20,870	26%	81%
CPA_J58	54,451	199,913	267%	46%	CPA_M72	47,455	35,577	-25%	82%
CPA_N79	6,954	17,752	155%	47%	CPA_G46	364,953	279,495	-23%	87%
CPA_N78	38,764	2,601	-93%	49%	CPA_J61	38,004	30,946	-19%	87%
CPA_C18	6,956	529	-92%	49%	CPA_S94	274	322	18%	87%
CPA_S95	1,820	276	-85%	49%	CPA_H52	60,671	51,088	-16%	88%
CPA_S96	2,427	495	-80%	50%	CPA_C27	148,848	170,611	15%	89%
CPA_E36	197	40	-80%	50%	CPA_C24	199,936	228,208	14%	91%
CPA_K66	49,432	11,960	-76%	52%	CPA_A03	3,935	4,482	14%	91%
CPA_N80T82	51,632	14,119	-73%	54%	CPA_M73	33,139	29,343	-11%	91%
CPA_H53	17,068	4,947	-71%	55%	CPA_C29	381,755	423,687	11%	93%
CPA_R90T92	10,093	17,126	70%	55%	CPA_J62_63	88,871	79,464	-11%	94%
CPA_L68	7,170	11,828	65%	55%	CPA_C22	109,947	120,499	10%	94%
CPA_O84	4,686	7,376	57%	55%	CPA_C31_32	96,312	105,531	10%	95%
CPA_P85	6,029	9,105	51%	56%	CPA_C20	361,498	394,645	9%	97%
CPA_R93	2,024	1,018	-50%	56%	CPA_A02	3,503	3,766	8%	97%
CPA_C13T15	94,274	137,371	46%	58%	CPA_C16	31,976	33,813	6%	97%
CPA_Q86	2,367	1,321	-44%	58%	CPA_F	16,812	15,930	-5%	97%
CPA_K64	156,572	90,185	-42%	62%	CPA_C30	149,974	157,404	5%	97%
CPA_C26	220,744	311,553	41%	67%	CPA_C10T12	258,896	270,978	5%	98%
CPA_M71	63,477	40,026	-37%	68%	CPA_A01	89,738	93,806	5%	98%
CPA_C33	13,105	8,484	-35%	69%	CPA_C19	169,599	162,350	-4%	99%
CPA_C21	142,949	190,377	33%	71%	CPA_C17	81,727	85,186	4%	99%
CPA_G45	44,527	58,801	32%	72%	CPA_C28	390,384	406,056	4%	100%
CPA_H51	68,446	47,676	-30%	73%	CPA_E37T39	52,060	50,173	-4%	100%
CPA_K65	48,003	33,811	-30%	74%	CPA_C25	108,302	106,932	-1%	100%
CPA_H50	109,258	77,047	-29%	76%	CPA_H49	91,586	90,446	-1%	100%
CPA_M74_75	21,925	15,485	-29%	76%	CPA_C23	49,735	50,294	1%	100%
CPA_G47	103,539	133,617	29%	78%					

Source: Author.

13.2.2 Analysis of discrepancies

In this section, we analyse the results of the total row and column discrepancies that resulted from building the inter-country statistical use table.

Figure 13.4: Approach to analyse total row and column discrepancies

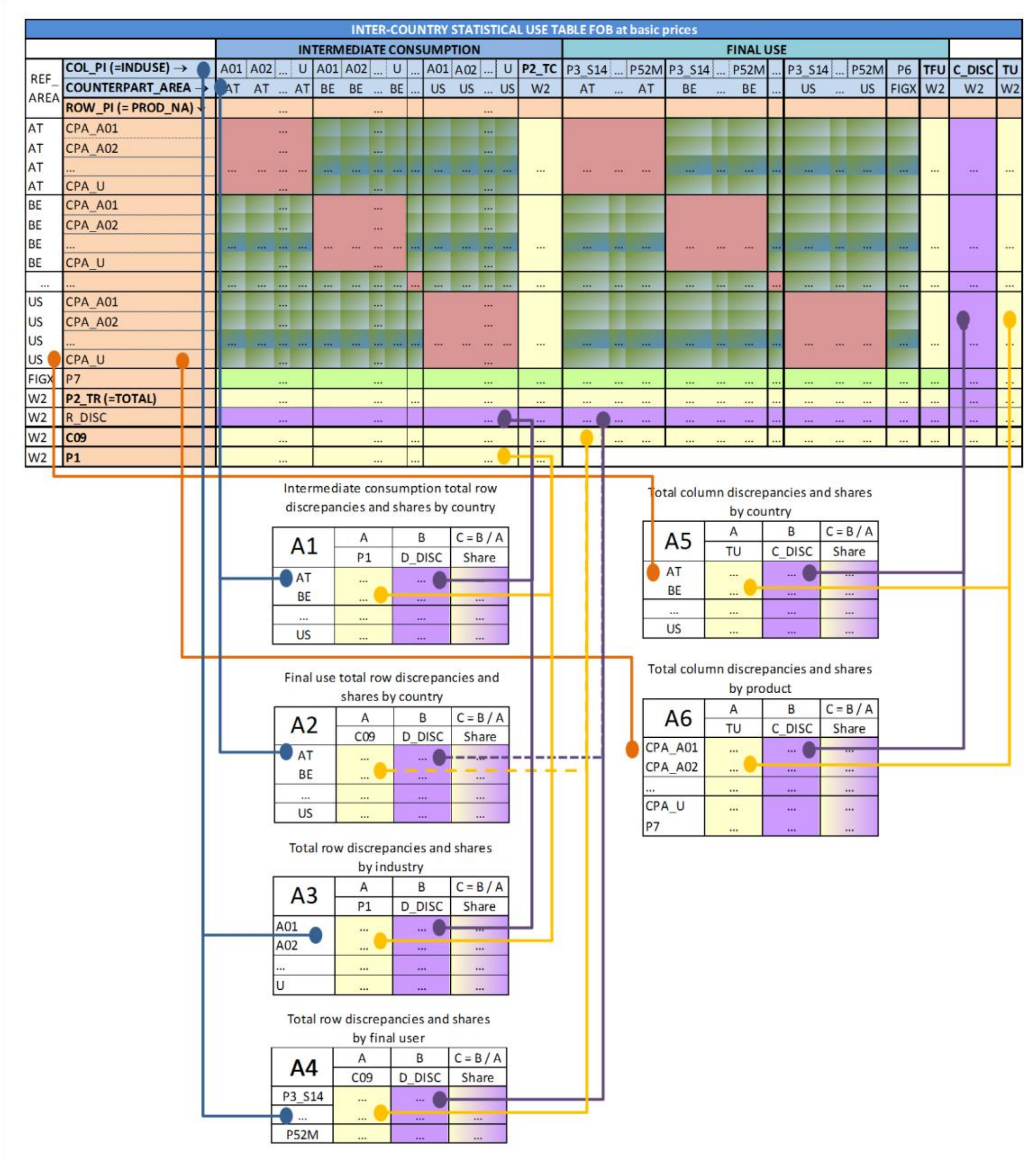


Figure 13.4 provides a diagram to guide the reader across the comparative analysis carried out in this section. For the sake of clarity, we have aggregated the total row and column discrepancies into six tables (A1 to A6) with different dimensions. A1 to A4 correspond to the row discrepancies distinguishing between intermediate consumption (A1 – by country – and A3 – by industry) and final uses (A2 – by country – and A4 – by final user). A5 and A6 serve to analyse the total column discrepancies by country (A5) and product (A6).

The analysis of discrepancies should not consider only the magnitude of the discrepancy itself and its relationship with respect to its overall total but also its share with respect to the corresponding target values. For instance, in the case of the total row of discrepancies (aggregates A1 to A4), it is also important to know the share of the discrepancy with respect to: (i) total output (P1) for the intermediate consumption; and (ii) total final use (C09). This applies in each of the cases by country, by industry or by product, respectively. In the case of the total column of discrepancies, the share is estimated with respect to the total use (TU) of the country or total use of the product. In Figure 13.4 for all aggregates A1 to A6, column C provides the shares, and these are obtained by dividing column B over column A. The reference variables are therefore total output (P1) and total final use (C09) for the total row of discrepancies and total use (TU) for the total column of discrepancies.

The following graphs and analyses refer to the information provided by the six specific aggregates shown in Figure 13.4 or a combination of them. We will start with the analysis of the total row of discrepancies, for the part of intermediate consumption (A1 and A3) and then, for final uses (A2 and A4). Subsequently, we will address the analysis of the total column of discrepancies (A5 and A6).

The results of aggregates A1 to A6, except for A4, will be presented with one single figure, each one separated in four different layers displaying their different dimensions in four smaller charts. Charts 1 depict the net and absolute sums of the discrepancies, ranking the top-five countries, products or industries, depending on the case. These charts deal with the positive, negative, and net and absolute sums of the discrepancies, divided into two different scale horizontal bar graphs (see Figure 13.5 as an example). The top horizontal bar graph contains the highest absolute discrepancy and the rest of the group (e.g. countries) considered, while the bottom graph shows the next four highest absolute discrepancies. These two graphs show the range of differences between positive and negative discrepancies that produce its net sum in each specific aggregation.

Charts 2 identify where the absolute sums of discrepancies are mostly concentrated by country, product and industry/user, depending on the case. This chart shows a pie graph with two layers. The inner layer of the pie depicts the six highest absolute sums of discrepancies (as in chart 1) and the share they represent over the total output or total use, depending on the case, in square coloured boxes. The colours are associated to the same countries both in charts 1 and 2 to ease the interpretation. The outer part of the pie considers the top-3 absolute sums of discrepancies and the rest is grouped together ("Rest"). For example, in Figure 13.9, the inner pie represents the countries and the outer pie stand for industries, within countries.

At the bottom, charts 3 break down the net sum of discrepancies and their shares over the total output or the total use, depending on the case. This chart considers the net sum of discrepancies and the shares in two different axes, one in euro magnitudes (in bars) and the other one in percentage values (shown by the diamond icon). This chart is sorted by the size of the net sum of discrepancies.

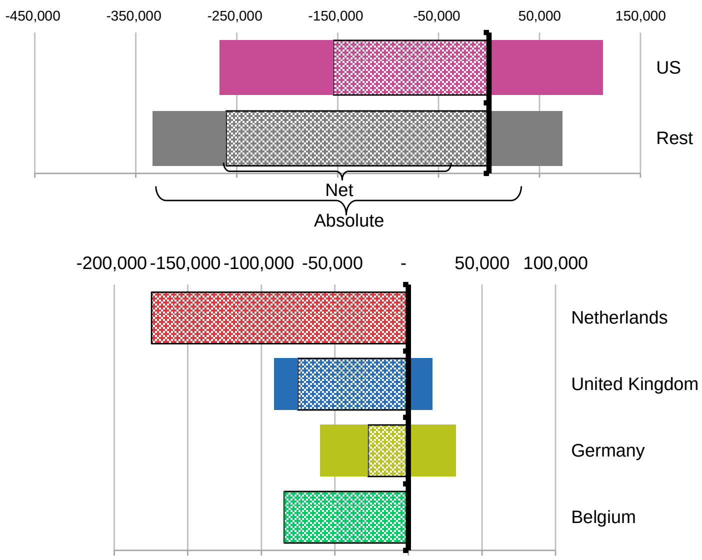
Chart 4 eventually deals with the top-9 shares of the net sums of discrepancies over their corresponding total output or total use, depending on the case. Here, the chart contains two different axes and it is sorted by the size of the shares.

A. DISCREPANCIES IN INTERMEDIATE CONSUMPTION BY COUNTRY

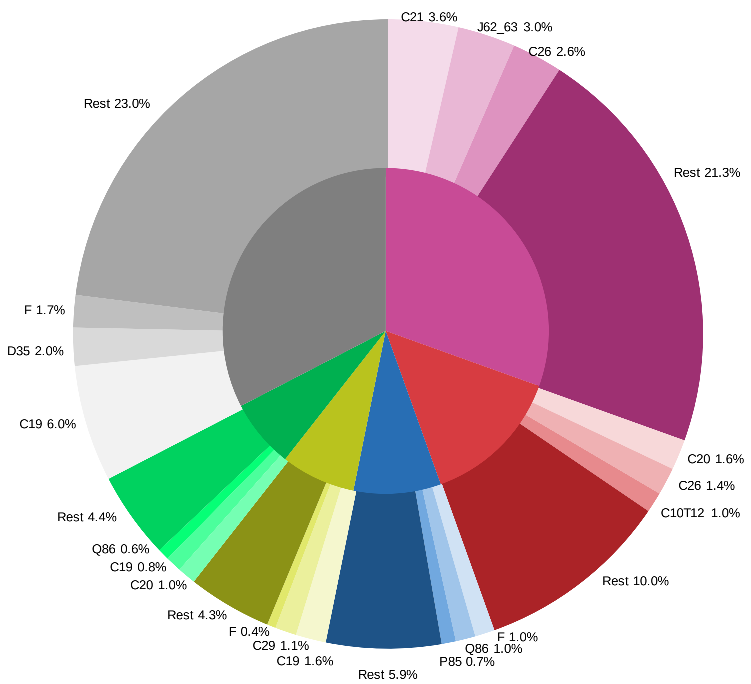
As shown in Figure 13.5 (charts 1 and 2), US accounts for 30 % of the total absolute discrepancies, representing -1.9 % of the share with respect to its total output (P1). The Netherlands (14 %), UK (9 %), Germany (7 %) and Belgium (7 %) have the four biggest absolute discrepancies. By looking at the industry level, we found that three largest discrepancies are found in the following US industries: 'Manufacture of basic pharmaceutical products and pharmaceutical preparations' (C21), 'Computer programming consultancy and information service activities' (J62_63) and 'Manufacture of computer electronic and optical products' (C26), with 3.6 %, 3 % and 2.6 %, respectively. In addition, the discrepancies of the 'Manufacture of chemicals and chemical products' (C20) in the Netherlands and the 'Manufacture of coke and refined petroleum products' (C19) in Germany represent 1.6 % of their respective total outputs. For the other remaining countries, the 'Manufacture of coke and refined petroleum products' (C19), 'Electricity gas steam and air conditioning supply' (D35) and 'Construction'' (F) industries accounted for 6 %, 2 % and 1.7 %, respectively.

Figure 13.5: Analysis of the total row discrepancies; net and absolute sum of discrepancies by country and industries (relates to A1 in Figure 13.4).

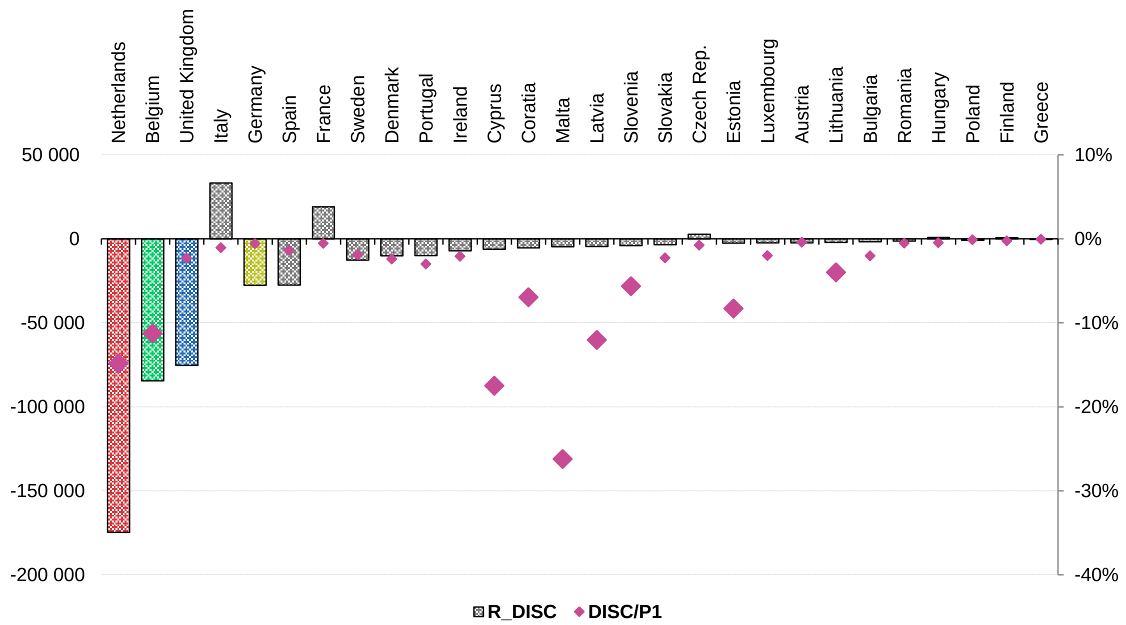
1. Positives, negatives, net and absolute sums of discrepancies; Top 5 countries



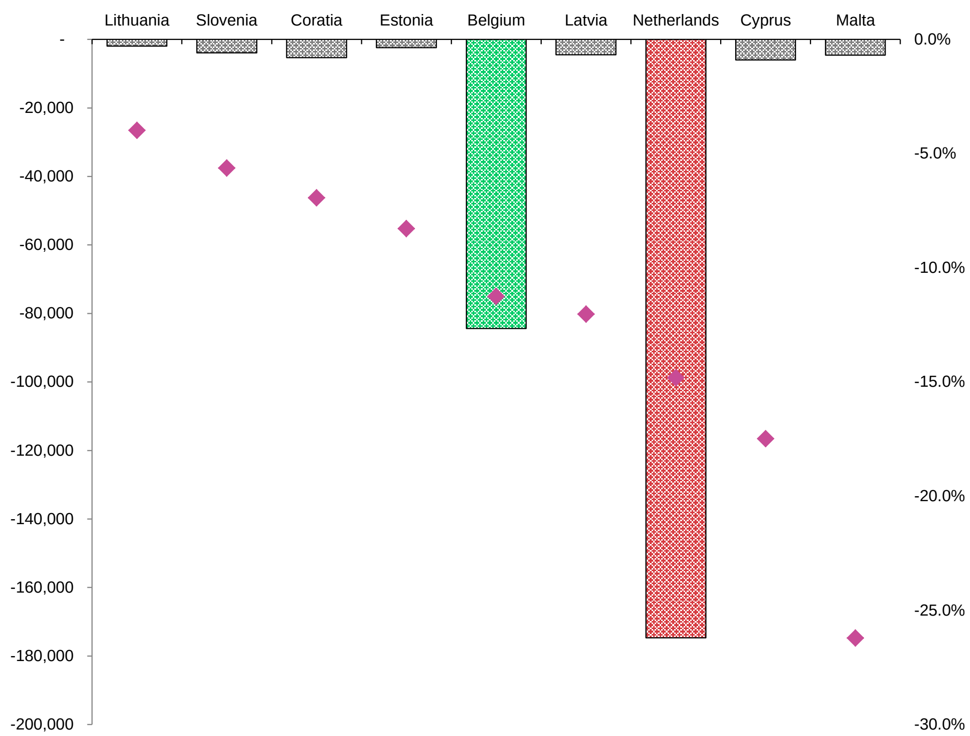
2. Distribution of the absolute discrepancies by country and by industry



3. Total row net sum of discrepancies and shares by EU countries with respect to output in the inter-country statistical use table, sorted by size



4. Top 9 shares over output by country; Net sum of discrepancies and shares



Source: Author.

Analysing the row net sum of discrepancies and shares by EU countries (Figure 13.5 – charts 3 and 4) the Netherlands, Belgium and UK account for more than 80 % of the total net sum of discrepancies in the EU. The Netherlands stands out with EUR -174 684 million, more than twice the sum of Belgium and the UK at EUR -84 444 and EUR -75 267 million, respectively. Italy has a positive net sum of discrepancies of EUR 33 379 million, while Germany and Spain recorded discrepancies of around EUR -27 500 million each. The rest of the European countries have a net sum of discrepancies below EUR 20 000 million in absolute values.

Considering the shares of the net sum of discrepancies compared with the total output (P1) of each country, Malta has the biggest share with -26.2 %, followed by Cyprus (-17.5 %), the Netherlands (-14.8 %), Latvia (-12 %) and Belgium (-11.3 %). Most countries have shares below -3 %, apart from Croatia, Slovenia, Lithuania and Estonia, which have shares between -4 % and -8 %. Nevertheless, these sums of net discrepancies are generally small in absolute values except for the Netherlands and Belgium, whose shares are both above 10 % with a significant amount of a net sum of discrepancies in intermediate consumption (see chart 4 in Figure 13.5).

To sum up, the analysis show that Belgium and the Netherlands are countries that would deserve special attention in future work regarding intermediate consumption of industries; leaving aside US, with a large discrepancy value that only represents a smaller part of its total output. Interestingly, the Figaro tables have generally overestimated the domestic exports attributed to Belgium and the Netherlands in comparison with the trade values reported by the respective national SUTs. Evidently, the assumptions made on the treatment of goods sent abroad and merchanting due to the lack of information in these countries might have played a role on this result. A similar reasoning applies to the estimation of re-exports in merchandise trade and the balancing of the trade asymmetries.

B. DISCREPANCIES IN INTERMEDIATE CONSUMPTION BY INDUSTRY

Figure 13.6 shows the breakdown of the row total intermediate consumption discrepancies by industry (A3 in Figure 13.4). The distribution is more spread than in the previous case.
The top-5 industries account for 30 % of the overall absolute sum of discrepancies. These five activities are 'Manufacture of coke and refined petroleum products' (C19), 'Manufacture of computer electronic and optical products' (C26), 'Construction'' (F), 'Manufacture of basic pharmaceutical products and pharmaceutical preparations' (C21) and 'Wholesale trade except of motor vehicles and motorcycles' (G46) with 10 %, 6 %, 5 %, 5 % and 4 %, respectively. The biggest net sum of discrepancies is reported by the 'Manufacture of coke and refined petroleum products' industry (C19) with EUR 92 714 million, around double the net sum of discrepancies of each of the other top-5 industries, which range between EUR -35 906 million and EUR -60 512 million.

In Figure 13.6 (chart 2) the outside ring shows that absolute sum of discrepancies of the other remaining industries is mostly concentrated in the US (20.6 %), followed by the Netherlands and the UK with 10.4 % and 6.8 %. The rest of the other countries are all below 2 %.

In charts 3 and 4 of Figure 13.6, the highest shares are concentrated in 'Manufacture of basic pharmaceutical products and pharmaceutical preparations' (C21), 'Manufacture of coke and refined petroleum products' (C19) and 'Travel agency tour operator reservation service and related activities' (N79) with -15.1 %, 10.7 % and -10.5 %, respectively. All other negative shares in all industries are below 9 %.

Leaving aside US, it can be concluded that the intermediate consumption of the 'Manufacture of basic pharmaceutical products and pharmaceutical preparations' (C21) and the 'Manufacture of coke and refined petroleum products' (C19) deserve special attention in future work, both in absolute and relative terms. Interestingly, the Figaro tables have underestimated the EU exports of refining petroleum products (C19) and overestimated the EU exports of pharmaceutical products (C21).

C. DISCREPANCIES IN FINAL USE BY COUNTRY

The absolute sum of discrepancies in final uses is much more concentrated among a few countries than for intermediate consumption. The top-5 countries account for 77 % of the overall absolute sum of discrepancies. The US accounts for 40 %, with a net sum of discrepancy of EUR -154 121 million, followed by the Netherlands (18 %), Belgium (9 %), Germany (5 %) and Italy (5 %) with net sum of discrepancies of EUR -68 451 million, EUR -34 075 million, EUR -10 502 million and EUR 16 939 million, respectively (chart 1 in Figure 13.7).

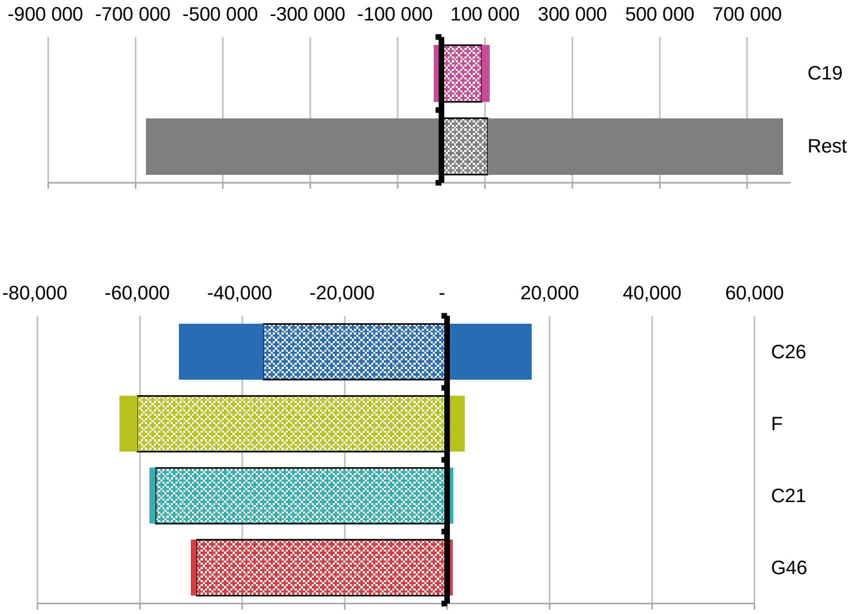
In addition, more than 90 % of the overall absolute sum of discrepancies are concentrated in the 'Final consumption expenditure by households' (P3_S14) and 'Gross fixed capital formation' (P51G), with 59.2 % and 32.5 %, respectively (see chart 2 in Figure 13.7).

Regarding the net sum of discrepancies, US is a specific case since the share of its net sum of discrepancies is just -0.3 % of its total final use, although it accounts for the highest net discrepancy (EUR -154 121 million) among the Figaro countries. In contrast, in the case of the EU (charts 3 and 4 in Figure 13.7), the net sum of discrepancies in Luxembourg represents the highest share with respect to its total output (-19.7 %) but also the smallest net sum of discrepancies in absolute terms (EUR -252 million). As shown in Figure 13.7 (chart 4), Luxembourg is followed by Latvia (-15 %), Malta (-14.6 %), the Netherlands (-11.8 %) and Lithuania (-10.6 %) with shares over 10 % of their total output. It is remarkable the case of Belgium, where the share of its net sum of discrepancies is -9.5 % of its total output with also a sizeable amount (EUR -34 075 million) in absolute terms. Cyprus (-9.4 %) and Croatia (-6.6 %) followed Belgium, while all of the other EU countries have shares below -4 %. In most cases, the net sum of discrepancies is small in absolute terms, even with big shares in a few cases.

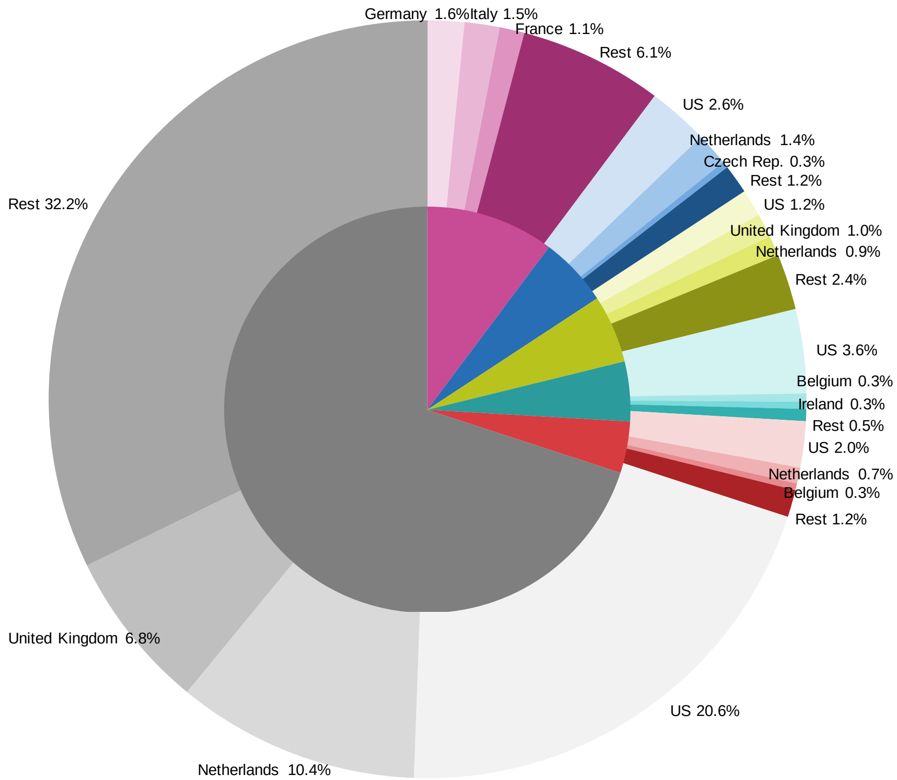
As for intermediate consumption, we can conclude that the Netherlands and Belgium are again countries presenting large shares and substantial net sums of discrepancies in absolute terms, thus deserving special attention in future work.

Figure 13.6: Analysis of the total row discrepancies; net and absolute sum of discrepancies by industry and countries (relates to A3 in Figure 13.4)

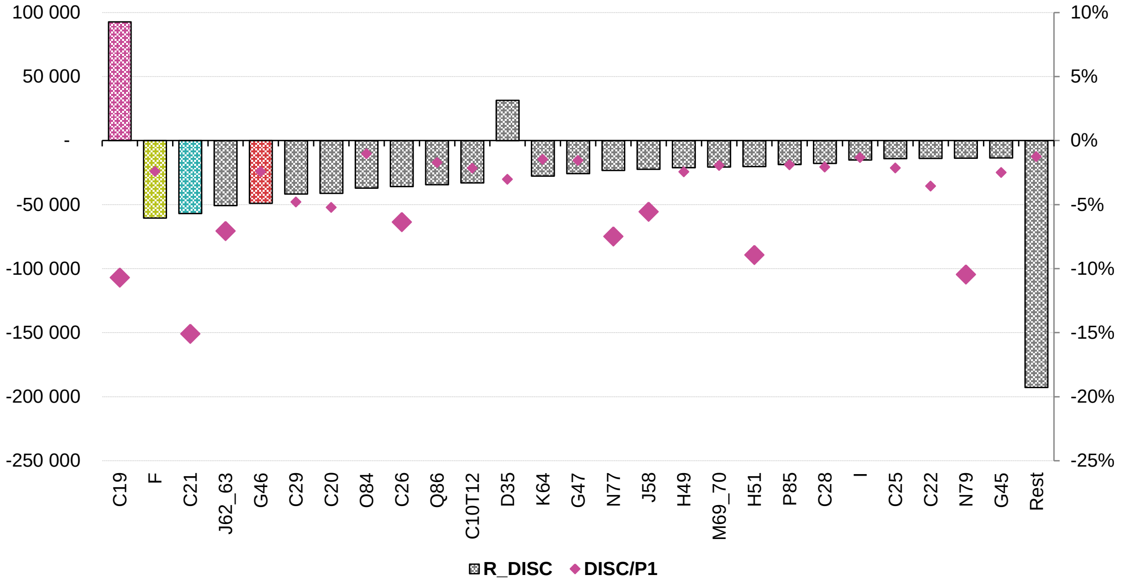
1. Positives, negatives, net and absolute sums of discrepancies; Top 5 industries



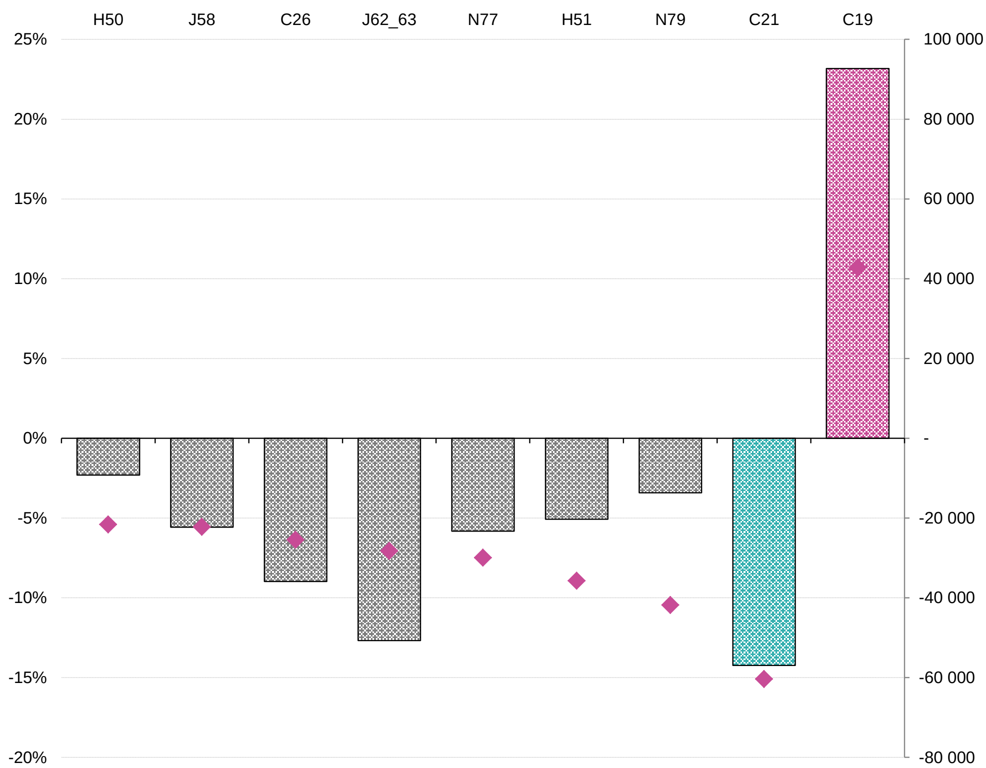
2. Distribution of the absolute discrepancies by industry and by countries



3. Total row net sum of discrepancies and shares by many industries with respect to the total output in the inter-country statistical use table, sorted by size



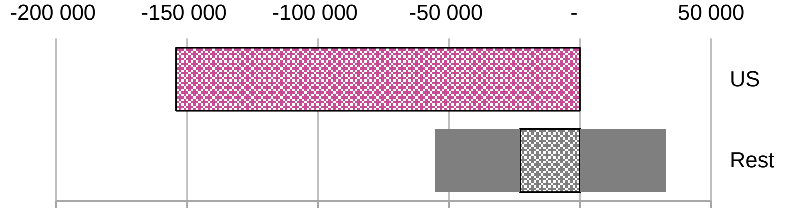
4. Top 9 shares over output by industry; Net sum of discrepancies and shares

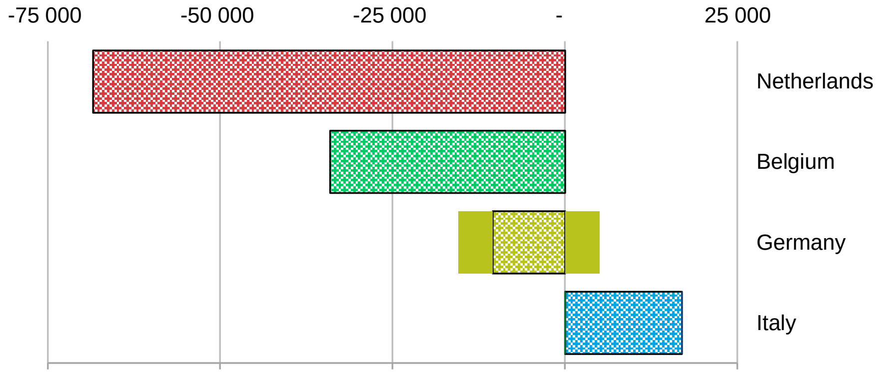


Source: Author.

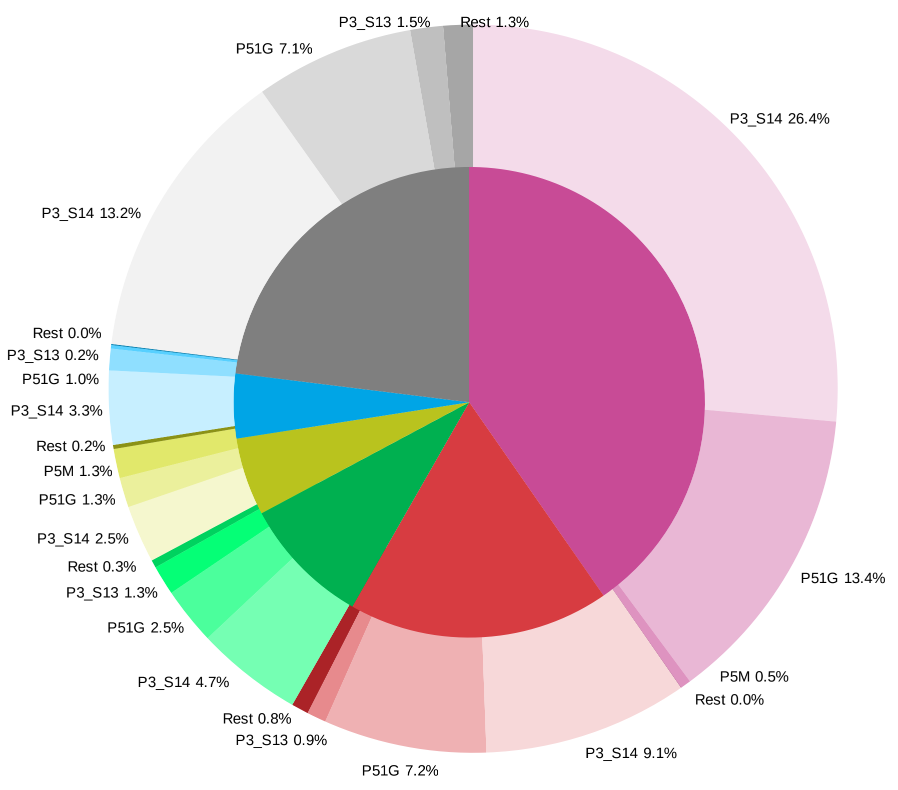
Figure 13.7: Analysis of the total row discrepancies; net and absolute sum of discrepancies by country and by final user (relates to A2 in Figure 13.4).

1. Positives, negatives, net and absolute sums of discrepancies; Top 5 industries

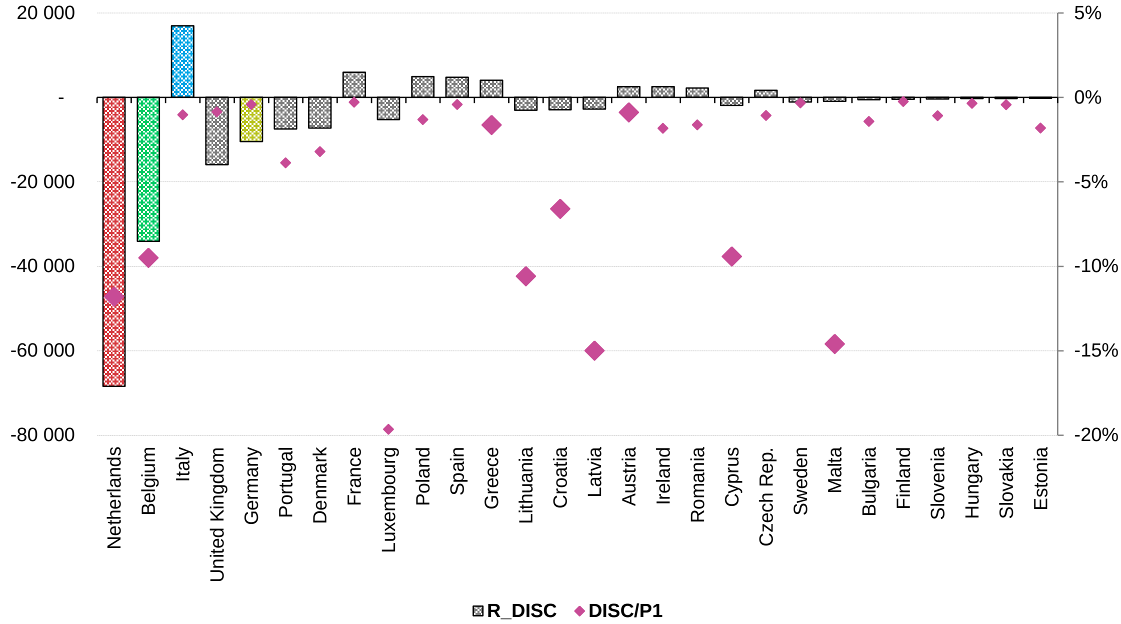




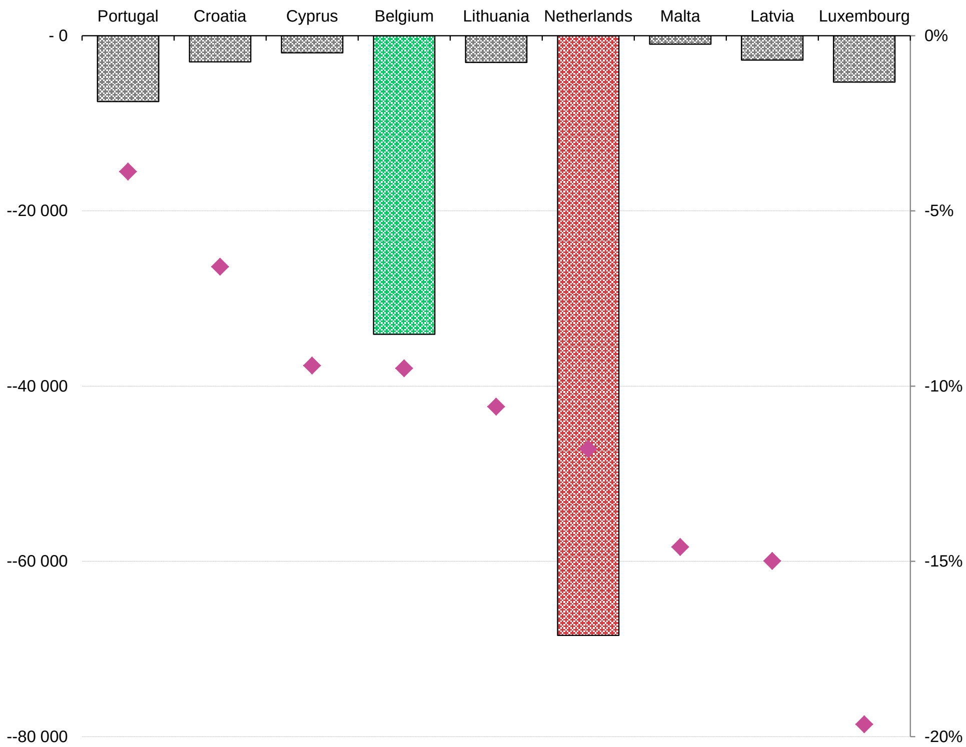
2. Distribution of the absolute discrepancies by industry and by countries



3. Total row net sum of discrepancies and shares by many industries with respect to the total output in the inter-country statistical use table, sorted by size



4. Top 9 shares over output by industry; Net sum of discrepancies and shares

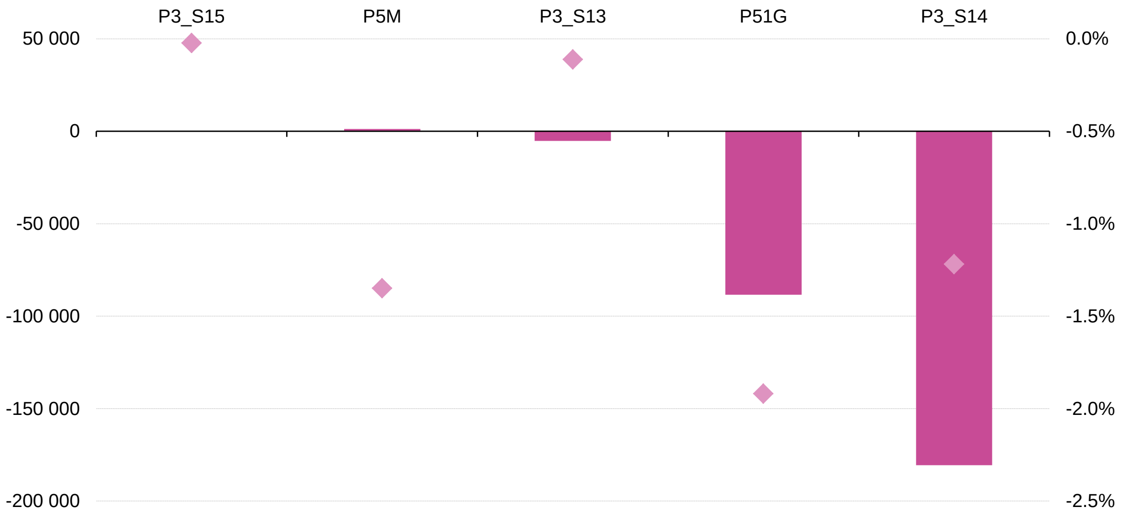


Source: Author.

D. DISCREPANCIES IN FINAL USE BY USER

This section considers the total net sum of discrepancies and shares by final users. Figure 13.8 shows that the sum of net discrepancies in the 'Final consumption expenditure by households' (P3_S14), − EUR -180 615 million − is more than twice that of the 'Gross fixed capital formation' (P51G), which is EUR -88 404 million. In both cases, the shares over their total output are below 2 %.

Figure 13.8: Analysis of the total row discrepancies; net sum of discrepancies and shares by final users (relates to A4 in Figure 13.4)



Source: Author.

E. TOTAL COLUMN DISCREPANCIES BY COUNTRY

The results of the total column discrepancies by country follow a similar pattern to the analysis made in the previous section to the total row discrepancies (see Figure 13.4). In this sense, Figure 13.9 shows that column discrepancies are mostly concentrated on the US. The US alone represents 38 % of the total absolute discrepancy, followed by the United Kingdom (9 %), Germany (8 %), France (8 %) and the Netherlands (5 %). The rest of the countries accounts for the remaining 32 % with none of them being bigger than 5 %. It is also possible to see that the negative discrepancies prevail over the positive ones. In some cases, the net effect is relatively low with respect to the absolute discrepancies, as in the case of the United Kingdom.

The total net sum of discrepancies for the US is EUR -378 372 million, representing almost 80 % of the total net sum of discrepancies for all EU (EUR -481 421 million). However, even though the column net sum of discrepancies for the US is large, it represents just 2 % of its total use, as in the EU as well.

In addition to the geographical dimension, the distribution by CPA product within each country (chart 2 in Figure 13.9) shows big discrepancies in the product CPA_N77, 'Rental and leasing services' (13.4 %), particularly in the US. Moreover, by adding the US 'Computer electronic and optical' (CPA_C26) and the US 'Publishing services' (CPA_J58) this share rises up to 18.8 %.

Other important CPA products that have big discrepancies are:

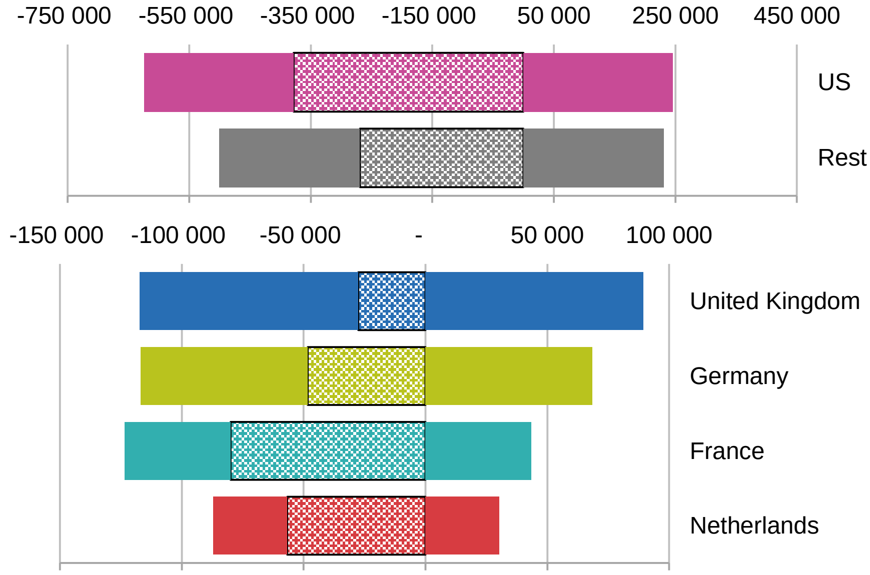
- 'Security and investigation services to buildings and landscape office administrative office support and other business support services' (CPA_N80T82);
- 'Services auxiliary to financial services and insurance services' (CPA_K66);
- 'Other transport equipment' (CPA_C30);

- ‘Accommodation and food services’ (CPA_I); and
- ‘Wholesale trade services except of motor vehicles and motorcycles’ (CPA_G46).

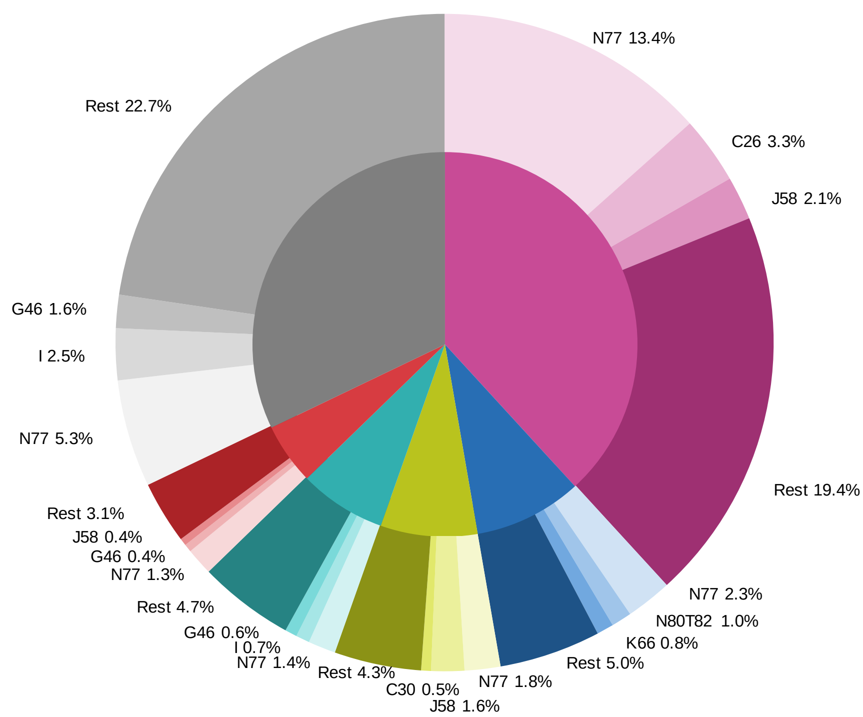
Considering the total column net sum of discrepancies and their shares over their total use by EU countries, chart 3 in Figure 13.9 shows that more than 70 % of the discrepancies are distributed in just seven of the 28 EU countries. In order of importance, these countries are: France, Belgium, the Netherlands, Germany, Spain, Italy and the UK; with a total net sum of discrepancies of EUR -351 811 billion, being the EU total EUR -481 421 billion. In the same chart, darker diamonds represent the countries with the highest shares of net sums of discrepancies over their total use.

Figure 13.9: **Analysis of the total column discrepancies; net and absolute discrepancies by country and by CPA products (relates to A5 in Figure 13.4)**

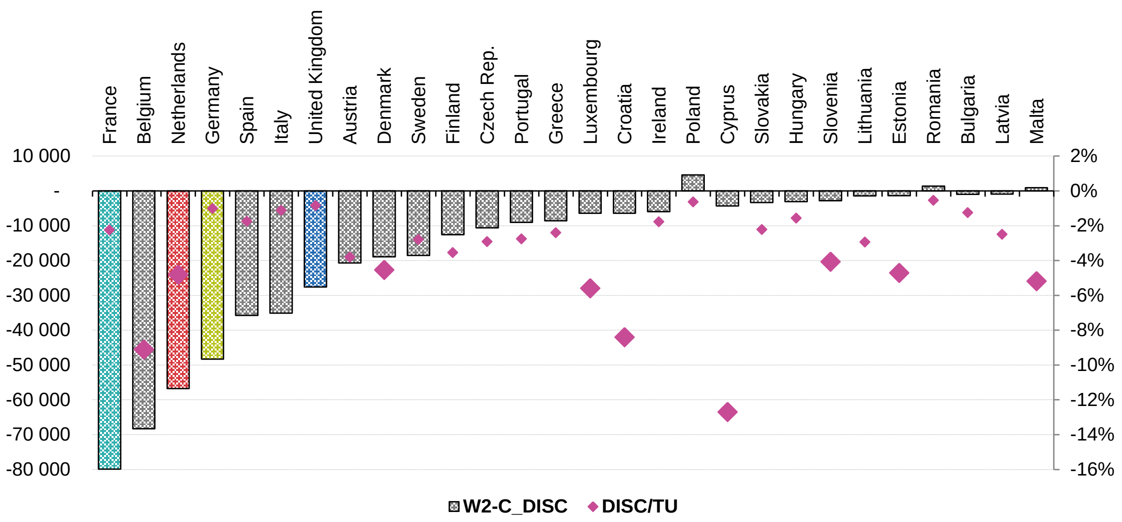
1. Positives, negatives, net and absolute sums of discrepancies; Top 5 countries



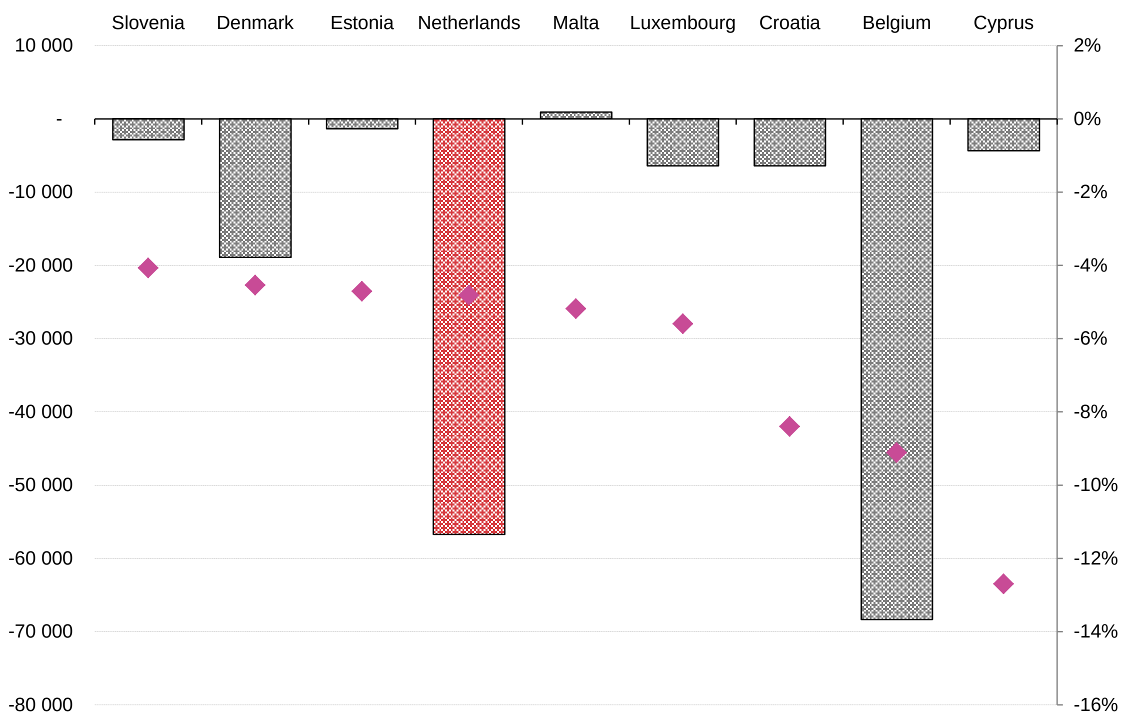
2. Distribution of the absolute discrepancies by country and product CPA



3. Total column net sum of discrepancies and shares by EU countries with respect to the total use in the inter-country statistical use table, sorted by size



4. Top 9 shares over total use by country; Net sum of discrepancies and shares



Source: Author.

Chart 4 complements the previous consideration and identifies the top-9 highest shares over the total use for each country. These shares are below -4.1 % in most of the countries, i.e. Slovenia (-4.1 %), Denmark (-4.5), Estonia (-4.7 %), the Netherlands (-4.8 %), Malta (-5.2 %) and Luxembourg (-5.6 %). The biggest negative shares correspond to Cyprus (-12.7 %), followed by Belgium and Croatia with -9.1 % and -8.4 %, respectively.

In most cases, the largest negative shares are concentrated on countries with negligible net sums of discrepancies. There are also cases with substantial discrepancies but with small shares, such as France (-0.6 %), Germany (-1.0 %), Spain (-1.8 %), Italy (-1.1 %) and the UK (-0.9 %), meaning that the discrepancies have a small impact in their total uses. However, the most relevant cases are those countries with substantial net sums of discrepancies and also high shares over their total uses. These are the cases of Belgium and the Netherlands, gathering both 8 % of the EU total net sum of discrepancies (EUR -68.361 million for Belgium and EUR -56.757 million for the Netherlands) and with shares of -9.1 % and -4.8 %, respectively. Similar to previous analyses, future work will have to pay special attention at the methodology and the results for Belgium and the Netherlands.

F. TOTAL COLUMN DISCREPANCIES BY PRODUCT

Regarding total column sums of discrepancies by CPA product, Figure 13.10 shows that ‘Rental and leasing services’ (CPA_N77) accounts for 44 % of the total absolute sum of discrepancies across countries. For the rest of the CPA products, none of them accounts for more than 3.8 % of the overall total, reaching altogether 56 %. There are exceptions, which are: ‘Publishing services’ (CPA_J58) – 7 % – and ‘Computer electronic and optical’ (CPA_C26), ‘Accommodation and food services’ (CPA_I) and ‘Wholesale trade services except of motor vehicles and motorcycles’ (CPA_G46) with 4 % each one.

The countries that account for the largest share of the absolute sum of discrepancies of CPA_N77 are the US (13.4 %), the United Kingdom (2.3 %) and Germany (1.8 %), making altogether 17.5 % of the total. Similarly, these three countries account for the largest share in the total absolute sum of discrepancies in the category ‘Rest’ of products, being their shares 18.9 %, 5.6 % and 4.2 %, respectively (see chart 2 in Figure 13.10); these sum up 28.7 %, which in turn represents 46.2 % of the total absolute sum of discrepancies of those three countries.

Chart 3 in Figure 13.10 shows a large net sum of discrepancies across countries of EUR -575.410 million in CPA_N77 compared with the total net sum of discrepancies of EUR -859.793 million. This amount is even more remarkable when compared with the total use of such CPA product (e.g. -135.9 %). In addition, there are five other CPA products with negative shares bigger than 16 %, namely: ‘Publishing services’ (CPA_J58) with -43.6 %, ‘Water transport services’ (CPA_H50) with 19.8 %, ‘Computer electronic and optical’ (CPA_C26) with -19.8 %, ‘Textiles wearing apparel leather and related products’ (CPA_C13T15) with -18.2 %, and ‘Basic pharmaceutical products and pharmaceutical preparations’ (CPA_C21) with -16 % (as shown in chart 4 in Figure 13.10).

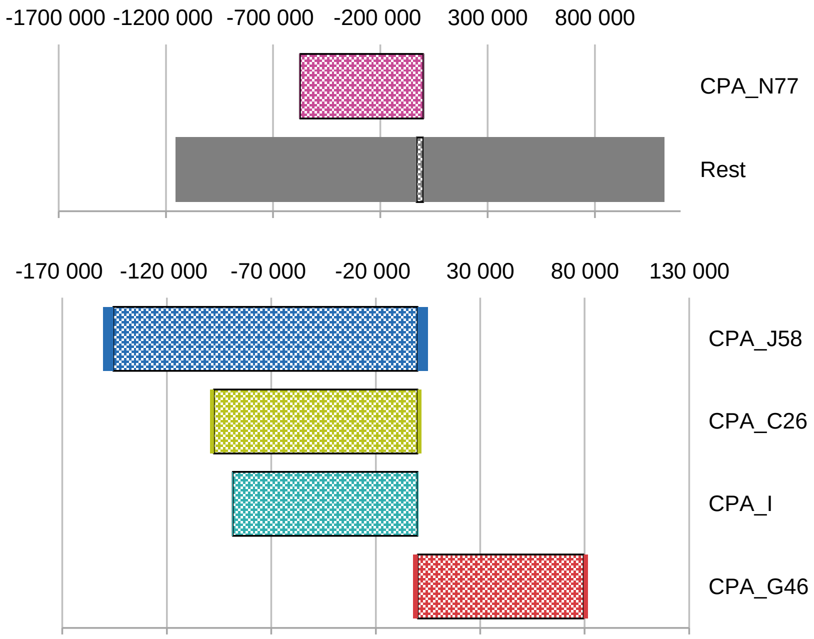
Combining both results, the aggregate by country (A5) and the aggregate by CPA product (A6), these are the CPA products that would deserve further attention in future work:

- ‘Rental and leasing services’ (CPA_N77)
- ‘Publishing services’ (CPA_J58),
- ‘Water transport services’ (CPA_H50),
- ‘Computer electronic and optical’ (CPA_C26),
- ‘Textiles wearing apparel leather and related products’ (CPA_C13T15)
- ‘Basic pharmaceutical products and pharmaceutical preparations’ (CPA_C21).

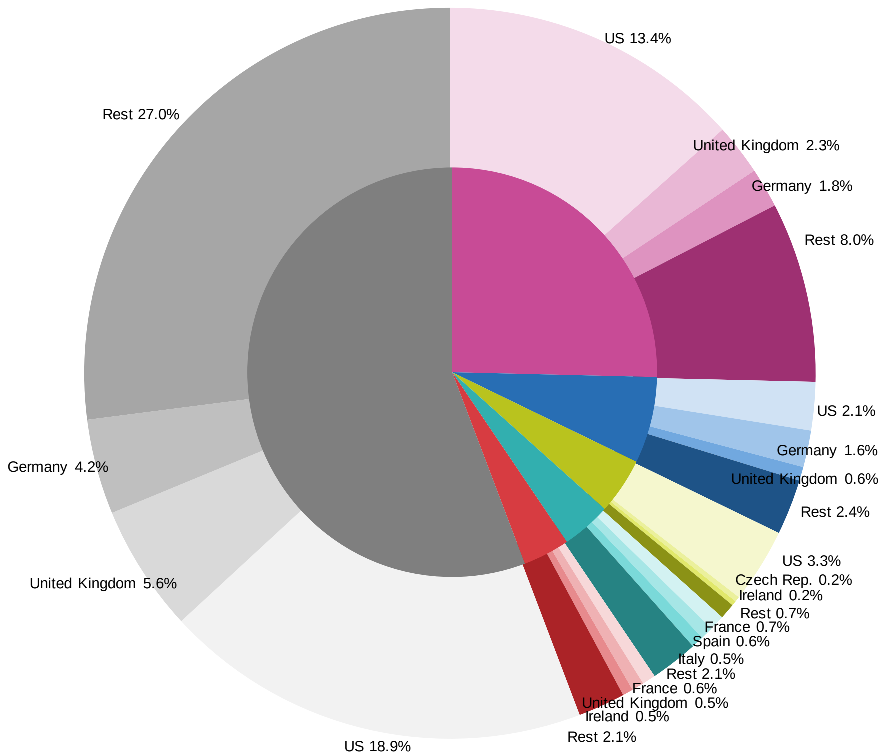
Country-wise and analogously to the analysis of the row discrepancies, Belgium and the Netherlands stand out again as countries for which further work is recommended.

Figure 13.10: Analysis of the total column discrepancies; net and absolute sums of discrepancies by CPA product and by countries (relates to A6 Figure 13.4)

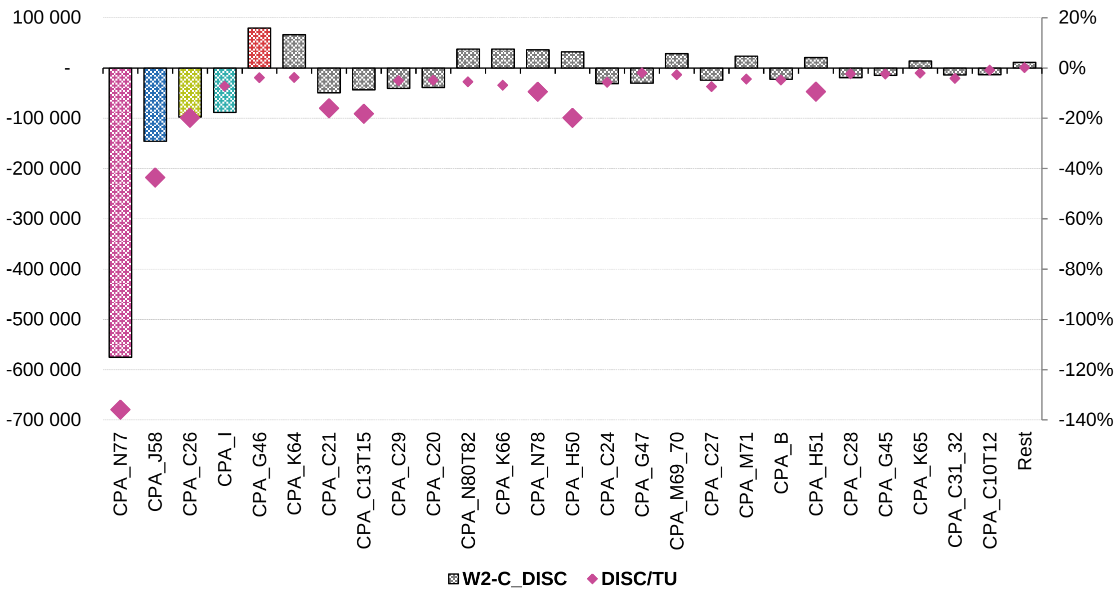
1. Positives, negatives, net and absolute sums of discrepancies; Top 5 CPA product



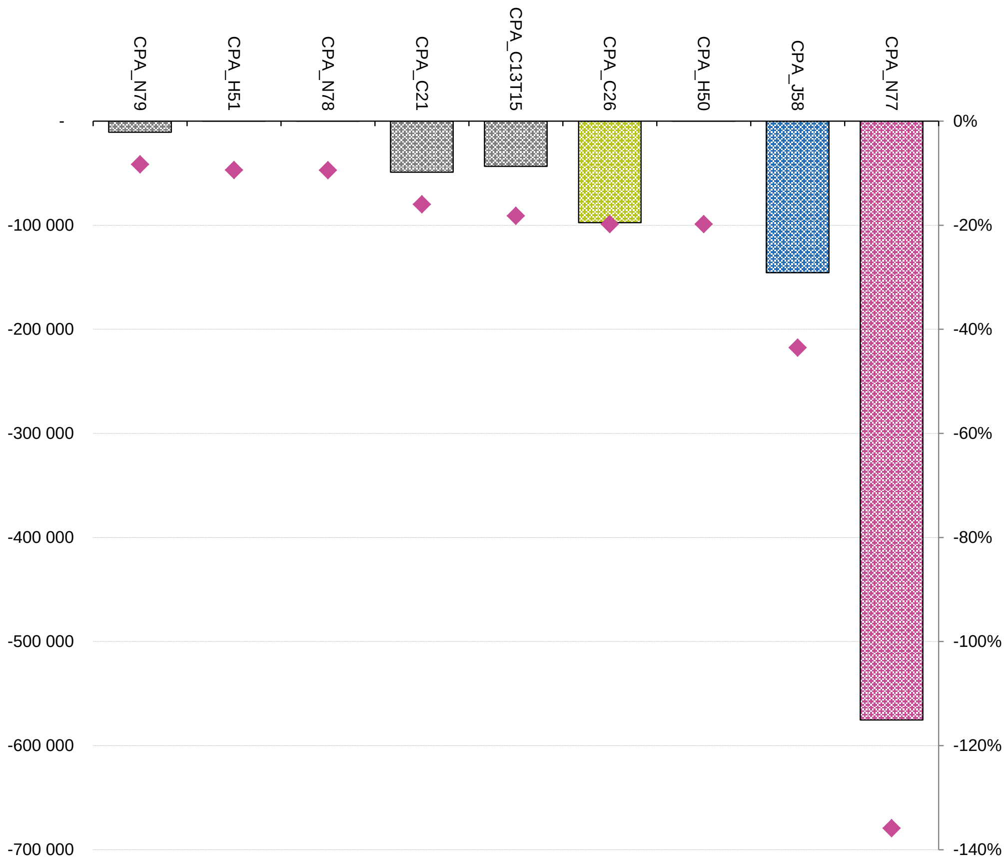
2. Distribution of the absolute discrepancies by CPA product and by countries



3. Total column net sum of discrepancies and shares by many CPA product with respect to the total use in the inter-country statistical use table, sorted by size



4. Top 9 shares over output by CPA product; Net sum of discrepancies and shares



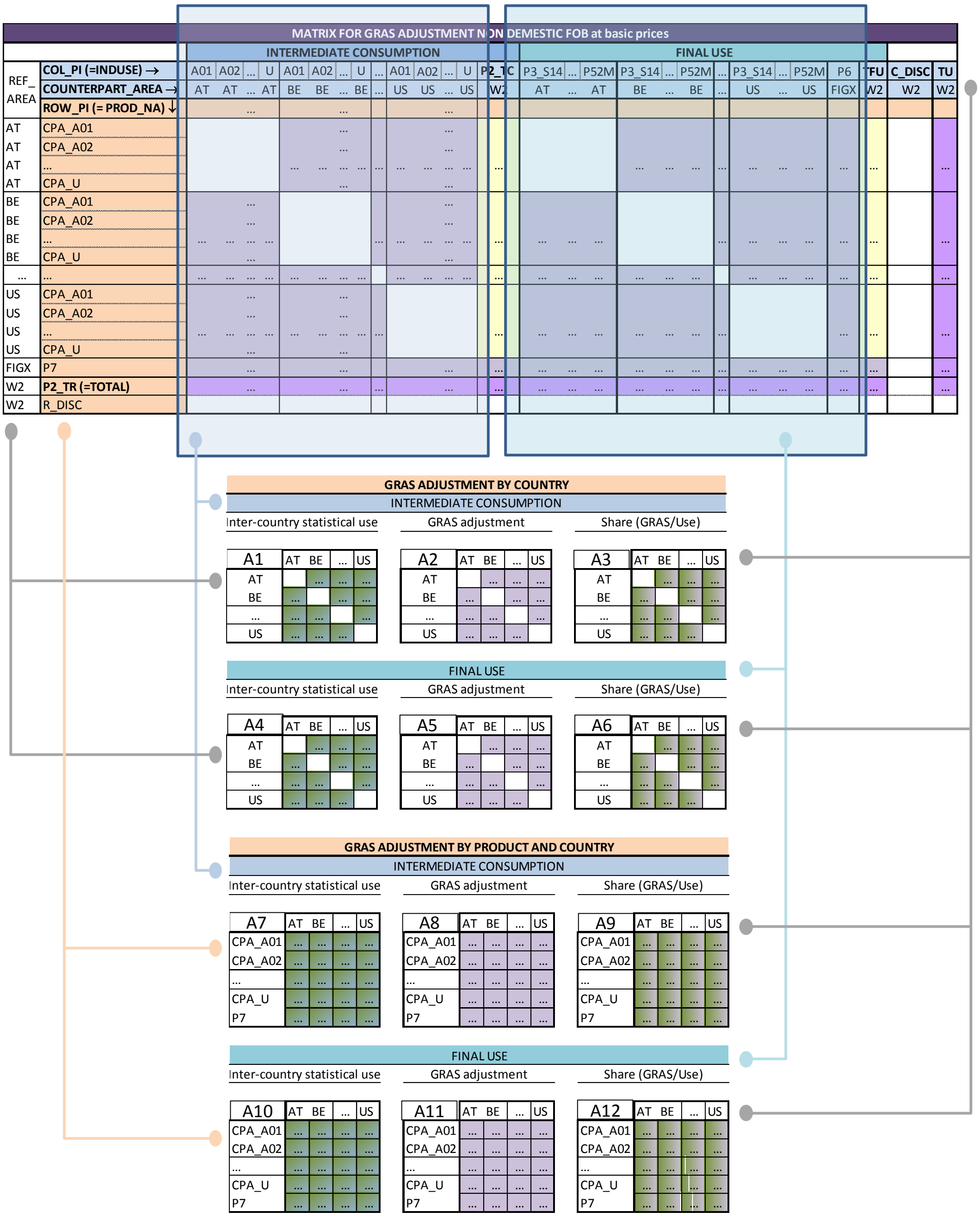
Source: Author.

13.2.3 GRAS analysis

The inter-country statistical use table is an intermediate step to build up the inter-country use table. In doing so, all discrepancies are transferred inside the intermediate and final use matrices, excluding the domestic parts. This section analyses the changes occurred in the preliminary inter-country statistical use table once discrepancies have been removed with the GRAS method (see Chapter 11.4). We illustrate the results with four different aggregations coming out from the intermediate and the final use matrices. These are shown in Figure 13.11.

- Intermediate consumption: use values from the inter-country statistical use tables, GRAS adjustment over them and share of adjustment over the former values, on a country by country basis (A1, A2 and A3 tables in Figure 13.11).
- Final uses: final use values from the inter-country statistical use tables, GRAS adjustment over them and share of adjustment over the former values, on a country by country basis (A4, A5 and A6 tables in Figure 13.11).
- Intermediate consumption: use values from the inter-country statistical use tables, GRAS adjustment over them and share of adjustment over the former values, on a CPA product by country basis (A7, A8 and A9 tables in Figure 13.11).
- Final uses: final use values from the inter-country statistical use tables, GRAS adjustment over them and share of adjustment over the former values, on a CPA product by country basis (A10, A11 and A12 tables in Figure 13.11).

Figure 13.11: Discrepancy (GRAS process) matrix in the interregional use framework



Source: Author.

Figure 13.12 focuses on the 28 biggest adjustments made in the intermediate consumption to balance the inter-country statistical use table, on a country by country basis. The first seven country pairs (starting from the left axis) represent 64.2 % of the total net sum of discrepancies. The first two, US and Dutch imports from non-EU countries (FIGX-US and FIGX-NL) have net sums of discrepancies above EUR -80 000 million ([110]). They are followed by German and British exports to US (DE-US and GB-US) for around EUR -47 000 million each one, and US exports to the United Kingdom (US-GB), US exports to Spain (US-ES) as well as French exports to US were adjusted for

([110]) FIGX includes non-EU countries, except the US.

values ranging between EUR -31 000 million and EUR -40 000 million. The rest of the bilateral country pairs were adjusted with values below EUR 27 000 million (either positive or negative).

Figure 13.12 also shows the shares of the GRAS adjustments over the values of the inter-country statistical use table (see red diamonds in the right axis) on a country by country basis. Besides the magnitude of the adjustments, the average share of the top-28 country pairs with the highest shares is -43.2 %. In particular, the highest shares come from the Spanish and the Danish exports to US (ES-US and DK-US), which both recorded -80 %. It is also remarkable that for the case with the highest adjustment value (FIGX-US), the share is just -14.6 %. However, the second highest adjustment (FIGX-NL), which has a similar adjustment value as FIGX-US, recorded a bigger share of -49.9 %.

Figure 13.12: GRAS adjustments and shares in the inter-country statistical use table, by reference area and counterpart area (relates to A2 and A3 in Figure 13.11).

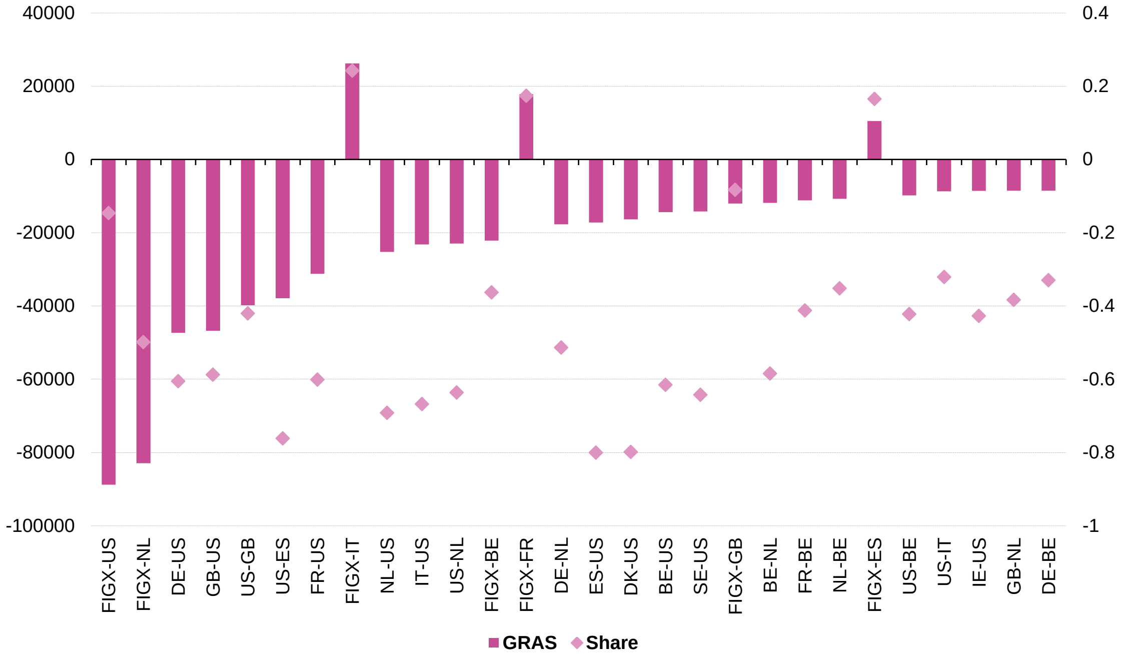
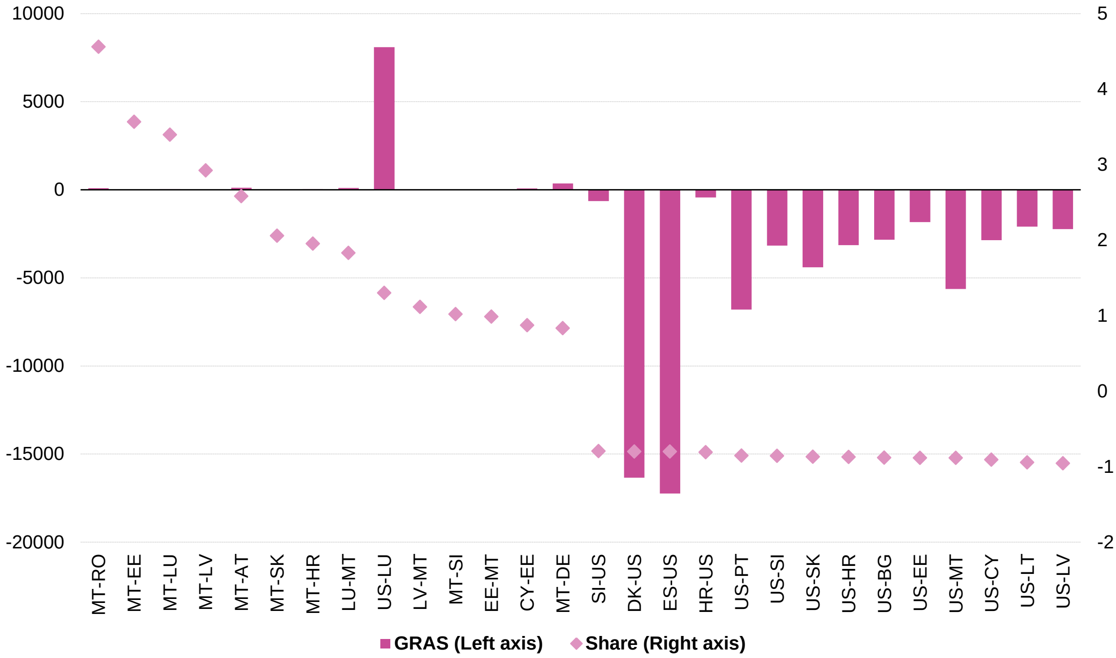


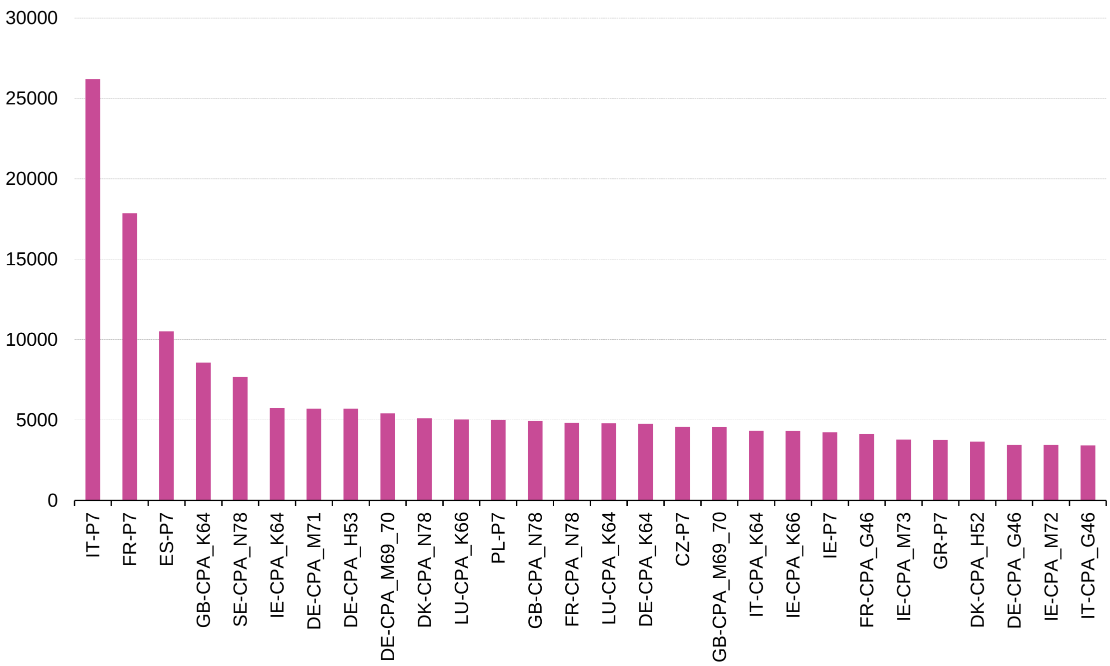
Figure 13.13 is equivalent to Figure 13.12 but sorted by the size of the shares. In this sense, the top-28 country pairs with the highest shares amounted to a total adjustment close to EUR -17 500 million. As a whole, the shares range from 79 % to 456 % in absolute values but, as it can be seen, the top-12 country pairs with the highest shares were very slightly adjusted (very small blue bar).

Figure 13.13: **GRAS adjustments and shares in the inter-country statistical use table, by reference area and counterpart area – sorted by shares (relates to A2 and A3 in Figure 13.4).**



As shown in Figure 13.14, Italian, French and Spanish imports from the rest of the world (excluding US) were the ones that suffered the biggest changes after the GRAS balancing process (IT-P7, FR-P7 and ES-P7), followed by UK imports of financial services (GB_CPA_K64) and Swedish imports of employment services (SE_CPA_N78). In terms of shares, we found huge values for some cases were the inter-country statistical use table had negligible values that eventually were transformed into substantial amounts. Evidently, this points out to some countries and products where to put more efforts in future work.

Figure 13.14: **GRAS adjustments at CPA product level (relates to A8 in Figure 13.11.).**
(million euro)



And last but not least, we provide two tree maps summarising the absolute values of the changes made by the GRAS adjustment by country (Figure 13.15) and CPA product (Figure 13.16). The total area represents 100 % of the total adjustment. Colours represent the reference area and each of them is divided into smaller boxes representing the counterpart area. Below the counterpart name is the share of the adjustment represented by such country compared with the overall total adjustment. Figure 13.15 considers 12 countries and a group of the remaining countries (Rest) for the reference counterpart areas. In addition, Figure 13.16 considers 28 CPA products and a group of the remaining products (Rest).

By countries, Figure 13.15 shows that the rest of the world (FIGX or non-EU countries, except for US) accounts for 28.5 % of the total adjustment in absolute terms, of which US and the Netherlands take around 8.5 % each. Next, US follows with 19 % of the total adjustment, of which UK, Spain and non-EU countries account for around 4 % each as counterpart areas. Germany, UK and France follow with shares between 6.4 % and 9.2 % of the total adjustment. In these three cases, US are the main counterpart area with shares between 3.1 % and 4.7 %.

Figure 13.16 identifies the following products as being the ones with the largest adjustments made during the last stage of the compilation of the inter-country use tables:

- ‘Rental and leasing services’ (CPA_N77)
- ‘Imports of EU countries and US from the rest of the world’ (P7)
- ‘Accommodation and food services’ (CPA_I)
- ‘Publishing services’ (CPA_J58)
- ‘Chemical and chemical products’ (CPA_C20).

Figure 13.15: GRAS share adjustments by reference and counterpart areas (relates to A2 in Figure 13.11.)

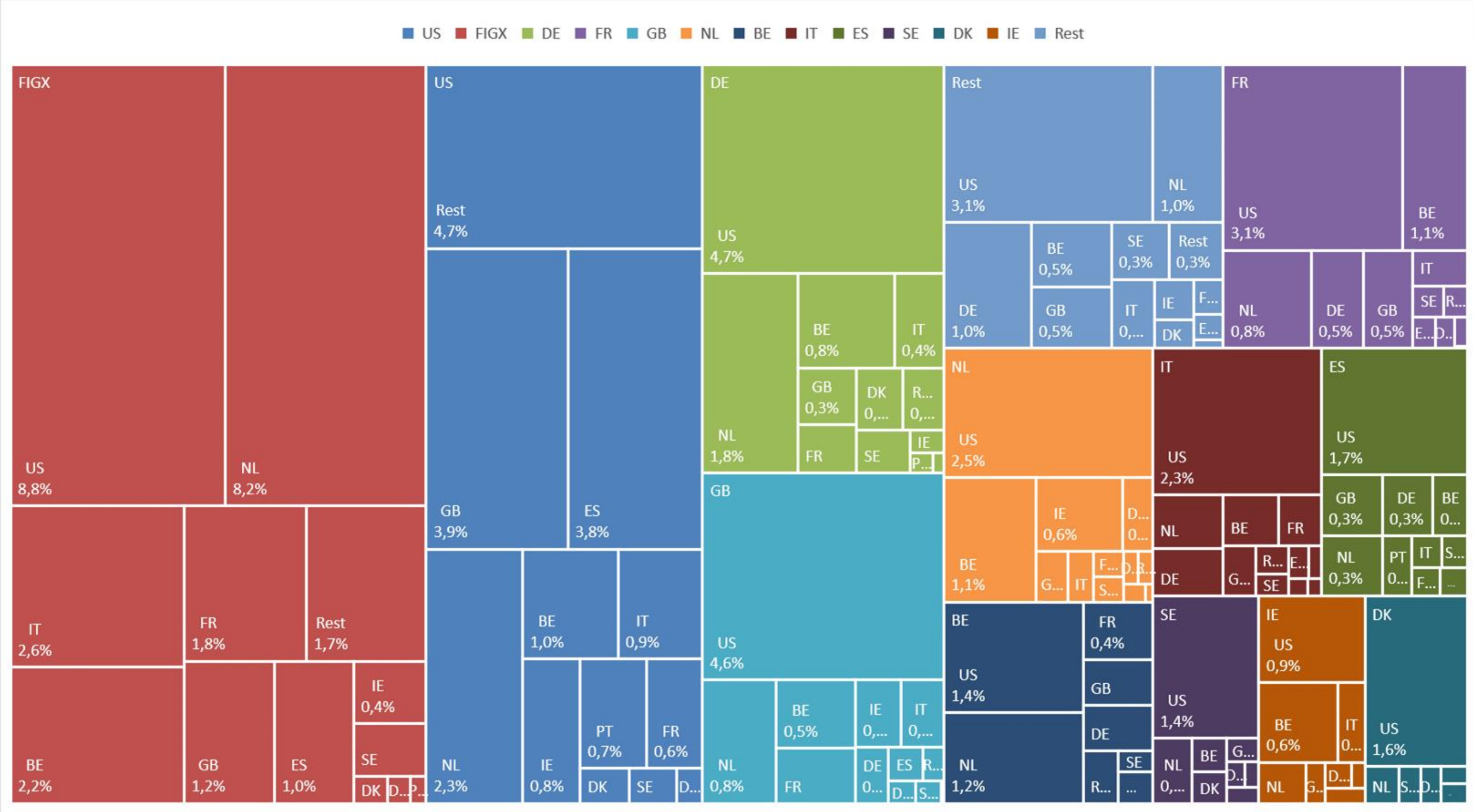
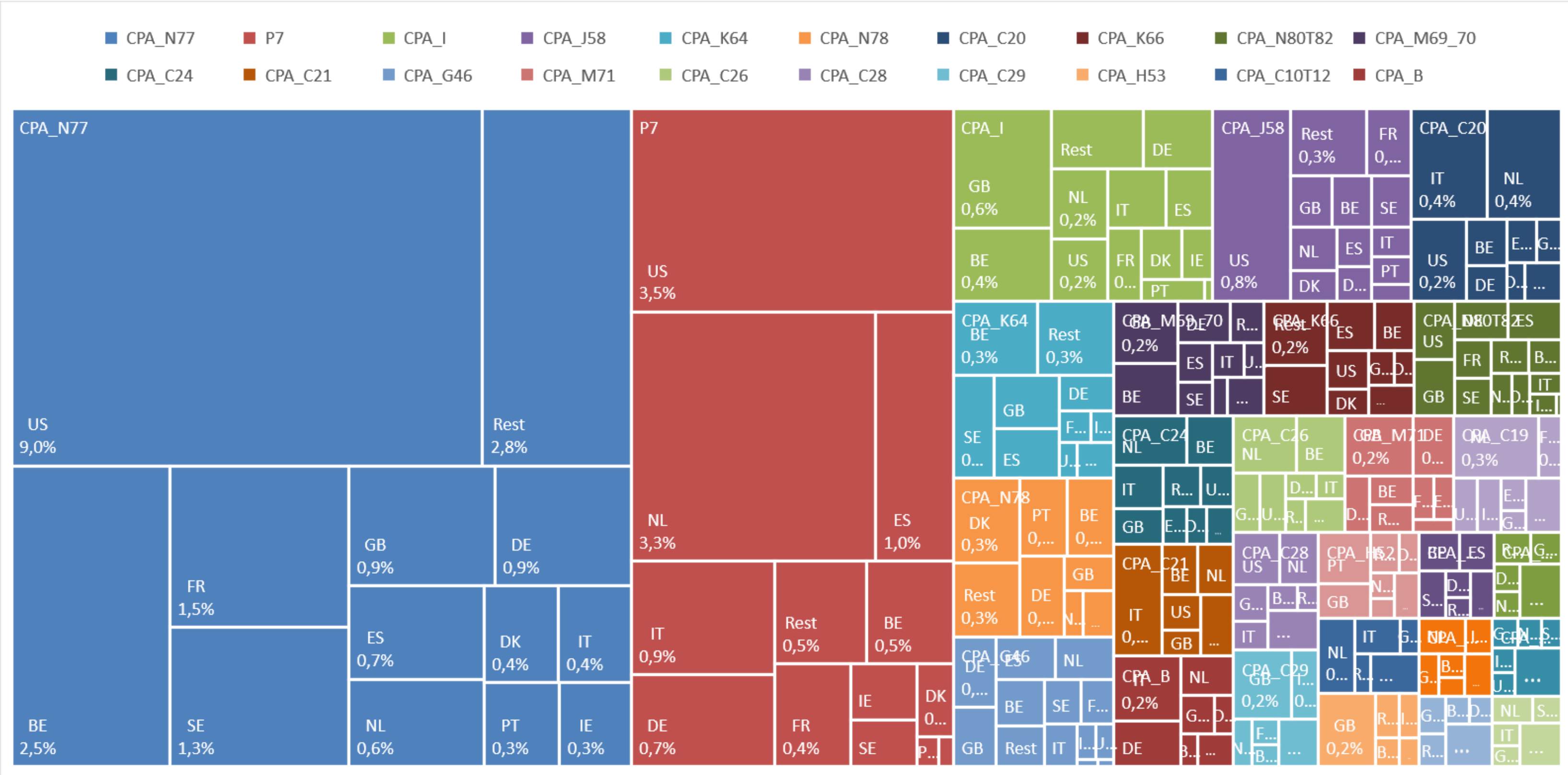


Figure 13.16: GRAS share adjustments with respect to the overall total adjustments (relates to A8 in Figure 13.11)



14 Air emissions

14.1 Introduction and methodology

This chapter presents an application using the European inter-country input-output tables from the Figaro project, in combination with EU Member States' air emission accounts.

The application focuses on EU air emissions embodied in EU exports to the rest of the world.

The methodology applied in this chapter and in the next is the Leontief quantity model, a standard model in the field of input-output modelling. The model builds on the availability of input-output tables. To describe the model we use an example of an IOT for three countries, which nonetheless includes all the structural elements needed.

14.1.1 An input-output table and model

An inter-country IOT contains, in monetary units, the transactions between industries and final users within and across a set of countries. In the case of the Figaro EU-IC-IOT, the countries are the EU-28 Member States, the US, and the rest of the world (RoW). Below we discuss the model, using a reference table with three countries and *n* industries. Table 14.1 depicts the configuration of this three-country IC-IOT table, where superscripts denote the country ([111]).

Table 14.1: Three-country inter-country input-output table

Countries	Intermediate uses 1	Intermediate uses 2	Intermediate uses 3	Final uses 1	Final uses 2	Final uses 3	Gross Output
1	$\mathbf{Z}^{11}$	$\mathbf{Z}^{12}$	$\mathbf{Z}^{13}$	$\mathbf{f}^{11}$	$\mathbf{f}^{12}$	$\mathbf{f}^{13}$	$\mathbf{x}^{1}$
2	$\mathbf{Z}^{21}$	$\mathbf{Z}^{22}$	$\mathbf{Z}^{23}$	$\mathbf{f}^{21}$	$\mathbf{f}^{22}$	$\mathbf{f}^{23}$	$\mathbf{x}^{2}$
3	$\mathbf{Z}^{31}$	$\mathbf{Z}^{32}$	$\mathbf{Z}^{33}$	$\mathbf{f}^{31}$	$\mathbf{f}^{32}$	$\mathbf{f}^{33}$	$\mathbf{x}^{3}$
Primary inputs	$(\mathbf{w}^{1})'$	$(\mathbf{w}^{2})'$	$(\mathbf{w}^{3})'$				
Total inputs	$(\mathbf{x}^{1})'$	$(\mathbf{x}^{2})'$	$(\mathbf{x}^{3})'$				

Source: Eurostat, JRC author

The main components of this IC-IOT table are the following:

$\mathbf{Z}^{rs}$ is a matrix of intermediate inputs going from country *r* to country *s*; its element z_{ij}^{rs} represents the sales of industry *i* in country *r* to industry *j* in country *s.*

$\mathbf{f}^{rs}$ is a matrix of final demand (i.e. private consumption, government consumption and investments) of country *s* for goods and services produced in country *r*; its element f_i^{rs} indicates the final demand in country *s* of commodities produced by sector *i* of country *r*; we can also define $\mathbf{f}^{r} = \sum_s \mathbf{f}^{rs}$ as the column vector of final demand for commodities produced

[111] Bold-faced lower-case letters are used to indicate vectors, bold-faced capital letters indicate matrices, and italic lower-case letters indicate scalars (including elements of a vector or matrix). Subscripts indicate industries and superscripts indicate countries. Vectors are columns by definition, row vectors are obtained by transposition, denoted by a prime. Diagonal matrices are denoted by ^. See also the overview of notation used at the beginning of the publication.

in country *r*, as the aggregation of the final demand of all countries.

$\mathbf{x}^{\mathrm{r}}$ is a column vector containing the output of industries in country *r*; its element x_i^r denotes the output of industry *i* of country *r.*

$\mathbf{w}^{\mathrm{r}}$ is a column vector containing the value added by industries in country *r*; its element w_i^r denotes the value added in industry *i* of country *r.*

The relation between $\mathbf{x}$, $\mathbf{Z}$ and $\mathbf{f}$ is defined by the following accounting equation: $\mathbf{x} = \mathbf{Zi} + \mathbf{f}$, where $\mathbf{i}$ is a column summation vector.

Next, the technical coefficients matrix is obtained as: $\mathbf{A}^{\mathrm{rs}} = \mathbf{Z}^{\mathrm{rs}}(\hat{\mathbf{x}}^{s})^{-\mathbf{1}}$, where $(\hat{\mathbf{x}}^{s})^{-\mathbf{1}}$ designates the inverse of the diagonal matrix of total output in country *s*.

With these elements the standard input-output model is defined as: $\mathbf{x} = \mathbf{Ax} + \mathbf{f}$ whose solution is $\mathbf{x} = \mathbf{Lf}$ where $\mathbf{L} = (\mathbf{I} - \mathbf{A})^{-\mathbf{1}}$ represents the Leontief inverse matrix.

Along with these elements, data on emissions by country and product is required in order to undertake this exercise. We can define the column vector $\mathbf{m}^{\mathrm{r}}$, indicating the emissions in country *r*, whose element m_i^r represents the emissions in product *i* of country *r*.

Air emission coefficients can then be calculated as: $\mathbf{d}^{\mathrm{r}} = (\hat{\mathbf{x}}^{r})^{-\mathbf{1}}\mathbf{m}^{\mathrm{r}}$

The total air emissions by product in a specific country can be obtained as: $\mathbf{m} = \mathbf{dx} = \mathbf{dLF}$.

14.1.2 Embodied effects

Employment and air emissions can be expressed as a function of final demand. To disentangle which part of the total employment or air emissions in the EU can be associated with EU exports to the rest of the world, it is sufficient to apply the above mathematical expressions to the appropriate part of the final demand (i.e. exports).

In this three-country case, assuming that country 1 and 2 are members of the EU-28, and country 3 is the rest of the world[112], we define the components of the IC-IOT framework of the EU as:

$$\mathbf{Z}^{\mathrm{EU}} = \begin{bmatrix} \mathbf{Z}^{11} & \mathbf{Z}^{12} \\ \mathbf{Z}^{21} & \mathbf{Z}^{22} \end{bmatrix} \qquad \mathbf{f}^{\mathrm{EU}} = \begin{bmatrix} \mathbf{f}^{11} + \mathbf{f}^{12} + \mathbf{e}^{13} \\ \mathbf{f}^{21} + \mathbf{f}^{22} + \mathbf{e}^{23} \end{bmatrix} \qquad \mathbf{x}^{\mathrm{EU}} = \begin{bmatrix} \mathbf{x}^{1} \\ \mathbf{x}^{2} \end{bmatrix} \qquad \mathbf{m}^{\mathrm{EU}} = \begin{bmatrix} \mathbf{m}^{1} \\ \mathbf{m}^{2} \end{bmatrix}$$

where $\mathbf{e}^{\mathrm{rs}} = \mathbf{f}^{\mathrm{rs}} + \mathbf{Z}^{\mathrm{rs}}\mathbf{i}$ are the exports from the Member State *r* to the non-EU country *s*. With these elements, we can obtain the employment (or air emissions) generated in the EU due to the production of extra-EU exports applying the following formula:

$$\mathbf{m}_{\mathrm{ex_{EU}}}^{\mathrm{EU}} = (\mathbf{m}^{\mathrm{EU}})'\mathbf{L}^{\mathrm{EU}}\mathbf{e}^{\mathrm{EU}} = (\mathbf{m}^{1})'\mathbf{L}^{11}\mathbf{e}^{13} + (\mathbf{m}^{1})'\mathbf{L}^{12}\mathbf{e}^{23} + (\mathbf{m}^{2})'\mathbf{L}^{21}\mathbf{e}^{13} + (\mathbf{m}^{2})'\mathbf{L}^{22}\mathbf{e}^{23}$$

Where $\mathbf{L}^{\mathrm{EU}}$ is the Leontief matrix corresponding to $\mathbf{Z}^{\mathrm{EU}}$, so $\mathbf{L}^{\mathbf{EU}} = \left(\mathbf{I} - (\mathbf{Z}^{\mathrm{EU}}(\hat{\mathbf{x}}^{\mathrm{EU}})^{-\mathbf{1}})\right)^{-\mathbf{1}}$

The $\mathbf{L}^{\mathrm{EU}}$ is the Leontief inverse related to $\mathbf{Z}^{\mathrm{EU}}$, but note that $\mathbf{L}^{11}$, $\mathbf{L}^{12}$, etc. are submatrices of $\mathbf{L}^{\mathrm{EU}}$ and not Leontief inverses of the related $\mathbf{Z}^{\mathrm{rs}}$, as the former includes all indirect linkages between EU Member States, while the latter would exclude these.

So $(\mathbf{m}^{\mathrm{r}})'\mathbf{L}^{\mathrm{rs}}\mathbf{e}^{\mathrm{st}}$ is the air emissions generated in country *r* of the EU due to exports of Member State *s* to a non-EU country *t.*

(112) Without loss of generality, in the Figaro tables this is a single vector instead of a matrix.

14.2 Data

The embodied air emission calculations are done for all air emissions. Data are provided for all emissions from final use of CPA products (breakdown of 64 products) for each EU Member State for the year 2010.

This work relies on two data inputs: the air emissions accounts and the inter-country input-output table. Air emissions accounts are collected under Regulation (EU) No 691/2011 on European Environmental Economic Accounts (balanced version[113]). Air emission accounts are compiled according to the system of environmental economic accounting (SEEA[114]) and can therefore be readily combined with input-output tables for further analysis.

Air emission accounts are publicly available. More information can be found on the dedicated webpage[115] on Eurostat's website and the data can be downloaded from the database[116] (data code env_ac_ainah_r2). Extensive metadata[117] on this dataset is also available online. For a list of air emissions included in the air emission accounts, see Table 14.2 below. Data on emissions of CO_2 from biomass used as fuel is not available for Malta and emissions of SF_6 and NF_3 are not available for the Netherlands.

Air emissions accounts are classified by economy activities. Given that the analysis is made using product-by-product IOTs, the emission data needed to be converted into accounts classified by product. This was achieved by applying the industry technology model as described in the Eurostat Manual of SUIOTs (Model B, page 349). The same model was used to produce the product-by-product IOTs.

14.3 Results

The estimates of EU air emissions due to extra-EU exports can also be split into two effects: the *domestic effect* and the *spillovers*. The **domestic effect** refers to the air emissions produced in the EU Member State that also exports the products embodying these emissions out of the EU. The **spillovers** refer to the effects on the rest of the EU Member States due to the supply of intermediates to the Member States exporting out of the EU. Both the domestic effects and spillovers include *direct effects* (emissions due to the production of intermediates used for producing the exported product) and *indirect effects* (emissions due to the production of intermediates used for producing the intermediates, and so on).

For presentation purposes, we have aggregated the massive amounts of results (28 exporter Member States x 64 exported CPA x 28 employer/emitting Member States x 64 employer/emitting CPA = 3 211 264 results per variable, e.g. CO_2 or persons employed (PS). Data are available for 24 different air emissions, including air emissions expressed also in equivalents of other air emissions and three aggregates, bringing the total number of results for EU air emissions embodied in extra-EU final demand to 7 070 336.

Table 14.2 gives an overview of the absolute results for all air emission variables. As an individual gas, CO_2 is emitted most in the EU (over 3 gigatonnes) and 21 % or 573 million tonnes of this total amount of CO_2 emitted is due to extra-EU exports. The EU CO_2 emissions due to extra-EU exports can be further split into a domestic effect of 452 million tonnes (79 %) and a spillover effect of 120 million tonnes (21 %).

([113]) http://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1416221752426&uri=CELEX:02011R0691-20140616

([114]) https://seea.un.org/

([115]) http://ec.europa.eu/eurostat/web/environment/emissions-of-greenhouse-gases-and-air-pollutants/air-emissions-accounts

([116]) http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=env_ac_ainah_r2&lang=en

([117]) http://ec.europa.eu/eurostat/cache/metadata/en/env_ac_ainah_r2_esms.htm

Table 14.2: EU emissions embodied in extra-EU exports (2010)

		total embodied in extra-EU exports	as % of overall EU-28 emissions	domestic effects	as % of embodied in extra-EU	spillover effects	as % of embodied in extra-EU
		thousand tonnes	%	thousand tonnes	%	thousand tonnes	%
ACG	Acidifying gases (SOX in SO2-eq, NOX in SO2 eq, NH3 in SO2 eq)	3 766	20	3 144	83	622	17
CH4	Methane	2 863	15	2 289	80	575	20
CH4_CO2E	Methane (CO2-eq)	71 584	15	57 214	80	14 370	20
CH4_NMVOCE	Methane (NMVOC-eq)	40	15	32	80	8	20
CO	Carbon monoxide	2 657	26	1 952	73	705	27
CO2	Carbon dioxide	572 655	18	452 229	79	120 426	21
CO2_BIO	Carbon dioxide from biomass used as a fuel	59 484	20	47 013	79	12 471	21
CO2_N2O_CH4_CO2E	Greenhouse gases (CO2, N2O in CO2-eq, CH4 in CO2-eq)	680 429	18	539 868	79	140 562	21
CO_NMVOCE	Carbon monoxide (NMVOC-eq)	292	26	215	73	78	27
HFC_CO2E	Hydrofluorocarbones (CO2-eq)	13 854	17	10 940	79	2 914	21
N2O	Nitrous oxide	121	16	102	84	19	16
N2O_CO2E	Nitrous oxide (CO2-eq)	36 191	16	30 425	84	5 765	16
NH3	Ammonia	496	13	430	87	66	13
NH3_SO2E	Ammonia (SO2-eq)	943	13	818	87	125	13
NMVOC	Non-methane volatile organic compounds	990	20	815	82	175	18
NOX	Nitrogen oxides	2 475	24	2 064	83	411	17
NOX_NMVOCE	Nitrogen oxides (NMVOC-eq)	3 019	24	2 518	83	502	17
NOX_SO2E	Nitrogen oxides (SO2-eq)	1 732	24	1 445	83	288	17
O3PR	Ozone precursors (NMVOC, NOX in NMVOC-eq, CO in NMVOC-eq, CH4 in NMVOC-eq)	4 341	23	3 579	82	762	18
PFC_CO2E	Perfluorocarbones (CO2-eq)	1 323	36	1 066	81	257	19
PM10	Particulates < 10µm	281	20	232	83	49	17
PM2_5	Particulates < 2.5µm	183	23	152	83	31	17
SF6_NF3_CO2E	Sulphur hexafluoride and nitrogen trifluoride (CO2-eq)	1 582	25	1 275	81	307	19
SOX_SO2E	Sulphur oxides (SO2-eq)	1 090	23	881	81	209	19

Note: eq = equivalent

Source: calculations by Eurostat

Figure 14.1 shows the results on EU emissions embodied in extra-EU exports for each air emission relative to the total air emissions in the EU. Perfluorocarbons (PFC) end up relatively high in extra-EU exports with 36 %, while ammonia (NH_3) accounts for relatively little, with only 13 % of total emissions being due to extra-EU exports.

Figure 14.1: EU emissions embodied in extra-EU exports as a percentage of total EU emissions (2010)

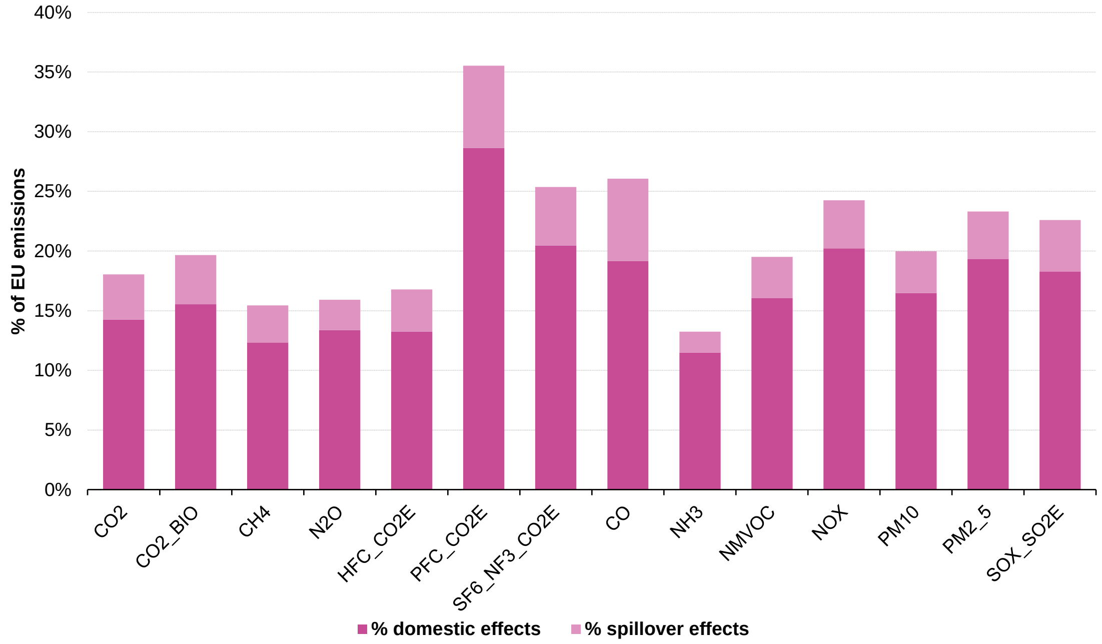


Figure 14.2 shows the amount of emissions caused in the EU by each Member State due to its extra-EU exports. Germany emits 109 million tonnes CO_2 due to its extra-EU exports; in addition, all other Member States emit 29 million tonnes CO_2 due to extra-EU exports by Germany. Malta and Cyprus both cause only 0.5 million tonnes CO_2 in total with their extra-EU exports. Of the EU CO_2 emissions due to the extra-EU exports of Bulgaria and Romania, more than 90 % is emitted domestically. In contrast, Ireland's' domestic CO_2 emissions due to its extra-EU exports only amount to 53 % of the total.

Figure 14.2: EU CO2 emissions due to extra-EU exports, by Member State exporting (2010)
(million tonnes)

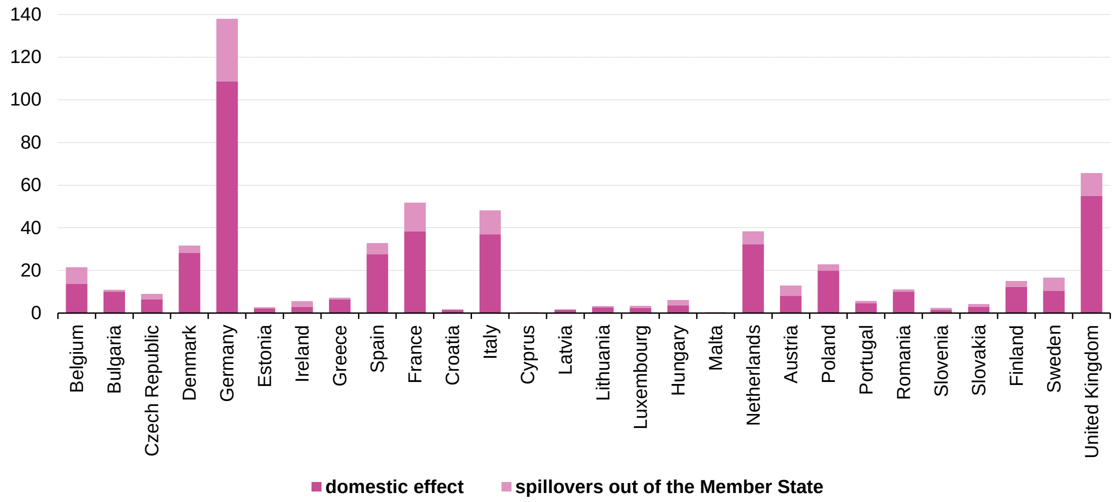


Figure 14.3 shows the amount of emissions caused in the Member State due to extra-EU exports by all Member States. The domestic effect is the same as in Figure 14.2. The spillover effect now shows emissions in the Member State due to the extra-EU exports of the other Member States. The next figure looks in more detail at the difference between the spillovers into and out of the Member State.

Figure 14.3: Geographical distribution of CO2 emissions due to extra-EU exports, by Member State emitting air emissions (2010)
(million tonnes)

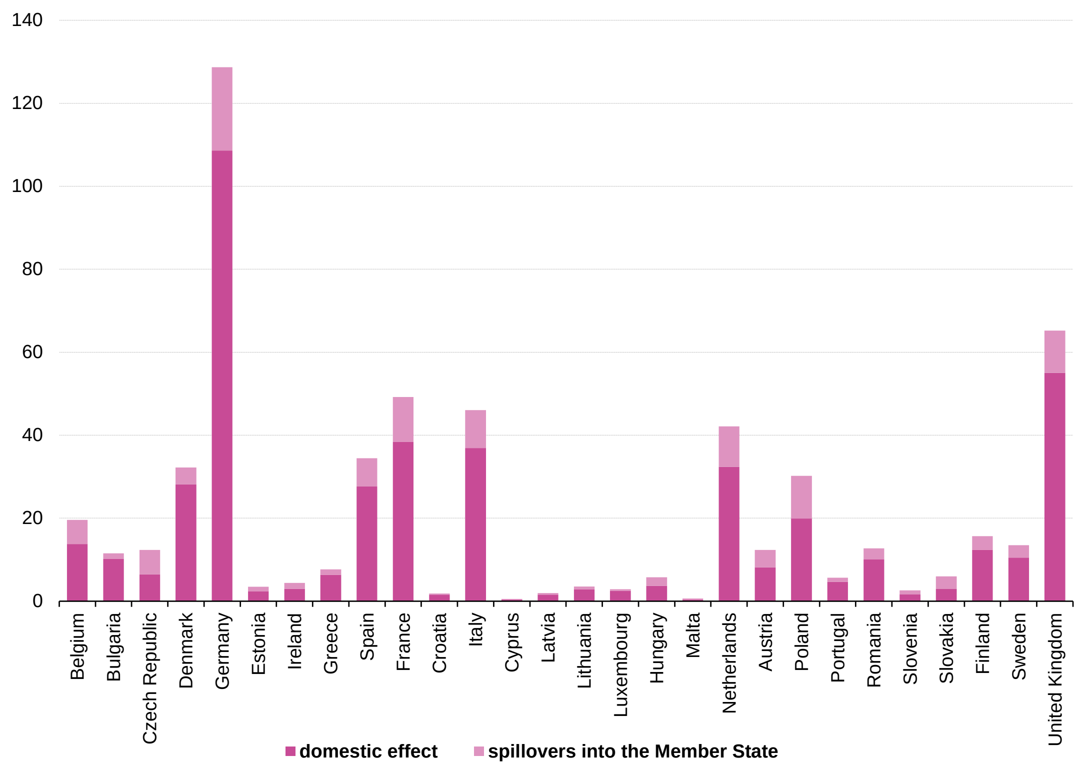
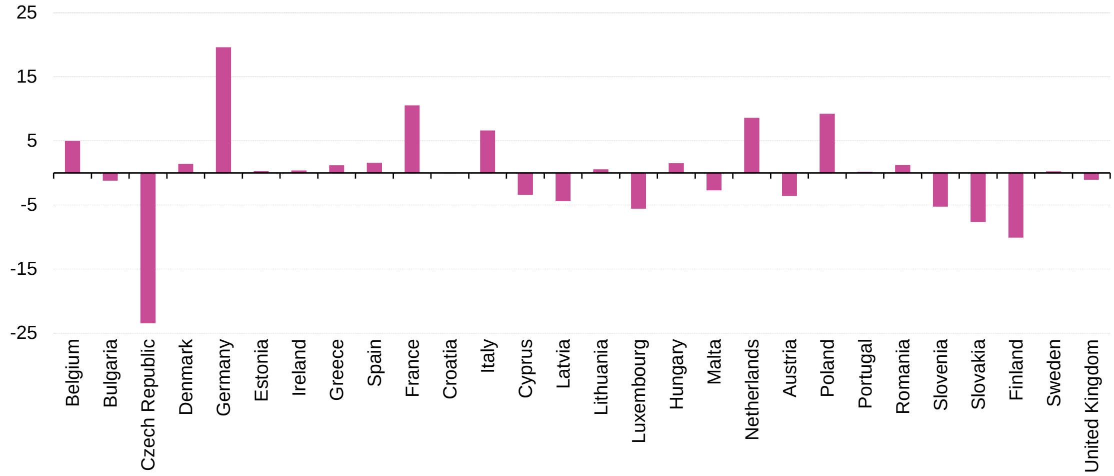


Figure 14.4 more clearly depicts the balance of the spillovers into the Member State and out of the Member State. A positive balance means that the emissions taken on for the extra-EU exports of

other Member States are larger than the emissions outsourced to other Member States. Out of 11 countries with a negative balance, Germany has the largest negative balance with minus 9 million tonnes CO_2. Poland, the Netherlands and Czechia have the largest positive balances with 7, 4 and 3 million tonnes CO_2 respectively.

Figure 14.4: Balance of CO2 emissions due to extra-EU exports spillovers, spillovers into the Member State minus spillovers out of the Member State (2010)
(million tonnes)



To better understand the relative size of the CO_2 emissions by each Member State due to extra-EU exports from the viewpoint of the Member State Figure 14.5 shows the same results as Figure 14.3 but now as a percentage of the Member State's' total emissions. At more than 30 %, the CO_2 emissions due to extra-EU exports of Denmark and Luxembourg are a sizeable portion of their total CO_2 emissions. Cyprus only emits 6 % of its emissions due to extra-EU exports. On average, Member States emit 15 % of their emissions due to extra-EU exports.

Figure 14.5: Geographical distribution of CO2 emissions due to extra-EU exports, by Member State emitting air emissions as percentage of the Member State's total emissions (2010)

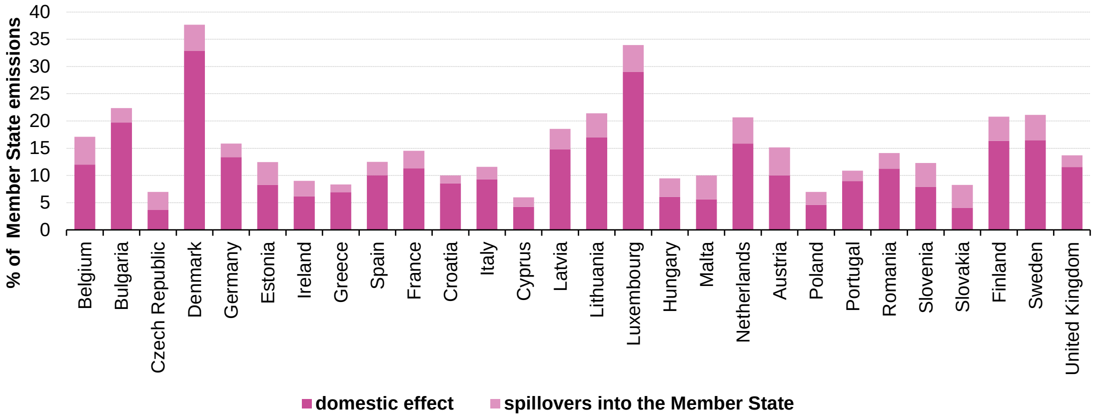


Figure 14.6 shows that the export of C20 — chemicals and chemical products is responsible for the highest amount of EU CO_2 emissions due to extra-EU exports, accounting for 71 million tonnes or 12 % of the total amount of EU CO_2 emissions due to extra-EU exports. Second and third are C24 — — basic metal and H50 — water transport services, with 63 million tonnes of CO_2 (11 %) and 57 million tonnes (10 %) respectively.

Figure 14.6: EU CO2 emissions due to extra-EU exports, by product exported out of the EU (2010)
(million tonnes)

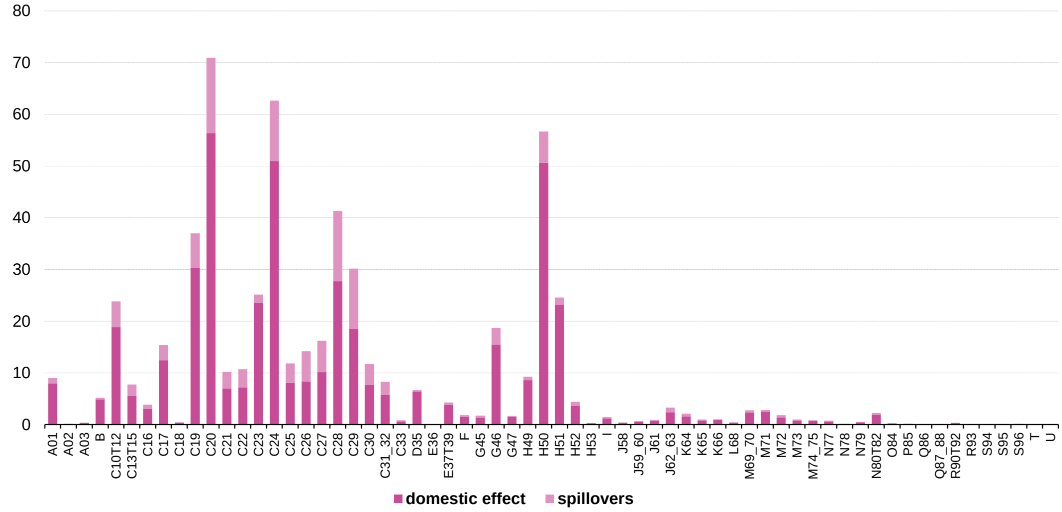
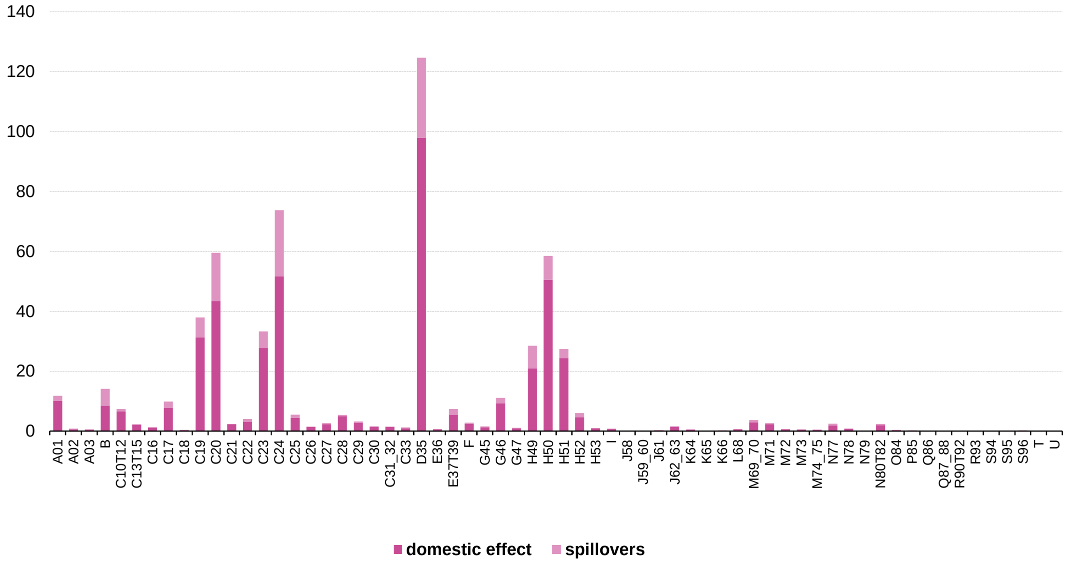


Figure 14.7 shows which products are at the source of the EU CO_2 emissions, or in other words, how much CO_2 is emitted in the EU to produce products that serve as inputs to extra-EU exported products. The production of product D35 — Electricity, gas, steam and air conditioning causes 125 million tonnes of EU CO_2 emissions. Other main sources of EU CO_2 emissions due to extra-EU exports are C20, C24 and H50 (see for the labels above).

Figure 14.7: EU CO2 emissions due to extra-EU exports, by product as CO2 emission source (2010)
(million tonnes)



15 Employment

15.1 Data

Data on the employment embodied in EU exports have been built upon the number of persons employed for each EU Member State and for 64 industries. The data provide insight into the relationships between employment at Member State level and Member States' trade with non-EU countries.

15.1.1 Employment data

This work assumes two data inputs: the employment data and the EU inter-country input-output table. The data on employment for each Member State for 64 industries come from the ESA 2010 transmission programme — Table 303. Once the IC-IOT is ready the employment embodied in exports can be calculated.

The dataset for this application was further supplemented by using non-publicly available data; imputations on persons employed; value added ratios; and reallocating some data to specific industries due to confidentiality reasons (i.e.: IE Q87-88 were allocated to Q86) and with the aim to estimate complete employment series.

15.1.2 Estimation by product

The employment data described above are on an industry basis, as usually reported in national accounts. Given that the analysis is made using product-by-product input-output tables, such employment data must be converted into a product basis by applying the industry technology model (the same model used to produce the product-by-product input-output tables) as described in the Eurostat Manual of SUIOTs (Model B, page 349).

15.2 Results

The results have been calculated using the same methodology as in the previous chapter, but using employment coefficients instead of emission coefficients. For presentation purposes we aggregated the massive amount of results (28 exporter Member States x 64 exported CPA x 28 employer Member States x 64 employer CPA = 3 211 264 results per variable, e.g. persons employed (PS) total) ([118]).

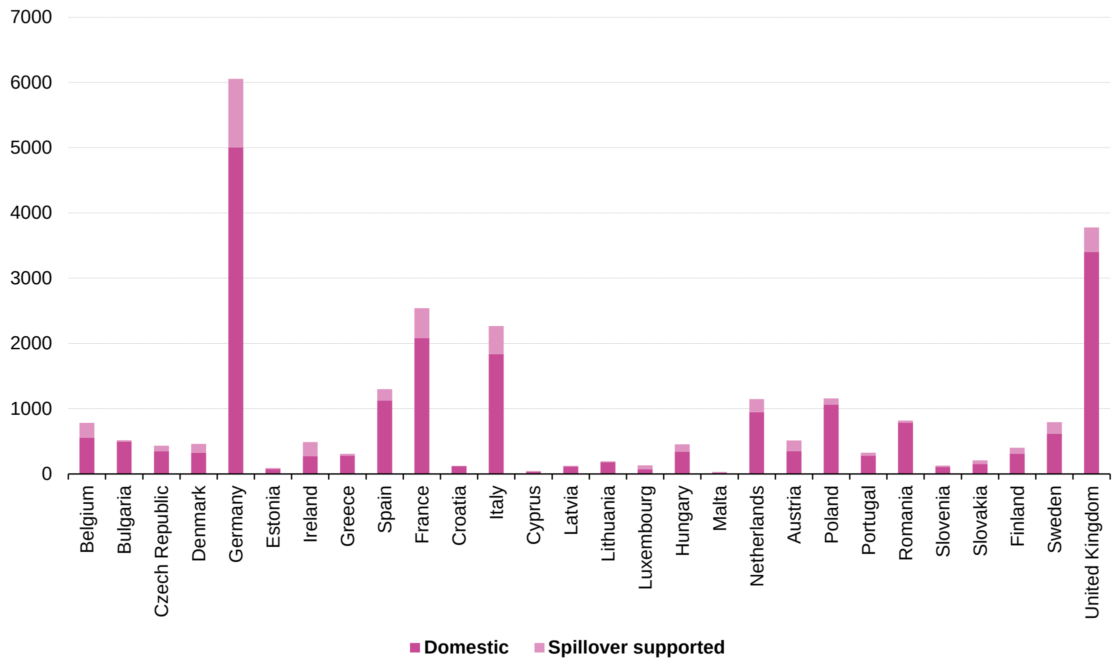
([118]) However, it is possible to dig deeper, reaching more detailed results.

Employment supported by extra-EU exports has two effects: the *domestic effect* and *spillover effects*. The domestic effect refers to those occurring in EU Member States exporting out of the EU. Spillovers are the effects on the rest of the EU Member States due to the supply of intermediates to Member States exporting out of the EU. Both the domestic effects and the spillovers include *direct effects* (the employment due the production of intermediates used for producing the exported product) and *indirect effects* (employment due the production of intermediates used for producing the intermediates, and so on).

In 2010, EU exports to the rest of the world supported around 25.5 million jobs in the EU-28 (Figure 15.1). Distinguishing by country, the figures range from around 6 million jobs supported by the extra-EU exports of Germany to 28 thousand jobs supported by the extra-EU exports of Malta.

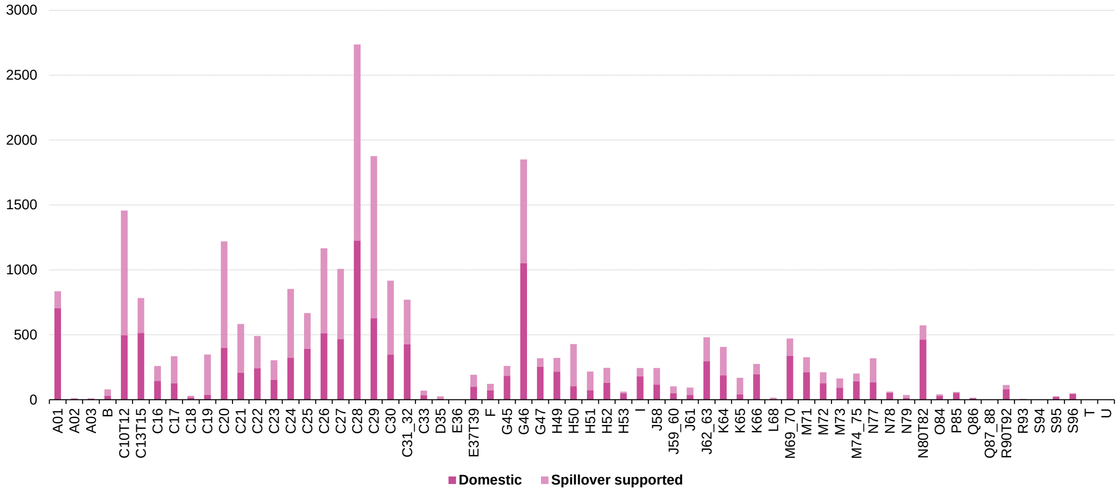
More than half of the EU jobs supported by EU exports to the rest of the world are concentrated in the following four countries: Germany, France, the UK and Italy (Figure 15.1).

Figure 15.1: EU employment supported by EU exports to the rest of the world, by Member State exporting out of the EU (2010)
(thousands persons)



Source: Authors, based on Figaro tables and national accounts main aggregates employment figures.

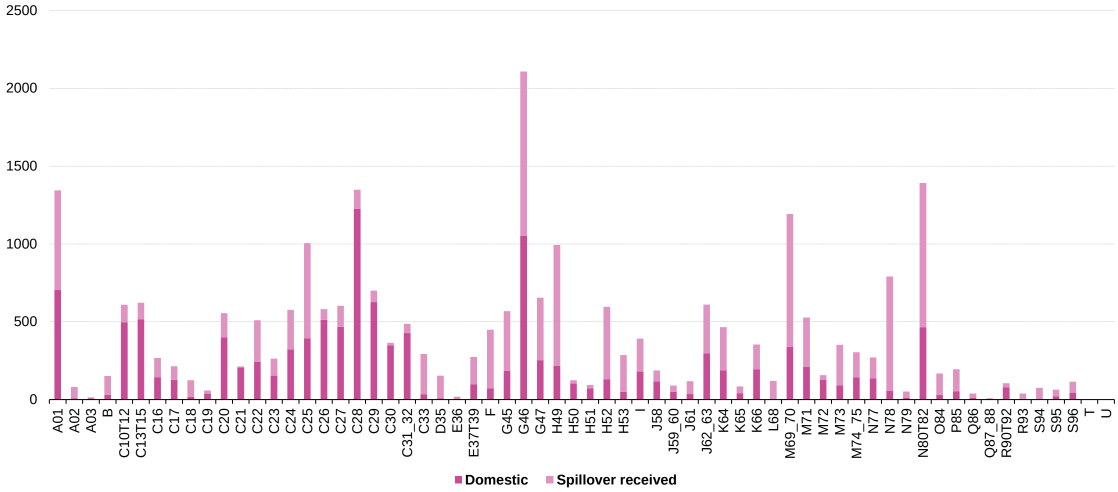
Figure 15.2: **EU employment supported by EU exports to the rest of the world, by product exported out of the EU (2010)**
(thousands persons)



Source: Authors, based on Figaro tables and NAMA employment figures.

In 2010, extra-EU exports of manufactured products accounted for ca. 60 % of the jobs supported by extra-EU exports (Figure 15.2. Manufacture of machinery and equipment (C28) accounted for 11 %.

Figure 15.3: **EU employment supported by EU exports to the rest of the world, by employing activity (2010)**
(thousands persons)

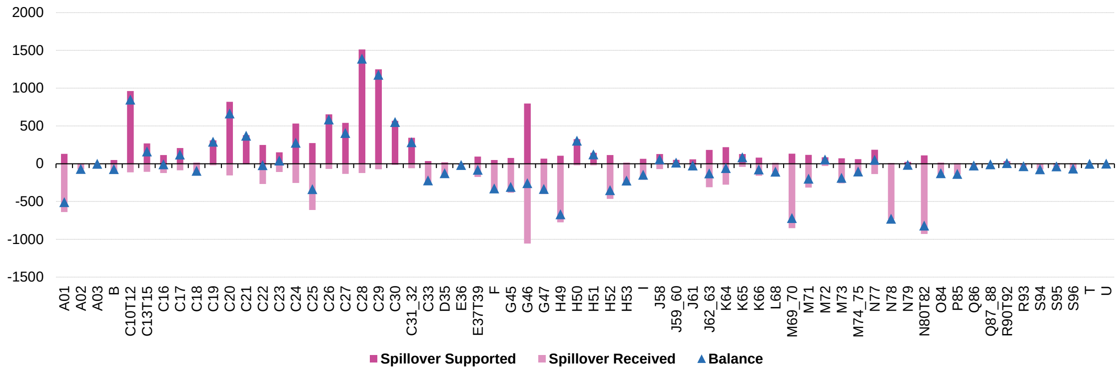


Source: Authors, based on Figaro tables and national accounts employment figures.

In 2010, 36 % of EU jobs supported by extra-EU exports were concentrated in the manufacturing industries (Figure 15.3). Wholesale trade accounted for 8 % of the jobs supported by extra-EU exports.

Figure 15.4 shows spillovers. Manufactured goods exports usually embody higher employment in other industries (positive balance) rather than the other way round, i.e. employment in manufacturing industries supported by the exports of other CPA items such as, for instance, services (negative balance).

Figure 15.4: **EU employment spillovers of EU exports to the rest of the world, by exporting product (supported) and employing activity (2010)**
(thousands persons)



Source: Authors, based on Figaro tables and NAMA employment figures.

16 Reducing discrepancies

16.1 Introduction

According to Ahmad (2017), misclassification of products can be one the sources of the discrepancies found in the compilation of inter-country statistical use tables. These discrepancies might come from the conversion made to trade statistics to CPA categories of goods and services, from the balancing process of trade asymmetries in merchandise trade and services trade statistics or because of a change in the valuation of the trade flows (from FOB to basic prices).

Hence, Ahmad (2017) proposed to reduce discrepancies by product by re-classifying bilateral trade flows of products while preserving import (by trading partner) totals in each economy. The main idea is to reallocate product discrepancy totals so that surpluses (negative discrepancies) are used to reduce shortages (positive discrepancies). This approach transfers trade flows from products (rows) where a surplus exists (i.e. national SUTs trade values are smaller than estimated trade flows) to reduce the existing shortage in a different product (i.e. national SUTs trade values are bigger than estimated trade flows). Reallocation is done by means of a conversion matrix calculated through an iterative process that determines, by row, what percentage of the product is reallocated into a different one. Hence, this transfer is done by means of a zero-sum reallocation process preserving the total value of trade of every country, i.e. without altering the geographical balanced view of trade.

In this way, due to the imposed preservation of imports by trading partner, discrepancies are not completely eliminated in this process; they are only reduced, eliminating entirely either all positive or all negative discrepancies. Ahmad (2017) also suggests doing this adjustment before splitting the balanced bilateral trade flows of goods and services by user (e.g. intermediate and final uses). However, for the Figaro project, we have developed an improved version of the Ahmad's (2017) method that:

- avoids possible negative values;
- makes de correction once the split by user has been made on the balanced view of trade adjusted for GSA and MCH, in basic prices.

Nevertheless, this method would only reduce discrepancies at the product level while remaining the overall total of discrepancies unchanged. In the next sub-sections, this chapter elaborates further the new improved version of Ahmad's (2017) method for reducing discrepancies.

16.2 Method for reducing discrepancies

16.2.1 Ahmad's (2017) approach: numerical example

Let us first introduce a numerical example. Table 16.1 describes trade between country A and the rest of other countries coming from a simulated inter-country statistical use table. There are four partner countries and five products in this example.

Table 16.1: Trade between country A and the rest of other countries, example

		CtryA	CtryB	CtryC	CtryD	Sum	Discrepancy	Target sum
CtryA	P1	0,0	80,0	30,0	10,0	120,0	10,0	130,0
	P2	0,0	10,0	0,0	40,0	50,0	-25,0	25,0
	P3	0,0	35,0	100,0	80,0	215,0	12,0	227,0
	P4	0,0	8,0	23,0	12,0	43,0	-15,0	28,0
	P5	0,0	150,0	30,0	20,0	200,0	30,0	230,0

Country A exports 120 units of product 1 abroad, of which 80 units to country B, 30 to country C and 10 to country D. According to the national SUT, exports of product 1 are 130, hence there is a positive discrepancy of 10 in our table (i.e. there is a shortage of product 1 in our inter-country use table). In contrast, for product 2, there an excess of exports in our inter-country use table compared to the national SUT exports, resulting in a negative discrepancy.

Ahmad's (2017) approach operates in the following way. The vector of positive and negative discrepancies is split into two vectors, one with only positive discrepancies ($\boldsymbol{D}^{+}$) and another one with negative discrepancies ($\boldsymbol{D}^{-}$). In this example, given that the sum of negative discrepancies (60) is bigger (in absolute values) than the sum of positive discrepancies (52), we would reallocate 52 units of surplus in products 2 and 4 to compensate shortages in products 1, 3 and 5. Given that there are 60 units of surplus and we want to use only 52 units to compensate, we need to rescale vector $\boldsymbol{D}^{-}$ to match 52 units. Hereafter, we denote the rescaled vector $\boldsymbol{D}^{-}$ as 'init'. Our goal now consists of turning this *init* vector into a *target* vector matching the total discrepancies we want to compensate.

	D^{-}	D^{+}	init	target (t*)
P1	0.0	10.0	0.0	10.0
P2	-25.0	0.0	-21.7	0.0
P3	0.0	12.0	0.0	12.0
P4	-35.0	0.0	-30.3	0.0
P5	0.0	30.0	0.0	30.0
Total	-60.0	52.0	-52.0	52.0

This implies that 21.7 units of P2 and 30.3 units of P4 will be transferred to P1 (10 units), P3 (12 units) and P5 (30 units). According to the Ahmad's (2017) approach, these transfers represent a reclassification of products (from P2 and P4 to P1, P3 and P5). These reclassifications can be expressed in the format of a square matrix $\mathbf{M} = (m_{ij})$, where m_{ij} stands for the share of product *i* that is reclassified as product *j*.

This matrix is calculated, through an iterative process, in such a way that $m_{ii} = 0$,$\sum_j m_{ij} = 1$ and the following expression holds:

$$-init \cdot \mathbf{M} = \mathbf{t}^{*}$$

for:

$$m_{ij} = \begin{cases} 0 & \text{if } i = j \\ \dfrac{a^{|j-i|}}{\sum_j a^{|j-i|}} & \text{if } i \neq j \end{cases} \quad \text{where } 0 < a < 1$$

The exponential decay of the parameter a guarantees that $m_{ij} > m_{ik}$ $\forall k > j$, that is, products are initially more likely to be reclassified as similar products, i.e. closer in the CPA classification. The higher the value of parameter a implies that, initially, products far away from product *i* in the CPA classification will receive only a marginal contribution. The final value of m_{ij} will depend on the empirical distribution of the discrepancies.

Assuming $a = 0.7$, matrix $\mathbf{M_0}$ yields:

$$\mathbf{M_0} = \begin{bmatrix} 0.00 & 0.39 & 0.28 & 0.19 & 0.14 \\ 0.31 & 0.00 & 0.31 & 0.22 & 0.15 \\ 0.21 & 0.29 & 0.00 & 0.29 & 0.21 \\ 0.15 & 0.22 & 0.31 & 0.00 & 0.31 \\ 0.14 & 0.19 & 0.28 & 0.39 & 0.00 \end{bmatrix}$$

being the target row vector $\mathbf{t}^* = [10 \quad 0 \quad 12 \quad 0 \quad 30]$ and **init** = $[0 \quad 21.7 \quad 0 \quad 30.3 \quad 0]$.

Step 1 consists in calculating the first estimation of the target with the initial matrix:

$$-\mathbf{init} * \mathbf{M_0} = \mathbf{t_0} = [11.45 \quad 6.66 \quad 16.30 \quad 4.75 \quad 12.84]$$

Step 2 carefully checks whether the tolerance ratio (**t* / t**$_0$) is below a certain threshold, ε for all the elements. If so, then the process would be finished; otherwise, we follow the next Step. For the sake of clarity, the tolerance ratio yields:

$$\frac{\mathbf{t}^*}{\mathbf{t_0}} = [0.87 \quad 0 \quad 0.74 \quad 0 \quad 2.34]$$

Evidently, each of the iterations should make all the elements of the tolerance ratio be progressively closer to 1 to match the target vector.

Step 3 generates a new matrix $\mathbf{M_1}$ by first (column-wise) rescaling matrix $\mathbf{M_0}$ with the tolerance ratio (**t* / t**$_0$), that is:

$$diag\left(\mathbf{t}^*/\mathbf{t_0}\right)\mathbf{M_0} = \begin{bmatrix} 0.00 & 0.00 & 0.20 & 0.00 & 0.32 \\ 0.27 & 0.00 & 0.23 & 0.00 & 0.36 \\ 0.18 & 0.00 & 0.00 & 0.00 & 0.48 \\ 0.13 & 0.00 & 0.23 & 0.00 & 0.73 \\ 0.12 & 0.00 & 0.20 & 0.00 & 0.00 \end{bmatrix}$$

and secondly, normalising the resulting matrix so that $\sum_j m_{ij} = 1$.

$$\mathbf{M_1} = \begin{bmatrix} 0.00 & 0.00 & 0.39 & 0.00 & 0.61 \\ 0.32 & 0.00 & 0.27 & 0.00 & 0.42 \\ 0.27 & 0.00 & 0.00 & 0.00 & 0.73 \\ 0.12 & 0.00 & 0.21 & 0.00 & 0.67 \\ 0.37 & 0.00 & 0.63 & 0.00 & 0.00 \end{bmatrix}$$

Step 4 repeats Step 1 but with $\mathbf{M_1}$, that is:

$$-\mathbf{init} * \mathbf{M_1} = \mathbf{t_1} = [10.58 \quad 0 \quad 12.17 \quad 0 \quad 29.26]$$

and then, steps 2, 3 and 4 would follow afterwards if the threshold is not reached. For informative purposes, the new tolerance ratio and the new matrix $\mathbf{M_2}$ are given by:

$$\frac{\mathbf{t}^*}{\mathbf{t_1}} = [0.95 \quad 0 \quad 0.99 \quad 0 \quad 1.03]$$

$$\mathbf{M_2} = \begin{bmatrix} 0.00 & 0.00 & 0.38 & 0.00 & 0.62 \\ 0.30 & 0.00 & 0.27 & 0.00 & 0.43 \\ 0.26 & 0.00 & 0.00 & 0.00 & 0.74 \\ 0.11 & 0.00 & 0.21 & 0.00 & 0.68 \\ 0.36 & 0.00 & 0.64 & 0.00 & 0.00 \end{bmatrix}$$

After 15 iterations, the resulting matrix **M** is given by:

$$\mathbf{M} = \begin{bmatrix} 0.00 & 0.00 & 0.38 & 0.00 & 0.62 \\ 0.30 & 0.00 & 0.27 & 0.00 & 0.43 \\ 0.25 & 0.00 & 0.00 & 0.00 & 0.75 \\ 0.11 & 0.00 & 0.21 & 0.00 & 0.68 \\ 0.36 & 0.00 & 0.64 & 0.00 & 0.00 \end{bmatrix}$$

The conversion matrix $\mathbf{M}$ is then used to calculate the amount of product that will be reclassified. For instance, 38% of the discrepancy in product 1 will be reallocated to product 3.

Next, we need to geographically distribute the **init** vector values across trading partners. This is done assuming a proportional share according to the given balanced view of trade. Suppose for Country A, the following geographical trade distribution:

	CtryA	CtryB	CtryC	CtryD
P1	0	80	30	10
P2	0	10	0	40
P3	0	35	100	80
P4	0	8	23	12
P5	0	150	30	20

→

	CtryA	CtryB	CtryC	CtryD
P1	0%	67%	25%	8%
P2	0%	20%	0%	80%
P3	0%	16%	47%	37%
P4	0%	19%	53%	28%
P5	0%	75%	15%	10%

	init
P1	0
P2	-21.7
P3	0
P4	-30.3
P5	0
Total	*-52*

×

	CtryA	CtryB	CtryC	CtryD
P1	0%	67%	25%	8%
P2	0%	20%	0%	80%
P3	0%	16%	47%	37%
P4	0%	19%	53%	28%
P5	0%	75%	15%	10%

→

	CtryA	CtryB	CtryC	CtryD
P1	0	0	0	0
P2	0	-4.33	0	-17.3
P3	0	0	0	0
P4	0	-5.64	-16.2	-8.47
P5	0	0	0	0

Finally, we make the reclassification by multiplying each of the country's **init** column value by the matrix of conversion **M**. For instance, for country B, $-init_B \cdot \mathbf{M} = \mathbf{t}_{\boldsymbol{B}}^{*}$, which is equal to [1.95, 0, 2.31, 0, 5.71] and in matrix form:

	CtryA	CtryB	CtryC	CtryD
P1	0	1.95	1.85	6.20
P2	0	0	0	0
P3	0	2.31	3.33	6.35
P4	0	0	0	0
P5	0	5.71	11.04	13.25

Then, the final result would come from adding the following three matrices:

	CtryA	CtryB	CtryC	CtryD
P1	0	80	30	10
P2	0	10	0	40
P3	0	35	100	80
P4	0	8	23	12
P5	0	150	30	20

\+

	CtryA	CtryB	CtryC	CtryD
P1	0	0	0	0
P2	0	-4.33	0	-17.3
P3	0	0	0	0
P4	0	-5.64	-16.2	-8.47
P5	0	0	0	0

\+

	CtryA	CtryB	CtryC	CtryD
P1	0	1.95	1.85	6.20
P2	0	0	0	0
P3	0	2.31	3.33	6.35
P4	0	0	0	0
P5	0	5.71	11.04	13.25

Table 16.2 shows the final result where it is easy to check that each country's recorded imports by trading partner are preserved. Moreover, discrepancies of products 1, 3 and 5 have been completely eliminated while for products 2 and 4, these have been reduced. Nevertheless, the overall total of discrepancy remained unchanged.

Table 16.2: Trade between country A and the rest of countries with reduced discrepancies

		CtryA	CtryB	CtryC	CtryD	Total	Disc.	Target
CtryA	P1	0.0	82.0	31.9	16.2	130.0	0.0	130.0
	P2	0.0	5.7	0.0	22.7	28.3	-3.3	25.0
	P3	0.0	37.3	103.3	86.4	227.0	0.0	227.0
	P4	0.0	2.4	6.8	3.5	12.7	-4.7	8.0
	P5	0.0	155.7	41.0	33.2	230.0	0.0	230.0

16.2.2 Ahmad's (2017) approach: revisited for negatives

Ahmad's (2017) approach assumes that the **init** vector should be the one summing the highest overall absolute value between $\boldsymbol{D}^{+}$ and $\boldsymbol{D}^{-}$. In the previous sub-section, $|\boldsymbol{D}^{+}| < |\boldsymbol{D}^{-}|$, and consequently, $\boldsymbol{D}^{-}$ acted as **init** and $\boldsymbol{D}^{+}$ as target vector. As we will see, this implicitly leads always to positive results and no negatives. However, we will prove with the example given in Table 16.3 that the Ahmad's (2017) approach can yield negatives if it is the other way round. That is: $|\boldsymbol{D}^{+}| > |\boldsymbol{D}^{-}|$.

Negatives are basically a consequence of the conversion matrix. When $\mathbf{M}$ is applied to the **init** vectors broken down by trading partners, the resulting (negative) target vectors might be bigger than those reported trade flows in the bilateral trade matrix, which would turn these flows into negative. This is set out in the next example. Assume that the initial trade matrix for country A is ([119]):

Table 16.3: Trade between country A and the rest of countries, new example

		CtryA	CtryB	CtryC	CtryD	Sum	Discrepancy	Target Sum
	P1	0.0	80.0	30.0	10.0	120.0	10.0	130.0
	P2	0.0	10.0	0.0	40.0	50.0	-25.0	25.0
CtryA	P3	0.0	35.0	100.0	80.0	215.0	12.0	227.0
	P4	0.0	8.0	23.0	12.0	43.0	-15.0	28.0
	P5	0.0	150.0	30.0	20.0	200.0	30.0	230.0

It is easy to see that now the total sum of negative discrepancies amounts to 40 and the total sum of positive discrepancies amounts to 52. Hence, the total absolute value of negative discrepancies is smaller than their positive counterpart:$|\boldsymbol{D}^{+}| > |\boldsymbol{D}^{-}|$.

	D^{-}	D^{+}	init	target (t*)
P1	0.0	10.0	7.7	0.0
P2	-25.0	0.0	0.0	25.0
P3	0.0	12.0	9.2	0.0
P4	-15.0	0.0	0.0	15.0
P5	0.0	30.0	23.1	0.0
Total	-40.0	52.0	40.0	40.0

So taking the same bilateral trade shares, we split the new **init** vector by trade partner, which yields:

	CtryA	CtryB	CtryC	CtryD
P1	0	5.128	1.923	0.641
P2	0	0	0	0
P3	0	1.503	4.293	3.435
P4	0	0	0	0
P5	0	17.31	3.462	2.308

With these results and setting again parameter $= 0.7$, we obtain the following conversion matrix,

$$\mathbf{M} = \begin{bmatrix} 0.00 & 0.82 & 0.00 & 0.18 & 0.00 \\ 0.00 & 0.00 & 0.00 & 1.00 & 0.00 \\ 0.00 & 0.70 & 0.00 & 0.30 & 0.00 \\ 0.00 & 1.00 & 0.00 & 0.00 & 0.00 \\ 0.00 & 0.53 & 0.00 & 0.47 & 0.00 \end{bmatrix}$$

which applied to the **init** vector by trading partner, yields:

	CtryA	CtryB	CtryC	CtryD
P1	0	0.00	0.00	0.00
P2	0	-14.4	-6.41	-4.14
P3	0	0.00	0.00	0.00
P4	0	-9.49	-3.27	-2.24
P5	0	0.00	0.00	0.00

([119]) Compared with Table 16.1, we have just added 20 units to the target sum of product 4.

As shown in Table 16.4, once these discrepancy corrections have been added to the initial trade distribution, undesired negative trade flows appear where the reported trade flow is smaller than the correction.

Table 16.4: Trade between country A and the rest of countries with reduced discrepancies, new example

		CtryA	CtryB	CtryC	CtryD	Total	Disc.	Target
CtryA	P1	0.0	85.1	31.9	10.6	127.7	2.3	130.0
	P2	0.0	-4.4	-6.4	35.9	25.0	0.0	25.0
	P3	0.0	36.5	104.3	83.4	224.2	2.8	227.0
	P4	0.0	-1.5	19.7	9.8	28.0	0.0	28.0
	P5	0.0	167.3	33.5	22.3	223.1	6.9	230.0

To sort this problem out, we propose to search instead for a different conversion matrix that calculates an **init** vector on the basis of a **target** vector. This matrix is not the inverse matrix of **M** but rather a matrix that makes the inverse transformation in this way: $-\mathbf{t}^* \cdot \mathbf{M}_{-1} = init$. In this situation, the elements $m_{ij^{-1}}$ represent the amount of reallocated product *i* that was initially misclassified into *product j* ([120]). In this setup, the **init** vector will be derived from $\mathbf{t}^*$ and not the other way round (i.e. as in 16.2.1).

Hence, provided that the negative discrepancies will be now removed from the target vector (using their trading partner shares), no negative elements can occur by definition. In turn, positive discrepancies will be reallocated through the $\mathbf{M}_{-1}$ matrix.

The process for deriving $\mathbf{M}_{-1}$ is exactly the same as the one described for $\mathbf{M}$ in the previous example. In practical terms, matrix $\mathbf{M}_{-1}$ can be calculated by only exchanging **init** and **t*** vectors as in: $-\mathbf{t}^* \cdot \mathbf{M}_{-1} = init$. In our example, setting the decay parameter to $a = 0.7$ again, we find that:

$$\mathbf{M}_{-1} = \begin{bmatrix} 0.00 & 0.00 & 0.37 & 0.00 & 0.63 \\ 0.27 & 0.00 & 0.27 & 0.00 & 0.46 \\ 0.18 & 0.00 & 0.00 & 0.00 & 0.82 \\ 0.06 & 0.00 & 0.16 & 0.00 & 0.78 \\ 0.27 & 0.00 & 0.73 & 0.00 & 0.00 \end{bmatrix}$$

The allocation of the target vector **t*** by trading partner results in:

	CtryA	CtryB	CtryC	CtryD
P1	0	0	0	0
P2	0	-5	0	-20
P3	0	0	0	0
P4	0	-2.79	-8.02	-4.19
P5	0	0	0	0

And post-multiplying $\mathbf{M}_{-1}$ by every (transposed) trading partner column vector *k* from the previous matrix (i.e.$-\mathbf{t}_k^* \cdot \mathbf{M}_{-1} = init_k$) results in the corresponding positive discrepancies corrections for products underestimating the target.

	CtryA	CtryB	CtryC	CtryD
P1	0	1.53	0.48	5.69
P2	0	0	0	0
P3	0	1.81	1.32	6.10
P4	0	0	0	0
P5	0	4.45	6.22	12.40

Finally, Table 16.5, with no negatives, would be the final solution with the same overall total discrepancy (+12) but with different discrepancy values for products; actually, these have been completely eliminated for products 2 and 4.

([120]) Matrix **M** instead represents the amount of reallocated product *j* that was initially misclassified into product *i*.

Table 16.5: Trade between country A and the rest of countries with reduced discrepancies, new example

		CtryA	CtryB	CtryC	CtryD	Total	Disc.	Target
CtryA	P1	0.0	81.5	30.5	15.7	127.7	2.3	130.0
	P2	0.0	5.0	0.0	20.0	25.0	0.0	25.0
	P3	0.0	36.8	101.3	86.1	224.2	2.8	227.0
	P4	0.0	5.2	15.0	7.8	28.0	0.0	28.0
	P5	0.0	154.5	36.2	32.4	223.1	6.9	230.0

16.2.3 Ahmad's (2017) approach: revisited for users' allocation

Our last example deals with the extension of the Ahmad's (2017) approach to allocate discrepancies among users within trading partners. Our starting point is Table 16.6 representing bilateral trade between Country A and trading partners B, C and D with 2 intermediate users (I1 and I2) and one final user (F1) for each trading partner. Discrepancies and target sums are the same as those of Table 16.3. Actually, Table 16.6 summed across users match exactly with Table 16.3.

Table 16.6: Initial trade matrix for country A by partner and user

		CtryA			CtryB			CtryC			CtryD					
		I1	I2	F1	I1	I2	F1	I1	I2	F1	I1	I2	F1	Sum	Disc.	Target Sum
CtryA	P1	0.0	0.0	0.0	20.0	10.0	50.0	10.0	10.0	10.0	4.0	4.0	2.0	120.0	10.0	130.0
	P2	0.0	0.0	0.0	8.0	2.0	0.0	0.0	0.0	0.0	20.0	10.0	10.0	50.0	-25.0	25.0
	P3	0.0	0.0	0.0	5.0	20.0	10.0	50.0	50.0	0.0	10.0	20.0	50.0	215.0	12.0	227.0
	P4	0.0	0.0	0.0	0.0	0.0	8.0	5.0	5.0	13.0	6.0	4.0	2.0	43.0	-15.0	28.0
	P5	0.0	0,00	0.0	40.0	35.0	75.0	5.0	15.0	10.0	0.0	0.0	20.0	200.0	30.0	230.0

The method proposed consists of using the GRAS method to balance bilateral trade blocs (e.g. Country A vs. Country B, C or D) as given by Table 16.6, having as column targets those found in the columns of Table 16.3 and as row targets, those given by the corresponding country user's import totals from Table 16.6. Table 16.7 shows the different blocs of the numerical example with the corresponding column and row targets. Table 16.8 presents the final solution.

Table 16.7: Proportional allocation of discrepancies by user

		CtryB					
		I1	I2	F1	Sum	Disc.	Target
CtryA	P1	20.0	10.0	50.0	80.0	1.5	81.5
	P2	8.0	2.0	0.0	10.0	-5.0	5.0
	P3	5.0	20.0	10.0	35.0	1.8	36.8
	P4	0.0	0.0	8.0	8.0	-2.8	5.2
	P5	40.0	35.0	75.0	150.0	4.5	154.5
Target		73.0	67.0	143.0			

		CtryB			
		I1	I2	F1	Sum
CtryA	P1	21.0	10.0	50.6	81.5
	P2	4.0	1.0	0.0	5.0
	P3	5.5	20.8	10.5	36.8
	P4	0.0	0.0	5.2	5.2
	P5	42.5	35.3	76.7	154.5
Target		73.0	67.0	143.0	

		CtryC					
		I1	I2	F1	Sum	Disc.	Target
CtryA	P1	10.0	10.0	10.0	30.0	0.5	30.5
	P2	0.0	0.0	0.0	0.0	0.0	0.0
	P3	50.0	50.0	0.0	100.0	1.3	101.3
	P4	5.0	5.0	13.0	23.0	-8.0	15.0
	P5	5.0	15.0	10.0	30.0	6.2	36.2
Target		70.0	80.0	33.0			

		CtryC			
		I1	I2	F1	Sum
CtryA	P1	9.8	9.6	11.0	30.5
	P2	0.0	0.0	0.0	0.0
	P3	51.2	50.1	0.0	101.3
	P4	3.1	3.0	8.9	15.0
	P5	5.9	17.2	13.1	36.2
Target		70.0	80.0	33.0	

		CtryD					
		I1	I2	F1	Sum	Disc.	Target
CtryA	P1	4.0	4.0	2.0	10.0	5.7	15.7
	P2	20.0	10.0	10.0	40.0	-20.0	20.0
	P3	10.0	20.0	50.0	80.0	6.1	86.1
	P4	6.0	4.0	2.0	12.0	-4.2	7.8
	P5	0.0	0.0	20.0	20.0	12.4	32.4
Target		40.0	38.0	84.0			

		CtryD			
		I1	I2	F1	Sum
CtryA	P1	7.6	6.0	2.2	15.7
	P2	11.9	4.7	3.4	20.0
	P3	15.9	25.0	45.2	86.1
	P4	4.6	2.4	0.9	7.8
	P5	0.0	0.0	32.4	32.4
Target		40.0	38.0	84.0	

Table 16.8: Final trade distribution by user after reducing discrepancies

		CtryA			CtryB			CtryC			CtryD					
		I1	I2	F1	I1	I2	F1	I1	I2	F1	I1	I2	F1	Sum	Disc.	Target Sum
CtryA	P1	0.0	0.0	0.0	21.0	10.0	50.6	9.8	9.6	11.0	7.6	6.0	2.2	127.7	2.3	130.0
	P2	0.0	0.0	0.0	4.0	1.0	0.0	0.0	0.0	0.0	11.9	4.7	3.4	25.0	0.0	25.0
	P3	0.0	0.0	0.0	5.5	20.8	10.5	51.2	50.1	0.0	15.9	25.0	45.2	224.2	2.8	227.0
	P4	0.0	0.0	0.0	0.0	0.0	5.2	3.1	3.0	8.9	4.6	2.4	0.9	28.0	0.0	28.0
	P5	0.0	0.0	0.0	42.5	35.3	76.7	5.9	17.2	13.1	0.0	0.0	32.4	223.1	6.9	230.0

This method has three advantages:

- By definition, the solutions to each bloc deviate the minimum with respect to the prior distribution of trade;
- The method does not change zero flows (this is a property of the GRAS method);
- Import totals by industry (user) remain unchanged.

Alternatively, one could have used the expression: $-\mathbf{t}_{\boldsymbol{k}}^{*} \cdot \boldsymbol{M}_{-\mathbf{1}} = init_{\boldsymbol{k}}$ combined with a proportional distribution of the target vector across users. However, since the **init** vector (positive discrepancies) is calculated from $\boldsymbol{M}_{-\mathbf{1}}$ (i.e. not proportional to bilateral trade values) there is a risk of creating new trade flows where it did not exist.

16.3 Conclusions

In this chapter we have further developed the Ahmad's (2017) method for reducing discrepancies in the construction of inter-country use tables. In particular, under certain conditions the Ahmad approach may lead to negative trade flows, so we have therefore developed a revised approach for such cases in order to obtain sound economic results instead. In addition, we have also described the way to reduce discrepancies once the bilateral trade flows have been previously split by users (intermediate and final uses), which was not explicitly mentioned in Ahmad (2017).

Nevertheless, the practical implementation of the revised Ahmad's (2017) approach had to be postponed until the follow-up project Figaro Act I. For the Figaro project, the row and column discrepancies were eventually removed by means of the GRAS method without making any previous corrections for possible misclassification of products.

17 Limitations and further improvements

17.1 Introduction

The Figaro project produced for the first time an experimental dataset of **EU inter-country supply, use and input-output tables** for the reference year 2010 in line with the European System of Accounts (ESA) 2010 methodology. The methodology for compiling the FIGARO tables was set up based on existing international experiments as well as on data available at European level. However assumptions were still necessary to fill data gaps. Therefore the FIGARO tables need to be considered as experimental until: (i) more national data transmitted by Member States are incorporated; (ii) the current methods and its improvements are agreed among the EU Member States; and (iii) the tables are regularly produced by Eurostat, disseminated and recognised by policy users and international organisations and integrated into the global inter-country input-output tables (such as the OECD ICIO tables).

From 2018 to 2020, Eurostat and the European Commission's Joint Research Centre will continue the project and produce a time series of EU-IC-SUIOTs (both on current and previous years' prices) and improve the data and methods used in this experimental project. This work will also be carried out in close collaboration with the OECD.

The FIGARO project revealed some limitations in the compilation process and in the data inputs that the FIGARO Act I will tackle. The improvements envisaged will deal with the use of more data, the implementation of refined methodologies and improvements in the production process.

17.2 Use of more data

The FIGARO tables' compilation process is built around three main inputs: the national supply, use and input-output tables, the balanced view of trade and the adjustments to align the trade concepts to national accounts concepts.

17.2.1 National supply, use and input-output tables

Regarding the first input, national supply, use and input-output tables, the ESA 2010 transmission program does not foresee any additional mandatory data transmission from Member States in the short/medium-term.

However Member States tend to compile more often than required the use tables at basic prices, including the split between domestic and imports and valuation matrices and more detailed data than the regulated 64 industries/products breakdowns.

The voluntary data transmission is now extended to 88 industries and products and already some countries are ready to transmit those data to Eurostat. All voluntary national SUIOTs are used in the

FIGARO tables' compilation process either directly for the EU-IC-SUT or indirectly in the balanced trade compilation process.

Another improvement relates to the estimation of use table of imports when not available, especially when it comes to differentiate intermediates and final demand of imports and even to go further to identify which industries would use the imports. For this, one needs to investigate the TEC (Trade by enterprise characteristics) and STEC data, the UN classification of broad economic categories (BEC) and try to match detailed goods (at the HS6 or CN level) uses by industry.

17.2.2 Trade data

In Chapter 6 we explain how CIF-FOB margins are applied at HS4 level to the product trade values. The CIF-FOB margins originate from the OECD database and have been estimated using, whenever available, country data. Obviously gathering more Member States CIF-FOB data by products will improve the estimation of CIF-FOB margins. Besides, the standard Eurostat SUIOT data transmission protocol has been enhanced to receive from countries detailed data of the CIF-FOB total adjustment by product (88 breakdowns) and by partner.

17.2.3 Adjustments from trade to national accounts concepts

The estimation of direct purchases abroad by product and by country of origin and destination will be improved with additional information coming from:

- Direct Member States data collection through the new Eurostat SUIOT transmission protocol;
- Tourism satellite accounts data provided by Eurostat.

In the data transmission protocol for Member States the split of total direct purchases abroad by residents and purchases of non-residents on the domestic territory by product and by partner country are now included. Member States are encouraged to provide this voluntary data to Eurostat.

The tourism satellite accounts data provides by country of origin and destination a breakdown of expenditures for a number of products (transport, accommodation, restauration, valuables-durables and others). The transport item is further split between transport by land, air and waterway. This information can give some structures for distributing the total amount of direct purchases abroad or purchases of non-residents on the domestic territory.

The second adjustment where more data would improve significantly the estimation process (see Chapters 8 and 9) is the one for goods send abroad for processing and merchanting. Here the FIGARO project relies on receiving more data from EU Member States. Such data transmission is now foreseen in the SUIOT transmission protocol.

At the same time trade data related to the nature of transactions will be investigated. However not all EU Member States collect data on that code. More information on the nature of transaction code is available in part 3.11 of the Compilers guide on European statistics on international trade in goods.

17.3 Methodological improvements

Because more data may be available (see previous section), the methodology set up in FIGARO will have to make sure that it exploits all new available data. This will be the case for the process of the adjustments for goods sent abroad for processing and merchanting, as well as the process for estimating the use of imports table using TEC and STEC data.

To improve the quality of the FIGARO outputs, further methodological improvements are foreseen and listed below:

- The FIGARO trade figures will be aligned, as close as possible, on trade data provided by national accounts and balance of payments. Similarly a benchmark to the latest national accounts macro aggregates will be evaluated and possibly implemented.
- The conversion of trade in services data in Ebops categories to product classification, currently using national bridge matrices, will be based on the bi-proportional RACE method (Rueda-Cantuche et al., 2013), taking into account totals both in the Ebops classification and in the product (CPA) classification.
- Sensitivity analyses are planned to identify the assumptions driving the outcomes and to identify quality indicators. Each step of the process will be measured.
- The biggest discrepancies (see chapter 13) will be investigated. Determining their possible causes will help developing a methodology to reduce discrepancies on the basis of the potential misallocation of product flows (see Chapter 16 for more details).

17.4 Improvements in the production process

The first input of national supply and use tables is an output of the regular data transmission and Eurostat SUIOT production process. This process includes validation steps of the data transmitted by Member States. The validation rules are described in the validation handbook of national accounts (see here). The same set of validation rules will be implemented in the FIGARO process.

The process related to a balanced view of trade in services (see chapter 7) will be reviewed. The data management and data treatment of trade in services will include more sub-processes such as cleaning tiny values, interpolation of time series, more imputations for missing data. At the same time a time series of balanced view of trade in services will be produced, implementing the same methodology as in trade in goods (especially the moving average for the weights, see 6.4.2). The gravity models will be re-run to estimate missing trade flows in specific trade services items.

Last but not least EU Member States, with the support of Eurostat, will continue their work on progressively reducing trade asymmetries in merchandise trade statistics and international trade in services statistics. Coordination efforts between countries and Eurostat's workshops on asymmetries will continue.

18 Integration with the OECD inter-country input-output tables

18.1 Background

The Figaro project is a joint collaboration between the Joint Research Centre and Eurostat, aiming to put in place:

- annual production of EU inter-country input-output tables;
- production every 5 years of EU inter-country supply, use and input-output tables (EU-IC-SUIOTs).

These tables constitute a further development of the current regularly published EU and euro area balanced supply, use and input-output tables ([121]).

The 2018 update of OECD TiVA (trade in value added) database, and the underlying ICIOs, include 64 economies covering the OECD, the European Union, G20 and a significant number of East and Southeast Asian economies for the years 2005-15. It covers 36 economic activities and related aggregates and is based on the latest System of National Accounts (SNA08) statistics and industrial classification (ISIC Rev. 4), allowing for easier comparison with other databases.

These tables are widely recognised as valuable tools to support analyses of: (i) the economic, social and environmental consequences of globalisation in the EU (and worldwide) in various policy-relevant aspects such as competitiveness, growth, productivity, employment, environmental footprints; and (ii) the respective impact of production integration via international trade, e.g. global value chains.

18.2 Scope of the Figaro project and links to the OECD ICIO tables

The EU-IC-SUIOTs are defined in basic prices, for the reference year 2010, based on the SNA08/ESA10 methodology and on the NACE Rev.2/CPA 2008/ISIC Rev.4 classifications. The number of products and industries is 64.

The global OECD ICIO tables ([122]) (edition 2018) are currently defined in basic prices, for a time series from 2005 to 2015, based on the SNA08 methodology and on the ISIC Rev.4 classifications. The number of industries covered is 36.

([121]) http://ec.europa.eu/eurostat/web/esa-supply-use-input-tables/data/database

([122]) http://www.oecd.org/sti/ind/measuring-trade-in-value-added.htm

One additional source of differences is that the Figaro project uses the BPM6 methodology for the treatment of bilateral international trade of services while the global OECD ICIO tables currently use the balanced trade in services based on BPM5, reflecting the fact that many countries have not yet converted to the new accounting standards.

The differences between Figaro and the OECD may not be negligible. The key methodological changes in this respect reflect the treatment of goods sent abroad for processing and merchanting activities that may cause not insignificant differences in export and import levels between the two sets of supply and use tables needed to create the underlying input-output tables. The second key methodological difference lies in the data input of national supply and use tables: in FIGARO the main input are the use tables at basic prices while the OECD tables are compiled using as the main input the use tables at purchasers' prices and thus, deriving their own use tables at basic prices.

As the OECD-ICIO tables recently (December 2018) moved to SNA08, this book could not include comparisons between the Figaro tables and the currently published global OECD ICIO tables for the year 2010. This analysis is part of the work program for the year 2019.

What is now needed is a joint Eurostat-OECD integration and consistency strategy to integrate the forthcoming EU-IC-SUIOTs into new editions of the OECD global ICIO tables.

The main objective is to have consistent EU-IC-SUIOTs that can be integrated into the OECD global ICIO tables for the years 2010-2015 (in SNA08/ESA10/BPM6, NACE Rev.2/CPA08/ISIC Rev.4) by the end of 2020.

18.3 Coordination and consistency framework

The coordination and consistency work can be carried out between Eurostat and the OECD based on the following terms of reference:

- Eurostat has more detailed and reliable data provided by the national statistical offices of EU Member States, with respect to (for example):
    - the access to confidential data (to be used but not disclosed);
    - the availability of import use tables (CIF) for almost all EU countries;
    - the access to all the information surveyed by the (service) trade enterprise characteristics (STEC, TEC) on the final/intermediate use of bilateral trade flows;
    - some specific information collected by Eurostat (from EU countries) on the estimation of CIF-FOB margins, and on the treatment of goods sent abroad for processing and merchanting within the SUIOT framework (although rarely available);
    - the use of Comext data, with additional information about the origin and destination of trade flows;
    - specific information on direct purchases abroad by residents.
- All the national statistical offices of the EU Member States have already moved to SNA08/ESA10, NACE Rev.2/CPA08/ISIC Rev.4 and BPM6, so the Eurostat EU-IC SUIOTs must be in line with the data provided by EU countries. However, other options may be explored between the OECD and Eurostat given the consequences of the new treatment of goods sent abroad for processing for input-output analysis (e.g. global value chains), which present particular problems for the construction of global IO tables, and indeed for many GVC applications and trade-in-value-added (TiVA) indicators.
- The OECD's experience in the construction of global ICIO tables will serve Eurostat as it refines its methodology and agree on the data to be exchanged to ensure full consistency of the EU-IC-SUIOTs with the resulting global OECD ICIO tables. Similarly, Eurostat's results will serve the OECD as an input to its global ICIO tables with regard to EU national input-output tables and trade

between non-EU countries and the EU Member States. Subsequent feedback loops are expected to arrive at a common solution to possible discrepancies.

- There is full alignment of the EU-IC-SUIOTs to national accounts data in terms of GDP and its main components.
- Both the OECD and Eurostat will use as much official information as possible, although this may mean deviating from some of the methods/assumptions currently used by other institutions.
- A central part of achieving consistent input-output and supply and use tables generated by the OECD and Eurostat is a coherent and consistent view of international bilateral trade in goods and services. The OECD and Eurostat will work to develop, together with other interested international agencies, an agreed methodology that creates internationally recognised benchmark datasets in these areas.

18.4 Work plan

The work plan is as follows:

- 2017 — Finalisation of the Figaro project with EU-IC-SUIOTs (2010) in different format/methodology to the OECD global ICIO tables (but as consistent as possible, despite differences in methodologies); drafting of a joint dissemination/communication plan and a revision strategy between Eurostat-JRC and the OECD.
- By end 2017 — agreement on the process and methodology for international balanced bilateral trade data (goods and services).
- 2018-2019 — Construction of the EU-IC-SUIOTs for 2010 consistent with the OECD global ICIO tables 2010; agreement for SUIOT and Figaro data transmission. First attempt at an annual time series of consistent with OECD global and EU-IC-SUIOTs for 2011-2012.
- 2020 — A fully consistent EU-IC-SUIOTs framework with OECD global ICIO tables (2010-16), including possible forecasts (2017-18).

The Eurostat and the OECD teams will have three to four meetings per year. JRC will also participate as an invited expert. The coordination framework will run for 3 years (2018-2020). Regular meetings can be held either at OECD headquarters (Paris) or at Eurostat (Luxembourg). Meetings can be convened by either of the participating bodies (i.e. OECD or Eurostat). The meetings can be convened on each occasion by the participants.

19 Figaro Act I

19.1 Motivation, scope and objectives

In continuation of its predecessor (FIGARO project), the FIGARO Act I ([123]) project aims to implement a regular production process of annual EU inter-country input-output tables and five-yearly EU inter-country supply, use and input-output tables ([124]). These would become official statistics, provided that the Eurostat quality standards are met and the EU Member States give their agreement.

The timely provision of official statistics is crucial for EU policy analysis. Therefore, this project implements projection methods to obtain more recent estimates of the EU inter-country supply, use and input-output tables. In line with the OECD experience, the results will comply as much as possible with the same quality standards as official statistics.

The project includes various analyses with the new dataset and explores two topics of relevance:

- the challenges when compiling extended supply and use tables (along the lines of the conclusions and recommendations of the OECD Expert Group on Extended Supply and Use Tables); and
- the compilation of EU inter-country national (and/or social) accounting matrices.

The project includes a description of the production process in terms of the statistical methodology. This includes the quality assessment of the outputs, the IT development and the dissemination activities.

The scope and objectives of the project are:

- to construct EU-IC-SUIOTs at basic prices for the reference years 2010-2018 in current and previous years' prices, based on SNA2008/ESA2010 methodology and the NACE Rev.2/CPA 2008/ISIC Rev. 4 classifications;
- to integrate the tables, wherever possible, with the OECD global inter-country input-output tables, in collaboration with the OECD;
- to describe a strategy for a regular production of Eurostat's annual EU-IC-IOTs and five-yearly EU-IC-SUIOTs;
- to produce full documentation describing the methodology and the production process of the Figaro tables for the reference year 2010. This publication would give more visibility to the European inter-country tables in different forums.

([123]) The project is managed under an administrative agreement between Eurostat and the Joint Research Centre.

([124]) The geographical area of Figaro covers the EU Member States.

- to explore possible extensions of the EU-IC-SUIOTs with global business statistics taking into account the recommendations of the OECD Expert Group of Extended Supply and Use Tables;
- to explore the compilation of a time series of EU inter-country national accounting matrices, with a potential extension to social/financial accounting matrices depending on the data availability;
- to carry on two illustrative analyses with the new dataset on: air emission footprints and employment embodied in domestic final use and/or exports;
- to set up the production process environment and organisation at Eurostat including the setting of quality indicators to assess the Figaro tables as official outputs.

19.2 Implementation of the project

The project's main actors are:

- Eurostat Unit C.5 — Integrated global accounts and Balance of Payments;
- Eurostat Unit G.6 — Trade in services, globalisation;
- Eurostat Unit G.5 — Trade in goods;
- Eurostat Unit E.2 — Environmental statistics and accounts; sustainable development;
- Eurostat Unit A.3 — IT solutions for statistical production;
- Eurostat Unit B.5 — Data and metadata services and standards;
- JRC Unit B.5 — Circular Economy and Industrial Leadership.

This project will benefit from close collaboration between the respective teams of the seven units.

In Eurostat, the team leader of SUIOTs (Unit C5) will manage this project. In the JRC, the project is managed by an expert with more than 7 years' experience in the SUIOT domain and accredited experience in economic statistics relevant for the project. The JRC ensures that its input to the project comes from experienced people in the SUIOT domain and/or experience in economic statistics relevant for the project (global business statistics, labour statistics and environmental statistics).

The project is organised into 12 work packages (see 19.3 for details) each led by a partner (leading partner) whose role is to coordinate the work of the different partners and make sure that reports and deliverables are submitted on schedule.

National experts from the EU Member States are involved in the project through regular discussions on the treatment of national data, the methodology and the results of the project. There will also be regular bilateral contacts with international agencies such as the OECD, UNSD and UNECE.

Three working groups are involved in this project:

- The Eurostat Coordination Group: at least one representative of each unit of ESTAT involved in the project will take part. The group will coordinate the work within Eurostat.
- The Steering Committee: comprised of the project partners, the main interested DGs and international agencies such as OECD, WTO, ECB, EIB, UNECE and UNSD, and interested global input-output database compilers from the scientific community ([125]).
- The Technical Group on Supply, Use and IOTs (or on EU consolidated tables): this group was created in 2008 and holds annual meetings with the participation of NSOs of the EU Member States, ECB, ESTAT and the JRC. Member States' participation is mainly channelled through this technical group, for which all Member States receive an invitation to participate.

([125]) EXIOBASE (TNO, Netherlands), WIOD (University of Groningen, Netherlands), OECD/WTO, GTAP (Purdue University, US), Eora (University of Sydney, Australia), IDE-JETRO (Japan External Trade Organisation, Japan) and GRAM (Vienna University, Austria).

19.3 Description of tasks

19.3.1 Task 1 — Construct EU-IC-SUIOTs at basic prices for the reference years 2010-2018 in current and previous year prices

The ESA2010 TP establishes that Member States must deliver on an annual basis Supply Tables at basic prices, including a transformation into purchasers' prices and Use Tables at purchasers' prices; and on a five-yearly basis (for reference years ending in 0 or 5) Input-Output Tables at basic prices. With the new ESA2010 TP, the following five additional tables at current prices must also be delivered on a five-yearly basis, starting from the reference year 2010 onwards:

- Use table at basic prices;
- Use table for domestic output at basic prices;
- Use table for imports at basic prices;
- Table of trade and transport margins;
- Table of taxes less subsidies on products

This project will therefore rely on the expected submissions of the Member States and will estimate the missing tables using as much as possible official statistics and Eurostat and JRC's expertise, accredited by the longstanding collaboration of the two institutions in the construction of the EU and euro area consolidated SUIOTs and the first experimental EU IC-SUIOTs (Figaro Project, 2015-17). As a result of the new ESA2010 TP, the EU-IC-SUTs will only be produced on a five-yearly basis given that the national supply and use tables at basic prices will only be available once every five years. In turn, the construction of the EU-IC-IOTs will be produced annually from the available data but without disclosing the underlying estimated use tables at basic prices.

The EU-IC-SUIOTs will be integrated with adjustments limited as much as possible into the OECD Global Inter-country Input-Output Tables. The previous joint work carried during 2015-17 by the JRC, ESTAT and the OECD on trade asymmetries, CIF-FOB margins, estimation of trade in services and the compilation of SNA08-based EU inter-country supply, use and input-output tables is an asset to build upon in order to compile a fully integrated time series of EU-OECD Global Inter-country Input-Output Tables.

The EU-IC-SUIOT will be compiled from official national SUIOTs transmitted by EU Member States. A clear and transparent process of feedback with the EU Member States will be implemented through the so-called technical group. Besides, they might also be consulted bilaterally on any necessary adjustment to their official national data that could come as a result of the consistency checks with other international trade and global SUIOT databases. The outcome of these consultations will be further implemented in the EU-IC-SUIOTs and communicated to the EU Member States and the OECD.

The EU-IC-SUIOT should consist of a time series of current prices tables from 2010 to 2018 by the end of 2020 and a time series of previous year prices from 2011 to 2018 by the end of 2020.

The EU-IC-SUIOTs will serve as an input to Eurostat's environmental accounts' unit for the calculation of demand-based air emission accounts. The use of EU-IC-SUIOTs in the raw material equivalents model will be further investigated due to the need for more detail in material-intensive industries. The EU-IC-SUIOTs allow improving the methods used so far for the estimation of the EU air emission footprints by considering country-specific emission intensities and country-specific technologies, i.e. using multi-regional input-output modelling. This task will include the validation and the consistency checks between air emission accounts and the monetary tables as a collaborative work between the environmental accounts unit and the SUIOT unit.

The EU-IC-SUIOTs will be based on data transmitted by Member States of the European Union. Therefore, the data presented in the EU-IC-SUIOTs will have to reconcile different statistical areas such as trade statistics, balance of payments and National Accounts. The work carried out during the previous Figaro Project will serve as guideline to accomplish the estimation of a full time series of EU-IC-SUIOTs and reconcile the different statistics. The use of confidential primary statistics and the application of reliability limits to them will be performed by the Eurostat's trade statistics units given their expertise and knowledge on the particular issues of the global business statistics databases (e.g. BEC classification, TECs, STECs …).

The EU-IC-SUIOTs will include supplementary information in the form of a bridge column (or a functionally equivalent alternative) from the ownership recording principle (ESA2010) as used in the official statistical table to relevant physical recording (in the sense of the System of Environmental-Economic Accounting (SEEA), for environmental-economic analytical purposes.

As novelties with respect to its predecessor, this project has two additional sub-tasks, namely:

- Estimation of a time series of EU-IC-SUIOTs at previous year prices;
- Use of projection methods to reduce the time lag of three years between the reference year and the year of publication to a minimum of one year;

The methodology to be used for the estimation of the EU-IC-SUIOTs at previous year prices will be based on the H-approach proposed by the UN Handbook on Supply, Use and Input-Output Tables (UNSD, 2017) and the work carried out by the JRC and ESTAT on the deflation of national SUIOTs (TIMESUT3 Project, 2014-16). Ideally, a simultaneous approach where current and previous year prices tables are jointly estimated would be recommendable. Nevertheless, other methods can also be used instead as long as they would allow the alignment to the existing global ICIO of OECD.

The projection methods to be used for reducing the time lag between the reference year and the year of publication (now-casting) will be based on the recent work developed by the OECD for their projection of the Global Inter-country Input-Output Tables 2012-14. At this point, for the most recent years, more aggregated tables will be considered depending on the data availability at national levels (e.g. macroeconomic aggregates) ([126]).

Besides, part of this task includes the editing and further publication of the present Eurostat's Working Paper Series publication, which should serve as starting point for developing a strategy for regular productions of annual EU-IC-IOTs and five-yearly EU-IC-SUIOTs by Eurostat.

19.3.2 Task 2 — Explore possible extensions of the EU-IC-SUIOTs

There are two directions for extension developed here: the first one relates to global business statistics taking into account the recommendations of the OECD Expert Group of Extended Supply and Use Tables; the second one relates to extend the EU-IC-SUIOTs for environmental modelling.

The OECD Expert Group of Extended Supply and Use Tables is expected to offer guidance in order to advance the creation of international standards for compiling Extended Supply and Use tables. In other words, this expert group will provide a series of recommendations and standard aggregations that have a minimal impact on data collection (i.e. which build on existing data sources and expertise such as TEC ([127]), FATS ([128]) and SBS ([129])) and are broadly replicable across countries, lending themselves to being integrated at the global level within Global Supply and Use tables.

The EU-IC-SUIOTs are a powerful tool for policy analysis and decisions. The EU-IC-SUIOTs could be further split considering three different dimensions such as ownership, trade status and size of firms. Substantial progress has been achieved over the last year in terms of availability of linked trade-business data, in particular via FATS statistics, TEC (goods) and STEC (services) statistics.

([126]) The current national accounts transmission programme provides benchmark data at a level of 21 industries within 9 months after the end of the reference period. This data will be used to project inter-country supply, use and IO tables with a time lag from 3 years to a minimum 1 year.

([127]) Trade by Enterprise Characteristics.

([128]) Foreign Affiliate Trade Statistics.

([129]) Structural Business Statistics.

The first part of this task consists therefore in defining a framework for the integration of selected global business statistics into the EU-IC-SUIOTs and in establishing a work plan for the regular production of these integrated statistics, where not yet available. It will take into account the work on data availability and methodology that has been undertaken by the OECD Expert Group of Extended Supply and Use Tables.

The second part of this task will explore future extensions required for environmental modelling, like increasing industry detail for material flow analysis; and links to energy accounts. Increasing industry and product detail will be studied taking into account the voluntary data transmission by Member States up to 88 products/industries that will be put in place in 2018 following the National Accounts Working Group of May 2017.

19.3.3 Task 3 — Explore the compilation of a time series of EU Inter-country National/Social/Financial Accounting Matrices

The European System of Accounts 2010 (p. 20) shows the sequence of interconnected accounts on which they are built around. In a simplified way, these are shown in Figure 19.1. In this figure, it can be seen that the Supply, Use and Input-Output Tables are just a part of the structure of the European System of Accounts, covering the Production and the Generation of Income Accounts. They also include the Goods and Services Account.

The Figaro Project (2015-17) produced for the first time official EU inter-country supply, use and input-output tables, which are considered a natural extension of the national Supply, Use and Input-Output Tables. What truly mattered in such extension was the geographical allocation of trade across countries, users and products/services. However, those tables (as any other inter-country supply, use and input-output tables) still miss important information that can be used for policy analyses. The use of other accounts such as the Allocation of Primary Income Account and the Secondary Distribution of Income Accounts would allow for analyses of income distribution across countries and institutional sectors by looking at, for instance, social transfers or property income. The use of the Disposable Income Account would give insight into the consumption patterns across countries and would make a neat link to their net savings. The Capital account would also provide further information about capital transfers on a bilateral basis across countries (i.e. foreign affiliates, foreign direct investment…), which are often important for measuring global value chains, too.

A National Accounting Matrix (NAM) is a particular representation of a system of economic accounts that captures the transactions and transfers of all economic agents. They are usually represented as square matrices, where the row and column sums match. Inflows are shown in rows and outflows in columns (e.g. Use table). A NAM is also comprehensive in the sense that it portrays all economic activities of the economy: production, consumption, accumulation and distribution; and flexible, allowing for various levels of disaggregation, particularly in the households sector.

The construction of NAMs has three important motivations:

- They help to bring together and ensure consistency to data coming from various sources (e.g. Supply and Use Tables, Household budget surveys, Labour force survey, trade statistics, balance of payments statistics, government budgets accounts, national accounts …).
- They clearly display in one single matrix the linkage between income distribution and economic structure; although it can also be between the real and the financial sides of the economy (e.g. by adding financial accounts to the NAMs).
- They are considered as a useful analytical database for modelling, such as for computable general equilibrium models. The majority of these models aim to examine the effects of real shocks on income distribution in the economy across socioeconomic groups of households.

A Social Accounting Matrix (SAM) goes one step further. It portrays different household types and/or employment categories integrated into the NAM framework. Constructing an EU-N/SAM would be an effort from Eurostat and the European Commission to improve the quality of the data to be used in current and future macro- and meso-economic models to better support EU policy. This task is mainly devoted to explore the feasibility to regularly produce official national and/or inter-country N/SAMs by Eurostat.

Figure 19.1: Sequence of accounts

Production account	
	Production
	Intermediate consumption
	Consumption of fixed capital
	(Balance) Net value added
Generation of income account	
	Net taxes on production
	Compensation of employees
	(Balance) Operating surplus/mixed income
Allocation of primary income account	
	Compensation of employees
	Net taxes on production and imports
	Property income, interests, dividends, other transfers
	(Balance of primary income) Net national income
Secondary distribution of income accounts	
	Income tax
	Net social contributions
	Social benefits
	Other current transfers
	(Balance) Net disposable income
Use of disposable income account	
	Comnsumption expenditure of households
	Adjustments in pension rights
	(Balance) Net saving
Capital account	
	Capital transfers
	Gross capital formation
	Fix gross capital formation
	Changes in inventories and valuables
	(Balance) Net lending (+)/ borrowing (-)
Financial accounts	

Supply, use, input-output tables (SUIOT)

National/social accounting matrix (N/SAM)

Financial social accounting matrix (FSAM)

19.3.4 Task 4 — Dissemination and analyses

Following up the work on its predecessor, the Figaro Project (2015-2017), two illustrative analyses will be carried out as a way to complement the dissemination activities of the new EU-IC-SUIOTs. These are the following:

- Calculation of a time series of air emission footprints for the EU using the same period covered by this project and by country;
- Calculation of the EU employment embodied in its domestic final use and/or exports for the period covered by the project and by country.

Regarding dissemination, this project will continue the work developed under the Figaro Project (2015-2017) by which the EU-IC-SUIOTs are published as experimental statistics and a specific section on the Eurostat webpage on 'Economic Globalisation' ([130]).

19.3.5 Task 5 — Quality assessment indicators and IT development

In order to increase the acceptance of the Figaro database and the underlying methodology, quality indicators will be developed. The development of these quality indicators will benefit from the modular IT and methodological structure set up in the Figaro project (2015-2017): it will allow measuring the changes from the original input data all the way to the end product (i.e. EU inter-country supply, use and input-output tables).

([130]) http://ec.europa.eu/eurostat/web/economic-globalisation-and-macroeconomic-statistics/overview

The set of explicitly defined, described and measured quality criteria will help to evaluate the outcome in respect to the usual Eurostat quality standards set for any official statistics data.

The task includes the IT process description for the regular annual production of the European inter-country supply, use and input-output tables at current prices. This will be developed during the first year of the project and will set up the planning work on the necessary IT developments (related to the production database and to the dissemination of the results) for the following two years of the project.

IT process production system will be evaluated in collaboration between unit C5 and directorate B. The Figaro 2015-2017 project has revealed issues of time processing due to the volume of data treated. As the project was covering only one year a careful assessment of the system is needed to face the coming increased coverage of Figaro tables (8 years and two types of prices by the end of 2020).

20 References and annexes

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20.2 Annex

20.2.1 Format of the Figaro tables

Figure 20.1: Inter-country supply table

	INDUSE →	A01	A02	...	U	P1_TC	P7	TS_BP	D21X31	OTTM	TS_PP	ITTM	TS_PF
REF_AREA	**PROD_NA ↓**												
AT	CPA_A01			...									
AT	CPA_A02			...									
AT	...	...	...	...	...	...	...	...	...	...	...	...	...
AT	CPA_U			...									
AT	**P1_TR (=TOTAL)**			...									
AT	C01												
AT	C02												
AT	**C03**			...									
AT	P11			...									
AT	P12			...									
AT	P13			...									
BE	CPA_A01			...									
BE	CPA_A02												
BE	...	...	...	...	...	...	...	...	...	...	...	...	...
BE	CPA_U			...									
BE	**P1_TR (=TOTAL)**			...									
BE	C01												
BE	C02												
BE	**C03**			...									
BE	P11			...									
BE	P12			...									
BE	P13			...									
...	...	...	...	...	...	...	...	...	...	...	...	...	...
US	CPA_A01			...									
US	CPA_A02			...									
US	...	...	...	...	...	...	...	...	...	...	...	...	...
US	CPA_U			...									
US	**P1_TR (=TOTAL)**			...									
US	C01												
US	C02												
US	**C03**			...									
US	P11			...									
US	P12			...									
US	P13			...									

Labels:
REF_AREA: Country of reference, e.g. AT (Austria), BE (Belgium), US (United States).
PROD_NA: Product classification, e.g. CPA_A01 (Agriculture)
IND_USE: NACE classification, e.g. A01 (Agriculture)
C01: CIF/FOB adjustment on imports
C02: Direct purchases abroad by residents; C03= C01+C02
P1_TR = Total output by industry
P11: Market output
P12: Output for own final use
P13: Non-market output
P1_TC: Total output by product
P7: Imports CIF
TS_BP: Total supply at basic prices
D21x31: Taxes less subsidies on products
OTTM: Trade and transport margins
TS_PP: Total supply at purchasers' prices
ITTM: International trade and transport margins
TS_PF: Total supply at purchasers' prices and FOB
Colours: Subtotals (yellow); Products and other concepts (orange); Activities and other concepts (blue); void cells (grey).

Figure 20.2: Inter-country statistical use table

	INDUSE →	A01	A02	...	U	A01	A02	...	U	...	A01	A02	...	U	**P2_TC**	P3_S14	P3_S15	P3_S13	P51G	P5M	P3_S14	P3_S15	P3_S13	P51G	P5M	...	P3_S14	P3_S15	P3_S13	P51G	P5M	P6	**TFU**	**C_DISC**	**TU**
	COUNTERPART_AREA →	AT	AT	...	AT	BE	BE	...	BE	...	US	US	...	US	W2	AT	AT	AT	AT	AT	BE	BE	BE	BE	BE	...	US	US	US	US	US	FIGX	W2	W2	W2
REF_AREA	**PROD_NA ↓**			...				...					...																						
AT	CPA_A01			...				...					...																						
AT	CPA_A02			...				...					...																						
AT	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...		...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
AT	CPA_U			...				...					...																						
BE	CPA_A01			...				...					...																						
BE	CPA_A02			...				...					...																						
BE	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...		...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
BE	CPA_U			...				...					...																						
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...		...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
US	CPA_A01			...				...					...																						
US	CPA_A02			...				...					...																						
US	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...		...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
US	CPA_U			...				...					...																						
FIGX	P7			...				...					...																						
W2	CIFOBADJ			...				...					...																						
W2	**P2_TR**			...				...		...			...																						
W2	**R_DISC**			...				...					...																						
W2	C02																																		
W2	C05																																		
W2	C07			...				...					...																						
W2	**C09**			...				...					...																						
W2	D1			...				...					...																						
W2	D29X39			...				...					...																						
W2	B2A3G			...				...					...																						
W2	**B1G**			...				...					...																						
W2	**P1**			...				...					...																						

Colours: (same as inter-country supply table)

Labels:

REF_AREA: Country of reference, e.g. AT (Austria), BE (Belgium), US (United States).
COUNTERPART_AREA: Trading partner, e.g. AT (Austria), BE (Belgium)…
P7: Imports CIF
FIGX: Rest of the world
CIFOBADJ: CIF/FOB adjustment (from SUTs)
P2_TR: Total intermediate consumption by activity
C02: Direct purchases abroad by residents
C05: Purchases of non-residents in the domestic territory
P2_TC: total intermediate consumption by product
C_DISC: Column of discrepancy
PROD_NA: Product classification, e.g. CPA_A01 (Agriculture)

P3_S14: Consumption of households
P3_S15: consumption NPISH
P3_S13: Government consumption
P51G: Gross fixed capital formation
P5M: Changes in valuables and inventories
TU: Total use
C07: Taxes less subsidies on products (also D21x31)
D1: Compensation of employees
D29x39: Other net taxes on production
B2A3G: Gross operating surplus
B1G: Gross value added
P1 = Total output
W2: Domestic
P6: Exports
TFU: Total final use
R_DISC: Row of discrepancy
IND_USE: NACE classification, e.g. A01 (Agriculture)
C09: Totals of intermediate consumption and final use

Figure 20.3: Inter-country use table

	INDUSE →	A01	A02	...	U	A01	A02	...	U	...	A01	A02	...	U	P2_TC	P3_S14	P3_S15	P3_S13	P51G	P5M	P3_S14	P3_S15	P3_S13	P51G	P5M	...	P3_S14	P3_S15	P3_S13	P51G	P5M	P6	TFU	TU
	COUNTERPART_AREA →	AT	AT	...	AT	BE	BE	...	BE	...	US	US	...	US	W2	AT	AT	AT	AT	AT	BE	BE	BE	BE	BE	...	US	US	US	US	US	FIGX	W2	W2
REF_AREA	PROD_NA ↓			...				...					...																					
AT	CPA_A01			...				...					...																					
AT	CPA_A02			...				...					...																					
AT	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...		...	...	...	...	...	...	...	...	...	...	...	...	...	...
AT	CPA_U			...				...					...																					
BE	CPA_A01			...				...					...																					
BE	CPA_A02			...				...					...																					
BE	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...		...	...	...	...	...	...	...	...	...	...	...	...	...	...
BE	CPA_U			...				...					...																					
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...		...	...	...	...	...	...	...	...	...	...	...	...	...	...
US	CPA_A01			...				...					...																					
US	CPA_A02			...				...					...																					
US	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...		...	...	...	...	...	...	...	...	...	...	...	...	...	...
US	CPA_U			...				...					...																					
FIGX	P7			...				...					...																					
W2	CIFOBADJ			...				...					...																					
W2	**P2_TR**			...				...		...			...																					
W2	C02																																	
W2	C05																																	
W2	C07			...				...					...																					
W2	**C09**			...				...					...																					
W2	D1			...				...					...																					
W2	D29X39			...				...					...																					
W2	B2A3G			...				...					...																					
W2	**B1G**			...				...					...																					
W2	**P1**			...				...					...																					

Colours: (same as inter-country supply table)

Labels:

REF_AREA: Country of reference, e.g. AT (Austria), BE (Belgium), US (United States).
COUNTERPART_AREA: Trading partner, e.g. AT (Austria), BE (Belgium)…
P7: Imports CIF
FIGX: Rest of the world
CIFOBADJ: CIF/FOB adjustment (from SUTs)
P2_TR: Total intermediate consumption by activity
C02: Direct purchases abroad by residents
C05: Purchases of non-residents in the domestic territory
P2_TC: Total intermediate consumption by product
PROD_NA: Product classification, e.g. CPA_A01 (Agriculture)

P3_S14: Consumption of households
P3_S15: consumption NPISH
P3_S13: Government consumption
P51G: Gross fixed capital formation
P5M: Changes in valuables and inventories
TU: Total use

C07: Taxes less subsidies on products (also D21x31)
D1: Compensation of employees
D29x39: Other net taxes on production
B2A3G: Gross operating surplus
B1G: Gross value added
P1 = Total output
W2: Domestic
P6: Exports
TFU: Total final use
IND_USE: NACE classification, e.g. A01 (Agriculture)
C09: Totals of intermediate consumption and final use

Figure 20.4: **Inter-country input-output table (product- by- product)**

	PROD_NA →	CPA_A01	CPA_A02	...	CPA_U	CPA_A01	CPA_A02	...	CPA_U	...	CPA_A01	CPA_A02	...	CPA_U	**P2_TC**	P3_S14	P3_S15	P3_S13	P51G	P5M	P3_S14	P3_S15	P3_S13	P51G	P5M	...	P3_S14	P3_S15	P3_S13	P51G	P5M	P6	**TFU**	**TU**
	COUNTERPART_AREA →	AT	AT	...	AT	BE	BE	...	BE	...	US	US	...	US	W2	AT	AT	AT	AT	AT	BE	BE	BE	BE	BE	...	US	US	US	US	US	FIGX	W2	W2
REF_AREA	**PROD_NA ↓**			...				...					...																					
AT	CPA_A01			...				...					...																					
AT	CPA_A02			...				...					...																					
AT	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...		...	...	...	...	...	...	...	...	...	...	...	...	...	...
AT	CPA_U			...				...					...																					
BE	CPA_A01			...				...					...																					
BE	CPA_A02			...				...					...																					
BE	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...		...	...	...	...	...	...	...	...	...	...	...	...	...	...
BE	CPA_U			...				...					...																					
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...		...	...	...	...	...	...	...	...	...	...	...	...	...	...
US	CPA_A01			...				...					...																					
US	CPA_A02			...				...					...																					
US	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...		...	...	...	...	...	...	...	...	...	...	...	...	...	...
US	CPA_U			...				...					...																					
FIGX	P7			...				...					...																					
W2	CIFOBADJ			...				...					...																					
W2	**P2_TR**			...				...		...			...																					
W2	C02																																	
W2	C05																																	
W2	C07			...				...					...																					
W2	**C09**			...				...					...																					
W2	D1			...				...					...																					
W2	D29X39			...				...					...																					
W2	B2A3G			...				...					...																					
W2	**B1G**			...				...					...																					
W2	**P1**			...				...					...																					

Colours: (same as Inter-country supply table)

Labels:

REF_AREA: Country of reference, e.g. AT (Austria), BE (Belgium), US (United States).
COUNTERPART_AREA: Trading partner, e.g. AT (Austria), BE (Belgium)…
P7: Imports CIF
FIGX: Rest of the world
CIFOBADJ: CIF/FOB adjustment (from SUTs)
P2_TR: Total intermediate consumption by activity
C02: Direct purchases abroad by residents
C05: Purchases of non-residents in the domestic territory
P2_TC: Total intermediate consumption by product
PROD_NA: Product classification, e.g. CPA_A01 (Agriculture)

P3_S14: Consumption of households
P3_S15: consumption NPISH
P3_S13: Government consumption
P51G: Gross fixed capital formation
P5M: Changes in valuables and inventories
TU: Total use
C07: Taxes less subsidies on products (also D21x31)
D1: Compensation of employees
D29x39: Other net taxes on production
B2A3G: Gross operating surplus
B1G: Gross value added
P1 = Total output
W2: Domestic
P6: Exports
TFU: Total final use
C09: Totals of intermediate consumption and final use

Figure 20.5: **Inter-country input-output table (industry-by-industry)**

	INDUSE →	A01	A02	...	U	A01	A02	...	U	...	A01	A02	...	U	**P2_TC**	P3_S14	P3_S15	P3_S13	P51G	P5M	P3_S14	P3_S15	P3_S13	P51G	P5M	...	P3_S14	P3_S15	P3_S13	P51G	P5M	P6	**TFU**	**TU**
	COUNTERPART_AREA →	AT	AT	...	AT	BE	BE	...	BE	...	US	US	...	US	W2	AT	AT	AT	AT	AT	BE	BE	BE	BE	BE	...	US	US	US	US	US	FIGX	W2	W2
REF_AREA	**IND_USE ↓**			...				...					...																					
AT	A01			...				...					...																					
AT	A02			...				...					...																					
AT	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...		...	...	...	...	...	...	...	...	...	...	...	...	...	...
AT	U			...				...					...																					
BE	A01			...				...					...																					
BE	A02			...				...					...																					
BE	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...		...	...	...	...	...	...	...	...	...	...	...	...	...	...
BE	U			...				...					...																					
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...		...	...	...	...	...	...	...	...	...	...	...	...	...	...
US	A01			...				...					...																					
US	...			...				...					...																					
US	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...		...	...	...	...	...	...	...	...	...	...	...	...	...	...
US	U			...				...					...																					
FIGX	P7			...				...					...																					
W2	CIFOBADJ			...				...					...																					
W2	**P2_TR**			...				...		...			...																					
W2	C02																																	
W2	C05																																	
W2	C07			...				...					...																					
W2	**C09**			...				...					...																					
W2	D1			...				...					...																					
W2	D29X39			...				...					...																					
W2	B2A3G			...				...					...																					
W2	**B1G**			...				...					...																					
W2	**P1**			...				...					...																					

Colours: (same as inter-country supply table)

Labels:

REF_AREA: Country of reference, e.g. AT (Austria), BE (Belgium), US (United States).
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IND_USE: NACE classification, e.g. A01 (Agriculture)

P3_S14: Consumption of households
P3_S15: consumption NPISH
P3_S13: Government consumption
P51G: Gross fixed capital formation
P5M: Changes in valuables and inventories
TU: Total use
C07: Taxes less subsidies on products (also D21x31)
D1: Compensation of employees
D29x39: Other net taxes on production
B2A3G: Gross operating surplus
B1G: Gross value added
P1 = Total output
W2: Domestic
P6: Exports
TFU: Total final use
C09: Totals of intermediate consumption and final use

20.2.2 List of CPA 2008 products

Code	Product
CPA_A	Products of agriculture, forestry and fishing
CPA_A01	Products of agriculture, hunting and related services
CPA_A02	Products of forestry, logging and related services
CPA_A03	Fish and other fishing products; aquaculture products; support services to fishing
CPA_B	Mining and quarrying
CPA_B05	Coal and lignite
CPA_B06	Crude petroleum and natural gas
CPA_B07	Metal ores
CPA_B08	Other mining and quarrying products
CPA_B09	Mining support services
CPA_BTE	Industrial products (except construction works)
CPA_BTF	Industrial products and construction works
CPA_C	Manufactured products
CPA_C10	Food products
CPA_C10T12	Food, beverages and tobacco products
CPA_C11	Beverages
CPA_C12	Tobacco products
CPA_C13	Textiles
CPA_C13T15	Textiles, wearing apparel, leather and related products
CPA_C14	Wearing apparel
CPA_C15	Leather and related products
CPA_C16	Wood and of products of wood and cork, except furniture; articles of straw and plaiting materials
CPA_C16T18	Wood and of products of wood and cork, except furniture; articles of straw and plaiting materials; paper and paper products; printing and recording services
CPA_C17	Paper and paper products
CPA_C18	Printing and recording services
CPA_C19	Coke and refined petroleum products
CPA_C20	Chemicals and chemical products
CPA_C21	Basic pharmaceutical products and pharmaceutical preparations
CPA_C22	Rubber and plastic products
CPA_C22_23	Rubber, plastic and other non-metallic mineral products

CPA_C23	Other non-metallic mineral products
CPA_C24	Basic metals
CPA_C24_25	Basic metals and fabricated metal products, except machinery and equipment
CPA_C25	Fabricated metal products, except machinery and equipment
CPA_C26	Computer, electronic and optical products
CPA_C27	Electrical equipment
CPA_C28	Machinery and equipment n.e.c.
CPA_C29	Motor vehicles, trailers and semi-trailers
CPA_C29_30	Motor vehicles, trailers and semi-trailers and other transport equipment
CPA_C30	Other transport equipment
CPA_C31	Furniture
CPA_C31_32	Furniture and other manufactured goods
CPA_C31T33	Furniture, other manufactured goods, repair and installation services of machinery and equipment
CPA_C32	Other manufactured goods
CPA_C33	Repair and installation services of machinery and equipment
CPA_D	Electricity, gas, steam and air conditioning
CPA_D35	Electricity, gas, steam and air conditioning
CPA_E	Water supply; sewerage, waste management and remediation services
CPA_E36	Natural water; water treatment and supply services
CPA_E37	Sewerage services; sewage sludge
CPA_E37T39	Sewerage services; sewage sludge; waste collection, treatment and disposal services; materials recovery services; remediation services and other waste management services
CPA_E38	Waste collection, treatment and disposal services; materials recovery services
CPA_E39	Remediation services and other waste management services
CPA_F	Constructions and construction works
CPA_F41	Buildings and building construction works
CPA_F42	Constructions and construction works for civil engineering
CPA_F43	Specialised construction works
CPA_G	Wholesale and retail trade services; repair services of motor vehicles and motorcycles

CPA_G45	Wholesale and retail trade and repair services of motor vehicles and motorcycles
CPA_G46	Wholesale trade services, except of motor vehicles and motorcycles
CPA_G47	Retail trade services, except of motor vehicles and motorcycles
CPA_GTI	Wholesale and retail trade; transportation and storage; accommodation and food services
CPA_GTU	Services
CPA_H	Transportation and storage services
CPA_H49	Land transport services and transport services via pipelines
CPA_H50	Water transport services
CPA_H51	Air transport services
CPA_H52	Warehousing and support services for transportation
CPA_H53	Postal and courier services
CPA_I	Accommodation and food services
CPA_I55	Accommodation services
CPA_I56	Food and beverage serving services
CPA_J	Information and communication services
CPA_J58	Publishing services
CPA_J58T60	Publishing services; motion picture, video and television programme production services, sound recording and music publishing; programming and broadcasting services
CPA_J59	Motion picture, video and television programme production services, sound recording and music publishing
CPA_J59_60	Motion picture, video and television programme production services, sound recording and music publishing; programming and broadcasting services
CPA_J60	Programming and broadcasting services
CPA_J61	Telecommunications services
CPA_J62	Computer programming, consultancy and related services
CPA_J62_63	Computer programming, consultancy and related services; Information services
CPA_J63	Information services
CPA_K	Financial and insurance services
CPA_K64	Financial services, except insurance and pension funding
CPA_K65	Insurance, reinsurance and pension funding services, except compulsory social security

CPA_K66	Services auxiliary to financial services and insurance services
CPA_L	Real estate services
CPA_L68A	Imputed rents of owner-occupied dwellings
CPA_L68B	Real estate services excluding imputed rents
CPA_M	Professional, scientific and technical services
CPA_M_N	Professional, scientific and technical services; administrative and support services
CPA_M69	Legal and accounting services
CPA_M69_70	Legal and accounting services; services of head offices; management consultancy services
CPA_M69T71	Legal and accounting services; services of head offices; management consultancy services; architectural and engineering services; technical testing and analysis services
CPA_M70	Services of head offices; management consulting services
CPA_M71	Architectural and engineering services; technical testing and analysis services
CPA_M72	Scientific research and development services
CPA_M73	Advertising and market research services
CPA_M73T75	Advertising and market research services; other professional, scientific and technical services and veterinary services
CPA_M74	Other professional, scientific and technical services
CPA_M74_75	Other professional, scientific and technical services and veterinary services
CPA_M75	Veterinary services
CPA_N	Administrative and support services
CPA_N77	Rental and leasing services
CPA_N78	Employment services
CPA_N79	Travel agency, tour operator and other reservation services and related services
CPA_N80	Security and investigation services
CPA_N80T82	Security and investigation services; services to buildings and landscape; office administrative, office support and other business support services
CPA_N81	Services to buildings and landscape
CPA_N82	Office administrative, office support and other business support services
CPA_O	Public administration and defence services; compulsory social security services
CPA_O84	Public administration and defence services; compulsory social security services

CPA_OTQ	Public administration, defence, education, human health and social work services
CPA_P	Education services
CPA_P85	Education services
CPA_Q	Human health and social work services
CPA_Q86	Human health services
CPA_Q87	Residential care services
CPA_Q87_88	Residential care services; social work services without accommodation
CPA_Q88	Social work services without accommodation
CPA_R	Arts, entertainment and recreation services
CPA_R90	Creative, arts and entertainment services
CPA_R90T92	Creative, arts, entertainment, library, archive, museum, other cultural services; gambling and betting services
CPA_R91	Library, archive, museum and other cultural services
CPA_R92	Gambling and betting services
CPA_R93	Sporting services and amusement and recreation services
CPA_RTU	Arts, entertainment and recreation; other services; services of household and extra-territorial organizations and bodies
CPA_S	Other services
CPA_S94	Services furnished by membership organisations
CPA_S95	Repair services of computers and personal and household goods
CPA_S96	Other personal services
CPA_T	Services of households as employers; undifferentiated goods and services produced by households for own use
CPA_T97	Services of households as employers of domestic personnel
CPA_T98	Undifferentiated goods and services produced by private households for own use
CPA_U	Services provided by extraterritorial organisations and bodies
CPA_U99	Services provided by extraterritorial organisations and bodies

20.2.3 List of detailed services categories for Figaro purposes (Ebops 2010)

Code	Services category
S	Services
SA	Manufacturing services on physical inputs owned by others
SB	Maintenance and repair services n.i.e.
SC	Transport
SC1	Sea transport
SC11	Passenger transport by sea
SC12	Freight transport by sea
SC13	Other (sea transport)
SC2	Air transport
SC21	Passenger transport by air
SC22	Freight transport by air
SC23	Other (air transport)
SC3	Other modes of transport
SC3A	Space transport
SC3B	Rail transport
SC3B1	Passenger transport on rail
SC3B2	Freight transport on rail
SC3B3	Other (rail transport)
SC3C	Road transport
SC3C1	Passenger transport on road
SC3C2	Freight transport on road
SC3C3	Other (road transport)
SC3D	Inland waterway transport
SC3D1	Passenger transport on inland waterway
SC3D2	Freight transport on inland waterway
SC3D3	Other (inland waterway transport)
SC3E	Pipeline transport
SC3F	Electricity transmission
SC3G	Other supporting and auxiliary transport services
SC4	Postal and courier services
SD	Travel
SD1	Goods (Travel)
SD2	Local transport services
SD3	Accommodation services
SD4	Food-serving services
SD5	Other services than goods (Travel), local transport services, accommodation services, and food-serving services

SE	Construction	
SF	Insurance and pension services	
SF1	Direct insurance	
SF11	Life insurance	
SF12	Freight insurance	
SF13	Other direct insurance	
SF2	Reinsurance	
SF3	Auxiliary insurance services	
SF4	Pension and standarised guarantee services	
SF41	Pension services	
SF42	Standarised guarantee services	
SG	Financial services	
SG1	Explicitly charged and other financial services	
SG2	Financial intermediation services indirectly measured (FISIM)	
SH	Charges for the use of intellectual property n.ie.	
SH1	Franchises and trademarks licensing fees	
SH2	Licences for the use of outcomes of research and development	
SH3	Licences to reproduce and/or distribute computer software	
SH4	Licences to reproduce and/or distribute audio-visual and related products	
SH41	Licences to reproduce and/or distribute audio-visual products	
SH42	Licences to reproduce and/or distribute other than audio-visual products	
SI	Telecommunications, computer and information services	
SI1	Telecommunications services	
SI2	Computer services	
SI21	Computer software	
SI22	Computer services other than computer software	
SI3	Information services	
SI31	News agency servcies	
SI32	Other information services	
SJ	Other business services	
SJ1	Research and development services	
SJ11	Work undertaken on a systematic basis to increase the stock of knowledge	
SJ111	Provision of customised and non-customised R&D services	
SJ112	Sale of proprietary rights arising from R&D	
SJ1121	Patents	
SJ1122	Copyrights arising from research and development	

SJ1123	Industrial processes and designs
SJ1124	Sales of proprietary rights arising from R&D other than patents,copyrights arising from R&D and industrial processes and designs
SJ12	Research and development services other than work undertaken on a systematic basis to increase the stock of knowledge
SJ2	Professional and management consulting services
SJ21	Legal, accounting, management consulting and public relations
SJ211	Legal services
SJ212	Accounting, auditing, bookkeeping and tax consulting services
SJ213	Business and management consulting and public relations services
SJ22	Advertising, market research and public opinion polling
SJ3	Technical, trade-related and other business services
SJ31	Architectural, engineering, scientific and other technical services
SJ311	Architectural services
SJ312	Engineering services
SJ313	Scientific and other technical services
SJ32	Waste treatment and de-pollution, agricultural and mining services
SJ33	Operating leasing services
SJ34	Trade-related services
SJ35	Other business services n.i.e.
SK	Personal, cultural and recreational services
SK1	Audiovisual and related services
SK11	Audiovisual services
SK1	Audio-visual and related services
SK11	Audio-visual services
SK12	Artistic related services
SK2	Other personal , cultural and recreational services
SK21	Health services
SK22	Education services
SK23	Heritage and recreational services
SK24	Other personal services
SL	Government goods and services n.i.e.
SL1	Embassies and consulates
SL2	Military units and agencies
SL3	Other government goods and services
SN	Services non-allocated

20.2.4 Data availability

Table 20.1: Average number of partner countries' data at three-letter services, per two-letter services category (year 2010)

Credit	SC	SD	SE	SF	SG	SH	SI	SJ	SK	SL
Belgium	45		28	36	56	40	46	51	25	
Bulgaria	52		3	9	43	13	48	37	32	11
Czech Republic	40	44	27	24	24	28	36	47	29	32
Denmark	51		36	23	54	35	42	50	37	49
Germany	47			17	59		41	58	30	36
Estonia	47		22	19	48	4	45	49	21	29
Ireland	12			52	48		26	27	5	2
Greece	48		39	32	52		44	52	43	18
Spain	48		18	25	42		43	45	32	12
France	58		58	58	58		58	58	58	58
Croatia	55		30	43	55		54	52	49	4
Italy	53		24	43	57		51	58	44	48
Cyprus	16		3	4	27		9	4	4	4
Latvia	32		7	3	34		12	20		2
Lithuania	34		22	9	27	3	20	39	13	27
Luxembourg	24		12	14	51		33	34	20	2
Hungary	57		30	34	58		52	50	46	36
Malta	26		1	6	96		75	45	46	24
Netherlands	124		63	44	126		155	155	89	107
Austria	46		17	15	40		36	44	18	18
Poland	47		30	16	41		41	46	31	4
Portugal	30		19	9	10	6	24	30	19	13
Romania	26		20	7	17	6	25	34	17	33
Slovenia	19	27	19	8	10		16	21	7	2
Slovakia	39		28	14	52	8	43	71	43	11
Finland	44		48	27	26		46	55	21	40
Sweden	51	33	34	46	38	42	48	51	27	4
United Kingdom	35		21	44	50		47	47	39	43

20.2.5 List of acronyms

APEC	Asia-Pacific Economic Cooperation
BEC	Broad economic categories (UN classification)
BPM5	Balance of Payments and International Investment Position Manual, fifth edition (IMF)
BPM6	Balance of Payments and International Investment Position Manual, sixth edition (IMF)
CEPII	Centre d'Études Prospectives et d'Informations Internationales (French institute for research into international economics)
CIF	Cost, insurance and freight
Comext	Eurostat's reference database for detailed statistics on international trade in goods
CPA	Classification of products by activity
CPC	Central product classification
DG	Directorate-General (European Commission)
EBOPS	Extended Balance of Payments Services
ECFIN	DG Economic and Financial Affairs
EMPL	DG Employment, Social Affairs and Inclusion
ENV	DG Environment
ESA	European System of Accounts
ESTAT	Eurostat
EU-IC-SUIOT	EU inter-country supply, use and input-output tables
EUR	Euro currency
Figaro	Full international and global accounts for research in input-output analysis
FOB	Free on board
FSAM	Financial social accounting matrix
GRAS	Generalised RAS
GROW	DG Internal Market, Industry, Entrepreneurship and SMEs
GTAP	Global trade analysis project
GVC	Global value chain
HS	Harmonised System (World Customs Organisations)
ICIO	Inter-country input-output
IC-SUIOT	Inter-country supply, use and input-output tables
IOT	Input-output table
ISIC	International Standard Industrial Classification
MRIO	Multirregional input-output
NACE	Statistical classification of economic activities in the European Community
NAFTA	North American Free Trade Agreement
NAM	National accounting matrix
OECD	Organisation for Economic Cooperation and Development
RTD	DG Research and Innovation
SAM	Social accounting matrix
STEC	Services trade by enterprise characteristics
SUIOT	Supply, use and input-output tables
SUT	Supply and use table
TEC	Trade by enterprise characteristics
TLS	Taxes less subsidies
TRADE	DG Trade
TTM	Trade and transport margins
UN Comtrade	United Nations International Trade Statistics database
UNSD	United Nations Statistics Division

20.2.6 List of country codes

AT	Austria
BE	Belgium
BG	Bulgaria
CY	Cyprus
CZ	Czechia
DE	Germany
DK	Denmark
EE	Estonia
EL, GR	Greece
ES	Spain
FI	Finland
FR	France
HR	Croatia
HU	Hungary
IE	Ireland
IT	Italy
LT	Lithuania
LU	Luxembourg
LV	Latvia
MT	Malta
NL	Netherlands
PL	Poland
PT	Portugal
RO	Romania
SE	Sweden
SI	Slovenia
SK	Slovakia
UK, GB	United Kingdom, Great Britain
US	United States of America