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Updating the 2010 Belgian interregional supply and use table

Towards a version compatible with ESA 2010

October 2019

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Federal Planning Bureau

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October 2019

Bart Van den Cruyce, bv@plan.be (*)

Abstract -

This paper describes the methodology to make the existing interregional supply and use table (ISUT) of 2010 compatible to ESA2010/SNA2008 rules and shows the results at a macro level. The ISUT describes, for each product and industry, all intra- and interregional flows caused by the intermediate use, final consumption expenditures, investments and exports of the three Belgian regions Brussels, Flanders and Wallonia.

In 2015, the Belgian Federal Planning Bureau constructed an interregional supply and use table for 2010. This table was compiled using a bottom-up approach based on VAT data and international trade data at the firm level. The table was consistent with the national SUT for 2010 published in December 2013 according to the ESA95 rules (European implementation of SNA93). The updated ISUT corresponds to the most recent national SUT (published in December 2015) and regional accounts for 2010 and therefore respects the ESA2010/SNA2008 rules.

The conversion consisted of a set of specific and automatic adjustments. The specific adjustments are asymmetric and respond to some major ESA revisions (including the treatment of R&D and goods for processing) and revisions of the Belgian national accounts (including the NACE attribution). The automatic adjustment process affects all products and industries symmetrically. It is set up as a two-step process, each step consisting of a series of RAS procedures by industry, final demand component or product to match new regional and national totals. The problem of zero values in the initial interregional SUT (while not in the new national table) is also addressed.

Jel Classification - R15, C67
Keywords - Regional, Supply and use tables, Regional economy

(*) My thanks go to my colleague Bernhard Michel for programming the series of RAS algorithms in Python

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Executive summary

This paper describes the method used to update the Belgian Interregional Supply and Use table (ISUT) of 2010 and shows the results in aggregated form. The Belgian ISUT first consists of three regional production tables, one per region. Their rows correspond to products, their columns to industries. The second part of the ISUT is the interregional use table. The columns in this table show the intermediate use by region and industry of destination as well as the final use by region of destination. In its rows it has products and their origin is shown: that is the region of production for the domestic part and imports.

The update transforms the old 2010 ISUT, that corresponds to the national SUT for 2010 computed in 2013 according to ESA95/ SNA93 rules, in a new version that corresponds to the national SUT for 2010 computed in 2015 according to ESA2010/ SNA2008. Both ISUTs are in line with the regional account totals for production, intermediate demand, final demand and value added that correspond to the mentioned national SUT tables.

The ISUT chosen as a starting point for the update, and thus also the new one, is expressed in basic prices. That means that trade margins and product-related taxes (e.g. excise taxes) minus subsidies have been removed from the products they are levied upon and transferred to either a trade service or a tax/subsidy row. This choice made it possible to fully respect the new national SUT in basic prices, and not just (as was the case in the old ISUT) the national SUT in purchasers' prices.

The update of the ISUT in basic prices was a combination of specific and automatic adjustments. The specific adjustments accommodated partly for some important changes in the ESA rules as well as in the Belgian national accounts. The changes in the ESA rules included a different treatment of R&D and of goods sent abroad for processing. The changes in the Belgian national accounts included a revision of the NACE attribution and specific improvements at the product or industry level.

Still, both in terms of number of cells as in terms of euros, most differences between the original and new SUT were resolved automatically. The automatic adjustment process for the three regional supply tables was a RAS procedure, using the elements of the national make table as product totals by industry and the production from regional accounts as industry totals by region. The automatic adjustment process for the interregional use table in basic prices consisted of two series of RAS algorithms, where the first was designed to determine the region of destination of domestic production and imports and the second to determine the region of origin of domestic production.

Both the use table of domestic production and the use table of imports have been updated. The resulting use tables of imports sum to the new national use table of imports. Yet, like the ESA 95 version of the interregional SUT for 2010, the industry totals of the use table of imports do not equal the import totals by industry in the regional accounts. This should not be so because the latter include all imports of goods by a region, including those that are resold to be used in one of the other regions. In contrast to this, a use table of imports only puts goods in the region and industry that uses them.

These tables can be obtained from the FPB for specific research projects, by sending a request to io@plan.be.

Synthese

Deze paper beschrijft de methode die wordt gebruikt om de Belgische ISUT (Interregional Supply and Use table – interregionale aanbod- en gebruikstabel) van 2010 te actualiseren en toont de geaggregeerde resultaten. De Belgische ISUT bestaat vooreerst uit drie regionale productietabellen. De rijen van die tabellen hebben betrekking op producten en de kolommen op bedrijfstakken. Daarnaast is er de interregionale gebruikstabel. De kolommen in deze tabel tonen het intermediair verbruik naar het gewest en de bedrijfstak van bestemming en het finaal verbruik naar het gewest van bestemming. In de rijen van deze tabel worden de producten opgenomen en wordt de oorsprong ervan getoond: dat is het gewest van productie voor het binnenlandse gedeelte en de invoer.

Met deze actualisering wordt de vroegere ISUT 2010, die overeenstemt met de nationale SUT voor 2010 zoals berekend in 2013 volgens de ESR95/SNR93-regels, omgezet in een nieuwe versie die overeenstemt met de nationale SUT voor 2010 zoals berekend in 2015 volgens de ESR2010/SNR2008. Beide ISUT's zijn coherent met de totalen van de regionale rekeningen voor de productie, het intermediair verbruik, de finale vraag en de toegevoegde waarde die overeenstemmen met de reeds vermelde nationale SUT-tabellen.

De ISUT die werd gekozen als startpunt voor de actualisering, en dus ook de nieuwe, is uitgedrukt in basisprijzen. Dat betekent dat de handelsmarges en de productgebonden belastingen (bijvoorbeeld accijnzen) minus de subsidies zijn weggelaten uit de producten waarop ze worden geheven en overgedragen naar een rij met handelsdiensten of belastingen/subsidies. Door deze keuze kon ook de nieuwe nationale SUT in basisprijzen volledig gerespecteerd worden en niet alleen (zoals het geval was in de vroegere ISUT) de nationale SUT in aankoopprijzen.

De actualisering van de ISUT in basisprijzen was een combinatie van specifieke en automatische aanpassingen. De specifieke aanpassingen houden gedeeltelijk rekening met een aantal belangrijke wijzingen in de ESR-regels en in de Belgische nationale rekeningen. De wijzigingen in de ESR-regels bevatten een verschillende behandeling van O&O en van het internationaal maakloonwerk. De wijzigingen in de Belgische nationale rekeningen omvatten een herziening van de NACE-toewijzing aan ondernemingen en specifieke verbeteringen op product- of bedrijfstakniveau.

Toch werden, zowel in termen van aantal cellen als in euro's de meeste verschillen tussen de oorspronkelijke en nieuwe SUT automatisch opgelost. Het automatische aanpassingsproces voor de drie regionale aanbodtabellen was een RAS-procedure, waarbij de elementen van de nationale productietabel als producttotalen per bedrijfstak en de productie van de regionale rekeningen als bedrijfstaktotalen per gewest werden gebruikt.

Het automatische aanpassingsproces voor de interregionale gebruikstabel in basisprijzen bestond uit twee reeksen van RAS-algoritmes, waarbij de eerste reeks werd ontworpen om het gewest van bestemming van de binnenlandse productie en de invoer te bepalen en de tweede reeks om het gewest van oorsprong van de binnenlandse productie te bepalen.

Zowel de gebruikstabel van de binnenlandse productie als de gebruikstabel van de invoer werden geactualiseerd. De resulterende gebruikstabellen van de invoer van de drie Belgische gewesten tellen op tot de nieuwe nationale gebruikstabel van de invoer. Net zoals de ESR95-versie van de interregionale SUT voor 2010, zijn de bedrijfstaktotalen van de gebruikstabel van de invoer echter niet gelijk aan de totale invoer naar bedrijfstak in de regionale rekeningen. Dat hoeft ook niet omdat die laatste alle invoer van goederen door een gewest omvat, waaronder ook de goederen die opnieuw worden verkocht en in één van de andere gewesten worden gebruikt. In tegenstelling hiermee wijst een gebruikstabel van de invoer goederen uitsluitend toe aan het gewest en de bedrijfstak die ze gebruikt.

De tabellen kunnen bij het FPB aangevraagd worden voor onderzoeksdoeleinden door een vraag te richten aan io@plan.be.

Synthèse

Le présent Working Paper décrit la méthode utilisée pour actualiser l'ISUT (Interregional Supply and Use Table – tableaux interrégionaux des ressources et des emplois) belge de 2010 et présente les résultats sous une forme agrégée. L'ISUT belge se compose tout d'abord de trois tableaux régionaux de production. Leurs lignes correspondent aux produits, et leurs colonnes aux branches d'activité. Le deuxième élément de l'ISUT belge est le tableau interrégional des emplois. Les colonnes de ce tableau montrent les emplois intermédiaires par région et branche de destination ainsi que les emplois finaux par région de destination. Les lignes du tableau montrent les produits en indiquant leur origine, c'est-à-dire la région de production pour la partie domestique et les importations.

L'ancien ISUT de 2010, qui correspond au SUT national de 2010 calculé en 2013 conformément aux règles SEC 95 / SCN 93, est transformé en une nouvelle version correspondant au SUT national de 2010 calculé en 2015 conformément aux règles SEC 2010 / SCN 2008. Les deux ISUT sont cohérents avec les totaux des comptes régionaux pour la production, la demande intermédiaire, la demande finale et la valeur ajoutée qui correspondent aux SUT nationaux susmentionnés.

L'ISUT choisi comme point de départ pour l'actualisation – et donc également le nouvel ISUT – est exprimé en prix de base. Cela signifie que les marges de commerce et les impôts nets des subventions sur les produits (par ex. les droits d'accises) ont été déduits des produits qu'ils grèvent et transférés soit à une ligne de service commercial soit à une ligne d'impôt/de subvention. Ce choix a permis de pleinement respecter le nouveau SUT national aux prix de base, et pas uniquement (comme c'était le cas de l'ancien ISUT) le SUT national aux prix d'acquisition.

L'actualisation de l'ISUT aux prix de base a nécessité une série d'adaptations spécifiques et automatiques. Les adaptations spécifiques ont permis de tenir partiellement compte de plusieurs changements importants apportés aux règles du SEC et aux comptes nationaux belges. Parmi les changements apportés aux règles du SEC, citons le traitement différent de la R&D et du travail à façon international. Les changements apportés aux comptes nationaux belges sont notamment la révision de l'attribution des codes NACE et des améliorations spécifiques au niveau des produits ou des branches.

Mais la plupart des différences entre les SUT initiaux et les nouveaux SUT, tant en termes de nombre de cellules qu'en termes de montants en euros, ont été résolues automatiquement. Pour adapter automatiquement les trois tableaux régionaux des ressources, une procédure RAS a été appliquée en utilisant les éléments du tableau de production national comme totaux des produits par branche et la production des comptes régionaux comme totaux des branches par région.

Le processus d'adaptation automatique du tableau interrégional des emplois aux prix de base a consisté en deux séries d'algorithmes RAS, la première visant à déterminer la région de destination de la production domestique et des importations et la seconde destinée à déterminer la région d'origine de la production domestique.

Tant le tableau des emplois de la production domestique que le tableau des emplois des importations ont été actualisés. La somme des tableaux des emplois des importations qui en résultent pour les trois

régions belges donne le nouveau tableau national des emplois des importations. Toutefois, à l'instar de la version du SUT interrégional de 2010 calculé sur base du SEC 95, les totaux des branches dans le tableau des emplois des importations ne sont pas identiques aux totaux des importations par branche dans les comptes régionaux. Cela n'est pas nécessaire parce que ces derniers englobent toutes les importations de biens par une région, y compris celles qui sont de nouveau vendues pour être utilisées dans l'une des autres régions. Par contre, un tableau des emplois des importations n'affecte des biens qu'à la région et à la branche qui les utilise.

Ces tableaux peuvent être obtenus à des fins d'analyse auprès du BFP, en adressant une demande à io@plan.be.

1. Introduction

In 2015, the Federal Planning Bureau constructed an interregional Supply and Use Table (SUT) in basic prices for Belgium for the year 2010[1] as well as an interregional input-output (IO) table[2].

The interregional input-output table, an industry-by-industry table, is a matrix transformation of some crucial parts of the interregional SUT in basic prices[3]. The interregional supply and use table for 2010 describes the intra- and interregional flows of goods and services between the country's regions Brussels, Flanders and Wallonia. To estimate these flows, a bottom-up approach[4] based on VAT data and international trade data at the firm level was followed. The table is consistent with the national SUT for 2010 according to ESA95 rules (European implementation of SNA93). We used this table to calculate regional income and employment multipliers (Avonds et al., 2016), while others estimated the regional carbon footprint for Flanders (VITO, 2016) and the possible impact of Brexit on Belgian regions (IWEPS, 2018). It also served as an input for the macroeconometric regional-bottom-up model Hermreg, currently developed by the Federal Planning Bureau in collaboration with the three regions (more precisely with IWEPS, IBSA/BISA and Statistiek Vlaanderen).

In December 2015 a new national SUT and input-output table was compiled for the year 2010. These new tables were compatible with the ESA2010/SNA2008 rules and included other changes in the Belgian national accounts. Since then the interregional SUT and IOT are no longer comparable with the last available national tables. In 2016 and 2017 new regional accounts were released in accordance with the national accounts of December 2015. These regional accounts include industry totals like value added and (unpublished) production totals, as well as the main final demand components (consumption expenditure and investments but not changes in inventories) by region.

The aim of this work is to adapt the interregional SUT to ESA2010/ SNA2008 rules and the corresponding new national SUT and regional accounts. This responds to requests made by users for tables that are compatible with more recent versions of the national accounts. It would also allow for the integration of the interregional tables into recent world IO tables.

Part 2 of the paper gives a detailed description of the update that is to be performed. Part 3 describes some of the methodological choices made. To carry out this update, a series of specific bottom-up adjustments first have been imputed. These were followed by a series of automatic adjustments based on the RAS algorithm. Part 4 discusses the results.

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1 This project was carried out in cooperation with the statistical authorities of the three Regions (IBSA/BISA, SVR and IWEPS), which also provided part of the funding. It was a further step with respect to the joint project of the National Bank of Belgium and the three regions to extend the regional accounts, which started in 2009.

2 Within the framework of agreements with the NBB and the regions, the FPB has compiled regional supply and use tables and interregional input-output tables for Belgium for 2003, 2007 and 2010. These tables, as well as the current update for 2010 can be obtained from the FPB for specific research projects, by sending a request to io@plan.be.

3 Our derivation follows the fixed product sales structure assumption. See part 2 for a discussion and the mathematical formula.

4 Strictly speaking, the approach followed was a pseudo bottom-up approach. This is because VAT and international trade data are only available at the firm level and not at the (lower) establishment or local unit level. For firms with units in more than one region, all values were regionalised according to the distribution of their employment over regions.

2. The update to be performed

2.1. General outline

The three major sources (with publication dates in brackets) used for the update are the following:

1. the interregional Supply and Use Table (ISUT) in basic prices for 2010 (June 2015)
2. the new national Supply and Use Table (SUT) in basic prices for 2010 (December 2015)
3. the new Regional Accounts totals by industry and for final demand for 2010 (February 2016 and 2017)

The aim of the update is to compile an ISUT in basic prices for 2010 that is compatible with both the new national SUT and the new regional account totals. To avoid cumbersome bottom-up recalculations, we decided to develop a methodology for updating the ISUT starting from an existing one. Once available, this method can also be used to update the new ISUT to more recent national tables and regional accounts.

While both new constraints in points 2 and 3 are compatible with ESA2010 (SNA 2008), this does not guarantee that the newly obtained ISUT is also compatible with ESA2010, nor is it assured that the adjustment process would be a smooth one. This issue is further discussed in parts 2 and 3.

The update can be split into a production part and a use part. The first part is the update of the production table, discussed in part 2.2. The second part is the update of the interregional use table in basic prices, discussed in part 2.3.

2.2. Updating the regional Production or Make tables

2.2.1. Why (only) update the production tables?

A production or make table shows the production by product and industry. The production table is only the first part of a supply table. The latter table also contains vectors of imports, trade margins and taxes and subsidies, each providing detail by product, but not by industry.

Although these vectors were available in the June 2015 interregional SUT, it is not necessary to update them to derive a new input-output table. Only a production table and a use table in basic prices are needed to derive an IO table for a national economy[5]. To derive an interregional IO table, a make table for every region and the domestic part of the interregional use table is necessary.

[5] The formula to derive the technical coefficients table of an industry-by-industry input-output table based on a fixed product sales structure assumption is given in the Eurostat Manual of Supply and Use tables (2008), pp. 348-349 as: $A_I = V'\hat{q}^{-1}U\hat{x}^{-1}$. Here V' is the transposed commodity by industry production matrix, U is the commodity by industry domestic use table in basic prices, x is the vector of industry output totals. The vector x is diagonalized and inversed. q is the vector of product output totals. Thus, both q and x only depend on the production matrix V. An element of the matrix A_I gives the inputs from industry i needed to produce the output of industry j.

Note that the information on imports, trade margins and taxes in the second part of the regional supply tables (that will not be updated) is limited in its usefulness. In the case of the imports of goods for example, the presence of an import flow in a regional supply table does not automatically imply that the imported goods are used in the region itself. They can be resold to another region or re-exported[6]. It is only when a use table of (international) imports is derived that it is clear in which region an imported good is really used.

The next three points briefly describe the sources that serve as a starting point for the update of the production table. In point 2.2.5, the update to be performed is described.

2.2.2. The (old) regional make tables for 2010 (June 2015, ESA 95)

Table A.1 in the appendix shows the 2010 aggregated production tables for the three Belgian regions: Brussels, Flanders and Wallonia[7]. These tables were published in June 2015 and are based on national and regional accounts that are compatible with the ESA95 rules. The full tables contain 350 products and 140 industries.

Even with only three products (rows) and corresponding industries (columns) distinguished, the numbers show important differences in the economic activity between the three regions. The largest region (Flanders) has an important share of goods production (30.4%) and a considerable share (20.4%) of trade and transport services, enhanced by the presence of several important international harbours. Other services represent 49.4% of production in Flanders. In contrast, the Brussels-Capital Region is dominated by the 'other services' that represent as much as 74.1% of its total production. The economic activity of Wallonia is situated between these extremes, both in terms of size and economic structure.

2.2.3. The national make for 2010

Table A.2 in the appendix shows both the old (ESA95, June 2015) and the new (ESA2010, December 2015) national production table in aggregated form. When compared at the high aggregation level of products and industries of table A.2, the changes in the national production table seem modest.

Yet behind these modest changes at the aggregate level lie significant changes at the detailed industry and product level. To demonstrate this, table A.2 shows the sum of all the differences in absolute value between the old and new make table at the detailed product and industry level (the 340x140 tables). These amount to 16.3% of the old production total of 748.9 billion euro. The degree of variation depends on the industry and product type.

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6 What matters when including a good in a country's supply table is the change of ownership. If a trader imports goods only to re-export them later (while realising a trade margin), the imports of the good are included in the supply table, while the exports are included in the use table. The same principle is applied in the Belgian regional accounts and regional SUT tables. Thus, if a Flemish trader imports goods to re-export them later to one of the other regions, they will appear in the Flemish supply table as imports and in the Flemish use table as interregional exports. Once the Belgian interregional use table in basic prices has been derived though, only the trade margins realised by the Flemish trader on these goods flows remain (as a part of the Flemish make table and as a Flemish trade service used in the regions of destination). The imported goods themselves are directly destined to the region where they are used.

7 For completeness, it also shows the production of the extra-regional area, which only includes Belgian diplomatic and permanent army posts abroad. This is treated as a separate entity in the regional accounts.

Changes in the 2010 national production table are, amongst other reasons, caused by:

– a revision of the NACE-industry attribution of firms in the Belgian national accounts register [8].

– a different treatment of the import and export flows of goods in the case of active or passive international processing[9] in ESA2010 versus ESA95. Because in the ESA2010 there is no longer a need for 'grossing' production and intermediate use, both will decrease with respect to ESA95[10].

– a different treatment of R&D in ESA2010 which increases production, particularly in industries with important R&D activities.

Because these changes can be asymmetric and may impact regions differently, where additional information was available, a series of specific adjustments was performed on the original make matrix before the automatic adjustment process was put into practice. These adjustments have reduced the absolute differences to 12.6% (see last part of table A.2). They will be discussed further in part 3.

2.2.4. The production totals for 2010 in the Regional Accounts

From the Belgian Regional Accounts (National Bank of Belgium) we obtained new production totals by SUT industry for 2010 according to the ESA2010 rules. These numbers are compatible with Regional Account versions published in February 2016 and 2017 [11].

Table A.3 in the appendix shows the old (June 2015) and new production totals by industry and region at the same aggregated industry level as in tables A.1 and A.2. The new production totals by region sum to the amount of 751.1 billion euro, which is also the total of the new national production in table A.2. A similar equality must hold for all industries.

The national and regional accounts revision had an impact on each region's share in total production in 2010: the share of Brussels decreased from 18.7% to 18.3 %, mostly to the benefit of Flanders: its share rose from 60.4% to 60.7%.

2.2.5. The automatic update of the regional make tables

The update to be performed on the regional production tables is straightforward. For each industry, the new national production table gives the product (row) totals, while the new regional totals give the industry (column) totals to be respected. The inner part comes from the adjusted regional production tables as given (in aggregated form) in table A.4. Since there are 140 industries, as much as 140 production tables must be adjusted.

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8 This leads, amongst other things, to a net reduction in the production in trade industries to the benefit of other industries.

9 In the case of active processing, resident firms process goods owned by non-resident firms. In the standard case, raw materials or semi-finished goods are imported, the processed goods are then re-exported. In the case of passive processing, resident firms have goods processed abroad that remain their property. The import and export flows related to processing were included in the SUT according to the ESA95 rules. In ESA2010, only the value of the processing fee is recorded, either as an exported or imported service.

10 In the case of active processing, "grossing" refers to an increase of the production value (with respect to a firm's turnover) and intermediate use (with respect to costs) to make sure it corresponds to the export and import value, which in the ESA95 includes the full value of goods when exported (imported) after (before) processing. In the ESA2010 this grossing is no longer required. A similar grossing existed in the ESA95 passive processing.

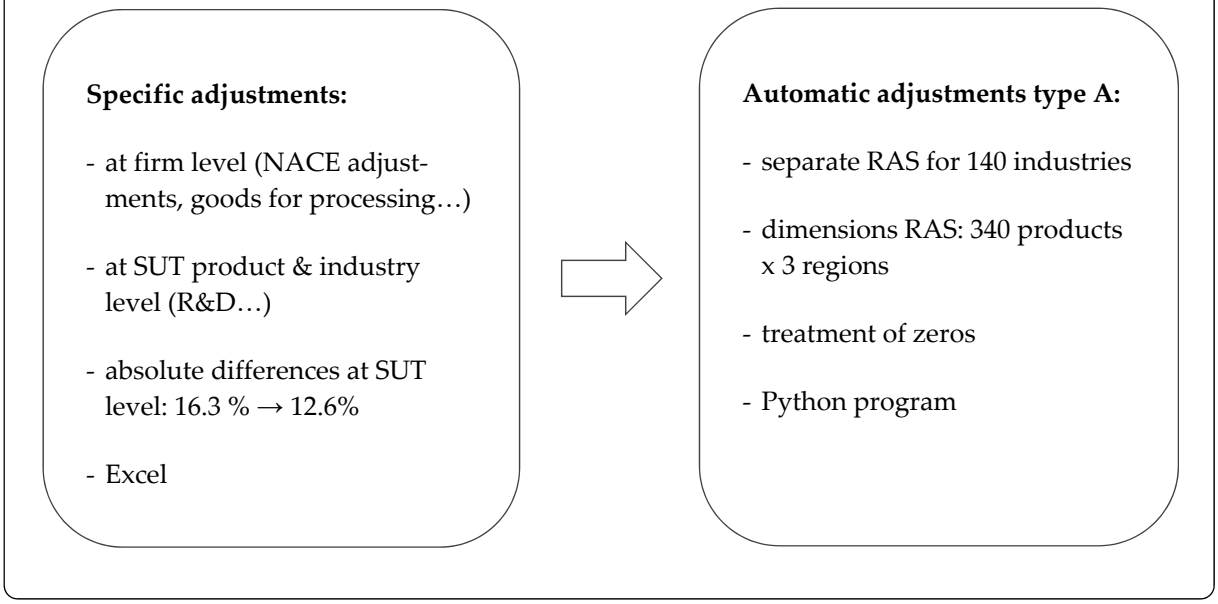
11 Some of the modifications already present in the new (ESA2010) national SUT for 2010 were only introduced in the regional accounts in February 2017, which is why two versions of the regional accounts are mentioned here.

The paragraph above describes the typical starting point of a (series of) RAS adjustment algorithms. This RAS algorithm was successfully used and is further discussed in part 3. The results are shown in table A.5. The RAS to update the regional production tables are called RAS type (or series) A to distinguish them from two different RAS series discussed below.

2.2.6. Summary of the adjustment of the regional make tables

The following figure summarises the adjustment process of the regional make tables. A series of specific adjustments, performed in Excel, preceded the automatic adjustment process using the RAS method, which was executed using a Python program.

Figure 1 The adjustment process of the regional make tables



The first box synthesises the specific adjustment process. All adjustments are related to the three initial regional make tables. Some adjustments were carried out at the firm level and then aggregated to the SUT product and industry level. Other adjustments, especially those based on additional information from the national and regional accounts (NBB), were directly applied at the SUT level. In comparison with the new national make table (at the SUT product and industry level), the specific adjustments have led to a reduction of the absolute differences from 16.3% to 12.6%. The remaining differences have to be removed automatically.

The second box synthesises the automatic adjustment process. This consists of a series of 140 RAS algorithms (one for each industry), each with 340 products and 3 regions. This series of RAS is called RAS type A. Before these can be executed, one must make sure that each RAS can converge. This involves the treatment of problematic zero-values in the initial (national) make matrix. This issue is further discussed in section 3.

2.3. Updating the interregional use table in basic prices

2.3.1. The interregional use table in basic prices for 2010 (June 2015, ESA 95)

Table A.10 in the appendix shows the aggregated interregional use table in basic prices, version June 2015 (ESA95). It consists of 9 use tables, one for each combination of region of origin (rows) or destination (columns) as well as a use table of international imports for each region[12].

To keep the interregional use table readable (given the extra final domestic demand vector column for each region), the industries in table A.2 have been aggregated to two, while the distinction between three products in table A.2 has been maintained. In the full table, final domestic demand for each region makes a distinction between final consumption expenditures (of households, NPISH and government), gross fixed capital formation and changes in inventories and acquisition less disposals of valuables.

The interregional use table is supplemented by a column for (international) exports[13]. By adding the three products, one can obtain the total exports by each region. The international exports by Brussels amount to 33 billion euro (=11.6+6.3+15.1). The international imports used by a region (for its intermediate and final use) can be read from the lines in the imports part. The international imports by Brussels amount to 33.4 billion euro (=11.9+2.6+4.5+0.1+2.0+0.0+0.4+11.2+0.7).

The intersection between the import rows and the export columns of table A.10 shows re-exports. These are goods imported by Belgian residents that have been re-exported later. The huge values for re-exports of goods (68.5+5.1 [14]) are one of the distinguishing features of the Belgian (as well as the Dutch) economy. This is because Belgium serves as a distribution centre for the neighbouring EU countries, owing to its strategically located harbours and its small economy. These re-exports also influence the inner parts of the use table, notably by increasing the exported trade and transport services, particularly in Flanders (38.7 billion) and to a lesser extent in Brussels (6.3) and Wallonia (5.1).

The imports part in table A.10 is followed by a row for the use of taxes less subsidies on products and one for value added[15]. Value added consists of compensation of employees, other taxes on production, other subsidies on production, operating surplus, mixed income (net) and consumption of fixed capital. These variables must also be readjusted to new national and regional totals according to ESA 2010.

2.3.2. The national use table in basic prices for 2010

Table A.6 in the appendix shows both the old (ESA95, June 2015) and the new (ESA2010, December 2015) national use table in basic prices in aggregated form. The use tables are supplemented with a table that gives the sums of the differences in absolute values between the (full) old and new use table in the situation before and after specific adjustments (discussed in part 3).

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12 While the use table of imports by region of destination may not be strictly necessary to derive an interregional input-output table, it can provide useful information for many applications of the interregional use table. Therefore, we choose to include its updating in the adjustment process.

13 In the full table, a distinction is made between the export of goods and the export of services.

14 It may seem contradictory to also find re-exports among other services, but this is due to the CPA-classification, which places books, newspapers, CDs, DVDs, movies in their physical form under the CPAs 58 and 59.

15 At the detailed level, a distinction is made between value added tax (VAT) and other taxes less subsidies on products (e.g. excise taxes).

In table A.6, the number of industries is reduced to two and supplemented with final domestic demand and exports as destinations.

Throughout table A.6, a distinction is made between the use of domestic production and that of imports. This distinction effectively doubles the number of products and cells in the use table with respect to the production table. It is therefore not surprising that the sum of the absolute differences between the new and old use table is, with 26.3% of the old use total, higher than in the production table (16.3%).

While for the primary and manufacturing industries, the ratio of absolute changes with respect to the old values was 20% in table A.2, it now rises to 35% in table A.6. For both services industries in table A.2, the ratio of absolute changes was only about 14-15%; now it amounts to 39%. This high percentage of changes in the services industries is mostly due to the use of "other services", both domestic and imported, where both the new ESA rules and some revisions in the Belgian national accounts have had a large impact.

The sum of the absolute changes in final domestic demand and in exports is resp. 18% and 19% of the original use values. While these percentages are lower than those for the intermediate use, they are still higher than those for production.

Table A.7 shows the use of the primary inputs in the national table. The primary inputs consist of the taxes less subsidies on products and the components of value added. Table A.7 gives the old and new values as well as the absolute differences between them at the detailed level. While the total value for taxes less subsidies has only increased by 0.3 billion euro, the value added has increased by 9 billion euro in the new national accounts for 2010[16]. This increase is partly due to the new treatment of self-produced and purchased R&D according to the ESA2010 rules[17].

2.3.3. The regional totals for intermediate use, domestic final demand and value added

At our request, the Belgian Regional Accounts (National Bank of Belgium) provided, for each region:

- New intermediate use totals by industry in purchaser prices including VAT
- New value-added totals by industry
- New totals for final consumption expenditures of households, NPISH and government in purchaser prices including VAT
- New totals for Gross fixed capital formation in purchaser prices including VAT

These data were published at a higher aggregation level of industries by the regional accounts in February 2016 and 2017 [18]. These data were the basis for the new regional constraints for domestic final

[16] Together, these changes imply a GDP increase of 9.3 billion euro.

[17] In ESA2010 self-produced R&D is considered as a production that increases both the capital stock and value added (by about 5.3 billion euro in 2010) while purchased R&D is considered as a purchase for investment and no longer as an intermediate use. Therefore, it no longer reduces value added, causing a further increase of about 1.2 billion euro in 2010.

[18] Some of the modifications already present in the new (ESA 2010) national SUT for 2010 were only introduced in the regional accounts in February 2017, which is why two versions of the regional accounts are mentioned here.

demand and for intermediate demand and value added by industry. Still, some calculations had to be performed before obtaining the new totals in basic prices:

1. VAT & other product-related taxes had to be first regionalised and then subtracted from intermediate demand by industry and from final demand to obtain regional totals in basic prices
2. Changes in inventories had to be regionalised to complete domestic final demand
3. Consumption expenditures by households were converted from the residential concept (in the regional accounts) to the interior concept (used in the national SUT)

The conversion of consumption expenditures towards the interior (or territorial) concept in point 3 is necessary, since the regional and national totals would otherwise not be compatible.

Not only the totals from regional accounts, but also the original interregional use table in basic prices itself was converted towards the interior concept[19]. This conversion involved three regional vectors of adjustment (with values by SUT product) for consumption expenditures of residents abroad (10.1 billion euro in 2010 in total) and three for consumption expenditures of non-residents in Belgium (6.9 billion euro in 2010 in total). After this transformation, consumption expenditures decrease by 3.2 billion euro with respect to those in the regional accounts.

The alternative to switch the national use table towards the residential concept was not chosen, because this would also imply adjusting the national valuation matrices of trade margins and import tables.

Tables A.8 and A.9 in the appendix give the old and new regional totals for intermediate use, domestic final demand and value added.

In the new version of the regional accounts for 2010, intermediate use is lower than in the old version, while domestic demand has increased. This shift is partially due to the new treatment of R&D in the ESA2010 rules. The 9 billion increase in value added already shown in the national table A.7 has specifically benefitted the Flemish region, which saw its share in domestic use increase from 57.2% to 57.5%.

Note that table A.8 does not include exports. In fact, the regional accounts (NBB) do produce exports by industry and region with a distinction between goods and services. These cannot be used in this exercise though, because of a difference in the meaning of goods exports with our interregional use table[20]. In the regional accounts, the exports of goods by a region include all its exports, even if the goods are first produced in one of the other regions.

In the interregional use table, a region's export values of goods can only include its own production or international imports. If a trader from another region comes in between the producer and the export of

[19] From the point of view of a region it is not correct to speak of a full transfer towards the interior concept. The transition is only partial. That is, like in regional accounts, the Flemish consumption expenditures continue to include the expenditures of Flemish residents in the two other Belgian regions. What differs is that now, unlike in the regional accounts, the Flemish consumption expenditures no longer include the consumption expenditures of Flemish residents outside Belgium.

[20] Because this difference in meaning does not exist for the export of services, these data could have been used as constraints for the new interregional use table. While the survey data behind the Regional Accounts industry totals were used to perform a series of specific adjustments on exported services (see section 3), using the industry totals on exported services as constraints, was not desirable, because of some conflicts with the national make table. A service that is exported by an industry must also be produced by that industry: and that was not always guaranteed in the make table for 2010.

the good, the trader may acquire a trade margin (which will be attributed to his region), but the basic value of the exported goods will be attributed to the region of production.

2.3.4. The automatic update of the interregional use table in basic prices

The table that needs to be updated to new regional and national totals is table A.10: the interregional use table in basic prices. The regional constraints are:

– totals of intermediate use in basic prices and of value added for each industry

– total use in basic prices for each component of the final domestic demand

– total production of each product in each region

The national constraints are:

– the national use table in basic prices with a distinction between the use of domestic production and that of imports

– the components of value added per industry

Given that there are separate regional constraints for the intermediate use and for value added per industry, the updates of both parts of table A.10 were done separately.

The update of the value-added table was based on specific data and did not involve an automatic adjustment algorithm. It will only be discussed (briefly) in this section.

In the national accounts, value added is broken up into 5 components. Table 1 below directly gives the results for a breakdown in three components: compensation of employees, other taxes less subsidies on production and gross operating surplus plus mixed income. Little (extra) effort had to be made to obtain these results: the regional split by industry for the compensation of employees was obtained from the 2018 version of the FPB Labour Accounts. The other taxes and subsidies on production and the gross operating surplus plus mixed income were only available at the national SUT industry level. There was some regional information on other (i.e. not product-related) subsidies and the consumption of fixed capital. After putting in this information, the remaining values were spread proportionally over the regions according to total value added for each region by industry.

Table 1 The update for the components of value added, results per region, 2010 (ESA 2010)
Billions of euro

Component of VA \ region	Brussels	Flanders	Wallonia	Total	Source of regionalisation
Compensation of employees	35.7	102.9	44.4	183.0	FPB Labour Accounts for 2010 (ESA 2010)
Other taxes less subsidies on production	-0.1	-2.4	-1.3	-3.7	National data at SUT-industry level + regional data on wage & other subsidies for aggregated industries
Gross operating surplus and mixed income (*)	24.9	87.2	34.9	147.0	National data at SUT-industry level + specific regional corrections for consumption of fixed capital (R&D)
Total (value added)	60.5	187.8	78.0	326.3	Regional Accounts 2016-2017 (NBB)

Source: Federal Planning Bureau.
(*) Including the consumption of fixed capital

Updating the intermediate and final use of the interregional use table (the upper part of table A.10), with 350 products, 140 industries and 8 final demand components, is a more elaborate process.

Here, we describe the automatic adjustment process used for this part of the interregional use table, knowing that it is preceded by a specific adjustment process discussed in part 3.

The automatic adjustment process consists of two consecutive series of RAS algorithms. These reflect the two regional dimensions present in table A.10: a region of origin (rows) and one of destination (columns). The first series of RAS algorithms concentrates on the region of destination. It leaves out the information on the region of origin or production but maintains the distinction between domestic production and imports. These RAS are called RAS type B. Table 2 below illustrates the starting point of a RAS type B for primary and manufacturing industries[21]. There is a separate RAS type B for each of the 140 industries and for the 6 components of domestic final demand[22]. The inner part of table 2 can be derived from table A.11, which is the interregional use table after specific adjustments (see part 3).

For example, the use of domestically produced goods of 4 billion euro by primary and manufacturing industries in Brussels equals 2.3 + 1.4 + 0.3 (found in the first column of table A.11). The constraints by product come from the new national use table in basic prices (second part, first column of table A.6), those by industry from the new regional totals (second part, first column of table A.8).

Table 2 Determining the region of destination by industry or domestic final demand component (RAS series B)
Billions of euro, primary and manufacturing industries

Origin	Products	Brussels	Flanders	Wallonia	Total	National totals (from table A.6)
Domestic production	Goods	4.0	26.8	7.1	37.9	38.9
	Trade & transport services	0.9	11.3	3.3	15.5	15.2
	Other services	1.4	15.2	6.0	22.6	23.4
Imports	Goods	9.9	52.8	11.6	74.2	68.1
	Trade & transport services	0.1	2.1	0.5	2.7	3.4
	Other services	0.5	5.5	2.7	8.7	8.2
Total		16.7	113.6	31.2	161.6	157.1
Regional Total (second part, first column of table A.8)		16.8	110.8	29.5	157.1	

Source: Federal Planning Bureau.

Once all RAS B are carried out successfully, we get an update of table 2 for each industry. The imports part of that table is already a definitive result. It is consistent with the national use table of imports and, together with the use table of domestic production, is also consistent with the use in basic prices of each region for each industry.

What is not determined yet is the region of origin of the use of each domestically produced product. That will be determined by a series of RAS algorithms for each product, called RAS series C. The inner part of a RAS type C can be obtained by using the full detail of table A.12. The constraints are, for the RAS for product i:

– the use of domestic production of product *i* by each industry in each region (from RAS B) plus

[21] Since primary and manufacturing industries are an aggregation of industries, the numbers in table 2 are not really the starting point for a RAS, but an aggregation of the start RAS B for all goods-producing industries.

[22] Consumption expenditures are split in 4 components: households, NPISH, government market and non-market; then there is fixed capital formation and inventory changes.

national exports in basic prices

– the total production of product *i* by each region as yielded by RAS series A (see table A.5).

Table 3 below illustrates the starting point for a RAS type C for the production of goods. The regions of origin are placed in columns and the regions of destination in rows.

Table 3 Determining the region of origin by product (RAS series C)
Billions of euro, numbers for goods

Destination	Industries \ region of origin	Brussels	Flanders	Wallonia	Total	Total use (RAS B & exports)
Brussels	Primary and manufacturing ind.	2.3	1.4	0.3	4.0	4.3
	Services industries	0.6	1.5	0.5	2.6	2.5
	Final domestic demand	0.8	1.0	0.2	2.0	1.9
Flanders	Primary and manufacturing ind.	1.0	23.1	2.7	26.8	27.4
	Services-industries	0.6	13.4	1.3	15.3	14.1
	Final domestic demand	1.0	11.6	1.1	13.7	13.0
Wallonia	Primary and manufacturing ind.	0.2	2.3	4.6	7.1	7.2
	Services-industries	0.3	1.6	3.6	5.5	5.2
	Final domestic demand	1.4	3.3	4.5	9.3	9.2
Exports		9.5	81.8	21.8	113.0	113.1
Total		17.7	141.1	40.6	199.3	197.8
Constraint: regional production totals (from RAS A)		17.8	140.1	39.9	197.8	

Source: Federal Planning Bureau.

There is one RAS for each of the 350 products. Each of these RAS algorithms takes the use of every combination of industry (or final demand component) and region of destination from the RAS series B results as a constraint. The RAS B results are supplemented with the exports of domestic production (for the product concerned) taken from the national use table[23]. The column totals in RAS series C must be consistent with the total production by each region of the concerned product. This is obtained from RAS A.

As can be verified in table 3, the sum of all column total constraints equals the sum of all row total constraints. This must be the case, otherwise the RAS could not converge.

2.3.5. Summary of the adjustment process of the interregional use table

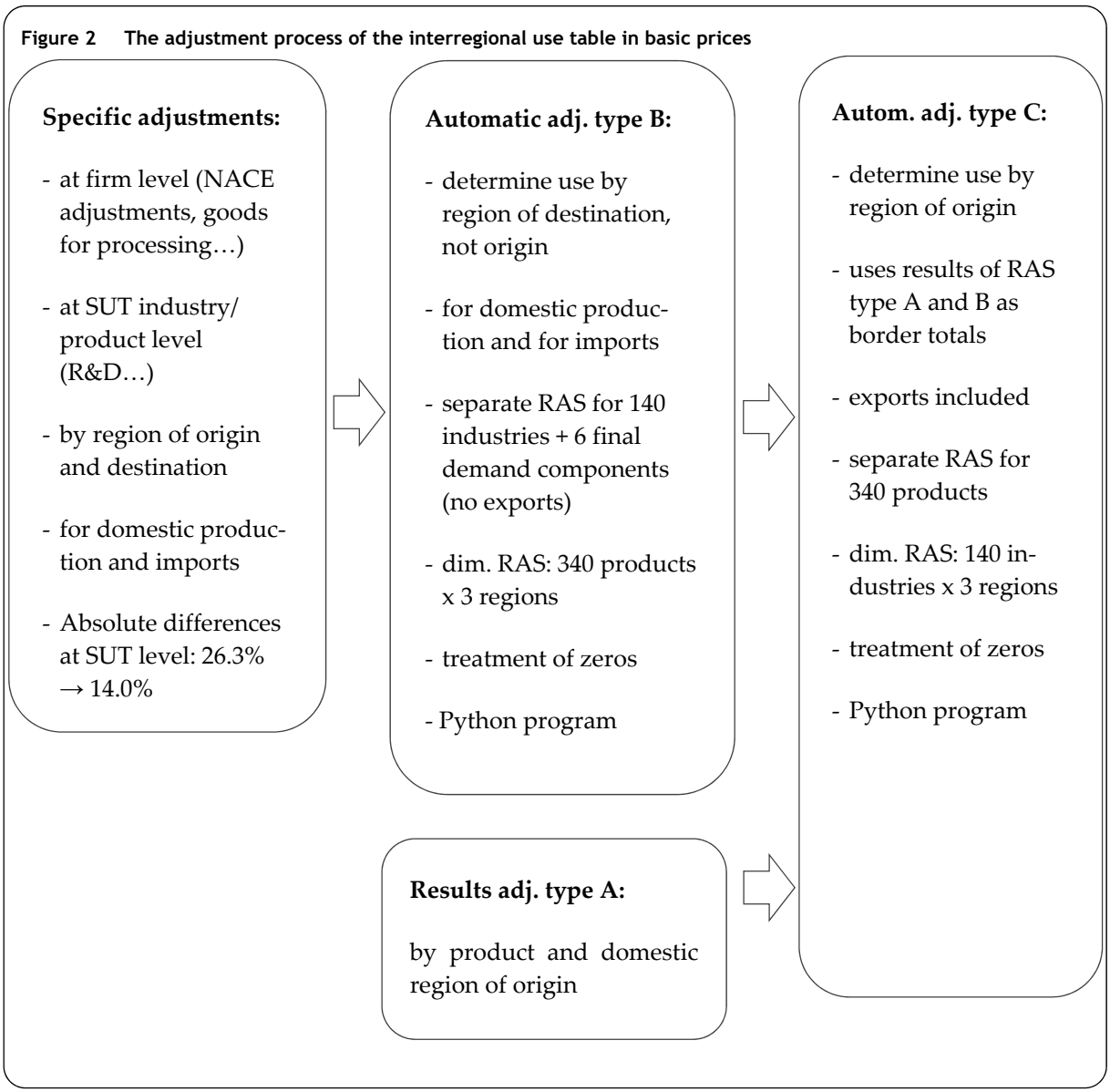
Figure 2 summarises the adjustment process of the interregional use table. A series of Specific adjustments, performed in Excel, preceded the automatic adjustment process using the RAS method, which was carried out with a Python program.

The first box synthesises the specific adjustment process. All adjustments are consistent with the interregional use table in basic prices. Some adjustments were carried out at the firm level and then aggregated to the SUT product and industry level. Other adjustments, especially those based on additional information from the national and regional accounts (NBB), were directly applied at the SUT level. In comparison with the new national make table (at the SUT product and industry level), the specific

[23] Exports only come in at this stage, because it does not make sense to differentiate Belgian exports by Belgian region of destination, which is what would be done in the context of RAS type B.

adjustments have led to a reduction of the absolute differences from 26.3% to 14.0%. The remaining differences are removed automatically.

Figure 2 The adjustment process of the interregional use table in basic prices



The automatic adjustment process is more complex than in the case of the make tables, for it now consists of two (recursive) steps. First, in a series of RAS called 'type B', the use by region of destination is determined. This consists of a series of 146 RAS algorithms (one for each industry plus one for 6 final demand components), each with 340 products and 3 regions. In the next step (adjustment type C) the region of origin is determined. This is only necessary for the domestic production, because the allocation of imports to the region of use has already been processed in the RAS type B. Unlike the adjustment process type A and B, the adjustment process type C consists of a separate RAS by product (no longer by industry). The necessary border totals by product are drawn from the production totals by region produced in adjustment process type A.

3. Specific versus automatic adjustments

3.1. Specific adjustments

3.1.1. The need for specific adjustments

The updated regional make tables and interregional use table in basic prices are fully consistent with the new ESA 2010 national table for 2010 as well as the new regional account totals that are also compatible with the new ESA. Does this imply that the update, that starts from tables in ESA95, generates tables that are compatible with ESA2010? This is an important question that cannot be answered easily.

Since the new national table is respected, what the update does is regionalise each cell in the new national table. Changes in the national table that affect all regions proportionally would not invalidate taking the old regional SUT as a starting point. Large modifications that have a disproportional effect on certain regions would influence new regional totals (e.g. of production or use by industry) so that the automatic adjustment process would even take this asymmetry into account.

However, for any change that affects a specific product in a specific industry (or final demand component) in a certain region, an automatic adjustment process would still unduly spread a part of it towards other products and/or industries in other regions. This may become even more problematic if multiple large changes occur at the same moment. In that case e.g. regional totals may not respond to a change that reduces production, because there is an offsetting change of similar size in a different product.

Therefore, if one has detailed information on important modifications that may affect the regions differently, it is better to adjust the inner part of the make and use table to it *before* the automatic adjustment is started. We call this 'making specific adjustments'.

A more technical reason to make specific adjustments has to do with zero values. If the modification of the national tables implies that positive values become zeros, this poses no problems for an automatic adjustment process like RAS. The inverse shift on the other hand is not possible: zero values in the original (national) table with positive ones in the new table cannot be processed with RAS.

The following ESA 2010 modifications have caused a shift from zero to positives in numerous cases:

– Use table: the new ESA rules on goods sent abroad for active processing have led to a shift from exports of goods to exports of (industrial) services[24]. In the Belgian numbers for 2010, this led to the appearance of (up to 4 billion euro) exported services in products where the old (ESA95) use table mostly had zeros (Van den Cruyce, 2016).

– Make table: self-produced R&D is treated as a production in ESA2010, whereas in the old ESA95 it was treated as an auxiliary activity. The product concerned (CPA 72) only had positive values in the

[24] In the Belgian SUT, the exports of goods are distinguished from those of services. In ESA2010 the export value of goods processed in Belgium while owned by a non-resident firm is no longer recorded as an export of goods. What remains is the value of the processing fee, which is considered as the export of a service. In ESA95 the full value of the exported goods was treated as an export of goods.

case R&D was sold to third parties in the old make table, while in the new table almost all industries have self-produced R&D.

The occasional revision of the Belgian national accounts has led to similar shifts:

– Make table: 5 SUT-products had (incorrect) zero production in the old make table for 2010 and a positive production in the new version[25]
– Use table: 5 SUT-products had zero values in the old SUT and positive import values in the new[26]
– Punctual improvements in the production or use data for specific industries (e.g. agriculture, inclusion of some 'new' products (e.g. prostitution)) have led to positive values replacing zeros
– The revision of the NACE attribution in the Belgian national accounts register has led to the replacement of zeros by positive values as well as the opposite

In all cases where zero values are replaced by positive ones, specific adjustments based on additional/individual information are desirable, yet an automatic adjustment is acceptable if a large number of zeros are turned into small positive values.

An additional reason for specific adjustments is that some of the modifications in ESA and the national accounts had different effects across the regions. One such modification is the treatment of goods for processing. The 4 billion euro shift from export of goods to export of services in the case of active processing was regionally spread as follows: 0.1 billion euro for Brussels, 2.8 billion euro for Flanders and 1.1 billion euro for Wallonia[27]. This is less than proportional for Brussels, where due to the smaller role of manufacturing, active processing is less important.

The revision of the NACE-industry attribution between the two versions of the national 2010 tables has also led to asymmetric changes in the matrices of production and intermediate consumption. To see this, we assume that a large firm shifts from industry *i* to industry *j* in region A. There are no similar shifts from *i* to *j* in the other regions. The shift results in new (smaller) industry totals of production and intermediate consumption in industry *i* and larger ones in industry *j* in region A. Thus far, this shift does not seem to disturb the adjustment process too much. The new regional totals correctly reflect the shift in the production and intermediate use from industry *i* to *j*.

Yet both the production and the input *vectors* of the (large) firm that was shifted away from industry *i* are unlikely to be representative for the national industry *i*. They are more likely to resemble those of industry *j* or something in between both industries. Since it is a large firm, its data have been used in industry *i* in the old SUT and in industry *j* in the new SUT. A standard RAS procedure does not use this information and is therefore likely to attribute a fraction of the production/intermediate use shift to the wrong products, industries or regions.

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[25] These were clothing of leather and fur (14A01), manufacturing of music instruments (32B01), repair of other equipment (33A08), market education (85A03) and prostitution (96A05).

[26] These were textile processing services (13A03), forming services of metal, powder metallurgy (25A06), repair and maintenance of motor vehicles and parts (45A01), services of holdings, trusts, funds and similar financial entities (64A02) and prostitution (96A05).

[27] We were able to track down the regional impact of the shift in ESA rules for the treatment of goods for processing by reaggregating firm-level information on the import and export values of Belgian resident firms involved in active or passive international processing before and after the application of ESA 2010.

3.1.2. The impact of specific adjustments

Specific adjustments have been carried out for the ESA 2010 modifications related to goods for processing (affecting mainly regional export values[28]) and the treatment of R&D. The latter affected production, intermediate demand and gross capital stock formation of the R&D product (CPA 72)[29] as well as value added for the industries with self-produced and purchased R&D.

Another series of special adjustments have been carried out to neutralise the impact of the revision of the NACE-attribution for a number of especially large firms[30]. Finally, some adjustments were made based on available regionalised information on some other revisions in national accounts[31].

Table A.4 shows the regional make tables after the specific adjustments. The new row and column totals still do not correspond to the constraints. Yet in table A.2 one can verify that the sums of absolute differences with the national table have been reduced globally from 16.3% to 12.6%.

Table A.11 shows the interregional use table in basic prices after specific adjustments. The impact these adjustments have had on the sum of absolute differences with the new national use table is shown below in table A.6. Compared with the situation without specific adjustments, the differences have dropped from 26.3% of total use in basic prices to 14%. The reduction of absolute differences was most impressive for exports (from 19% to only 1.4%), followed by domestic final demand (from 18% to 7%).

3.2. The automatic adjustments

The automatic adjustments involve a series of RAS adjustment algorithms. The different series of RAS (A, B and C) and their sequence have been set forth in section 2.

For the execution of the RAS algorithms, a programmed solution in a python environment was developed. This program did not only execute the RAS algorithms, but also took care of some remaining obstacles to convergence. This includes the zero values issue, which was only partly solved with specific adjustments. The specific adjustments were oriented to solve all cases where initial zeros become large positives[32]. But even a situation where an initial zero becomes a 'small' 0.5 million euro in the new national table poses a technical problem to RAS. There are many such small cases.

Table 4 below reports the zero values after specific adjustments. For each RAS series, the table gives the number of cases and the total value in billions of euro in the new or old table that corresponds with the situation. A difference is made between a zero in the new table but not in the original one and the situation where there was a zero in the original table and not in the new table[33]. The first situation poses

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28 I.e. replacing the export of goods by the export of services, since the processing fee is treated as a service since ESA2010.

29 We are grateful to the Regional Accounts (NBB) for providing us unpublished data on the effects of the new treatment of R&D on production, intermediate use and value added.

30 In the regional make table, this type of specific adjustments was carried out until all differences at the national level were less than 50 million euro. Due to a lack of time, in the interregional use table this specific adjustment process was already stopped once all differences between the old and new national numbers were below 350 million euro in absolute value.

31 There was a revision in the production and intermediate use for agriculture by region, improvements in the import and export values of good and services by product and in consumption expenditures for households, NPISH and government.

32 What is large may differ between the make and use table (see two footnotes above).

33 It should be remembered that the original and new tables refer here to the tables at the national level.

no technical problem for the RAS, therefore no adjustment was done. The second situation makes it impossible for the RAS to converge.

Recall that the 'original' and 'new' table refer to the tables at the *national* level. An initial zero in only one or two of the regions usually does not make it impossible for RAS to converge and will remain a zero in the end result. If *all* the regions have a zero value in the original table, and the new national table has a positive one, each zero regional cell was augmented with initial values proportional to the 'total' regional share in the national production or use. The 'total' is taken from the industry or final demand component in the case of RAS A and B and from production by product in the case of RAS C.

The last row in table 4 gives the number of positive cells in the new national make table (RAS A), the new domestic + imported use table (RAS B) and the new use table of domestic production (RAS C).

Table 4 The zero-values problem per RAS series

Situation	Frequency and value	RAS A (R. production)	RAS B (R. destination for domestic & imports)	RAS C (R. origin if domestic)
Non zero in old table, zero in new table	Number of cases	639	3680	2690
	Value of this type (billion €)	8.0	5.3	2.6
Zero in old table, non zero in new table	Number of cases	464	2362	3257
	Value of this type (billion €)	2.5	4.0	2.4
Cells with non-zero values in new national (make/use) table		2663	30186	16746

Source: Federal Planning Bureau.

In the case of RAS A, the number of cells with zero in the old table (464 or 17.4%) seems high with respect to the total of 2 663 cells with positive values in the new make table. Yet the total value of these cells in the new table only amounts to 2.5 billion euro. This is relatively small compared to the total production of 751.1 billion euro (see tables A.2 or A.3).

For RAS series B and C, the number of cases with zero in the old table and non-zero values in the new table is much higher with 2362 and 3257 respectively. Yet the number of non-zero cells in their corresponding national tables is also higher. In RAS C, 19.5% of the cells with positive values in the new table have zero values in the old national table. Luckily, the total value of these cells only amounts to 2.4 billion euro, which is 0.3% of the total production of 751.1 billion euro.

Table 4 shows that the number of cases with zero value in the new table and non-zero values in the old table always exceeds the opposite situation (with zero values in the old and non-zero in the new). The amounts involved are also more important, particularly in the case of the production table, where 8 billion euro in the old table becomes zero in the new one. This higher frequency has two causes:

– The NACE correction in the national accounts register has reduced secondary production in the make table by putting wrongly allocated firms in their correct industry[34].

– Many specific adjustments (including those for R&D, exports of services, new products…) were carried out to address situations with zero values in the old and non-zeros in the new table.

[34] While the special adjustments to the make table often implied reallocating the bulk of the production of large firms with a NACE change towards their new industries, a small fraction of the production was sometimes left in the old industry. Because the new national make table was derived bottom up starting from the new register, no such traces were found in this table.

Besides the zero values problem, there was also a negatives problem. Negatives appeared in the case of changes in inventories (inventory decreases). At the aggregation level of the tables, this problem is not visible. Despite the availability in the literature of more elaborate solutions for updating with negatives[35], this issue was addressed by withdrawing the inventory changes from the automatic adjustments after making sure (with a specific adjustment) that the national totals were respected[36].

[35] See e.g. Junius & Oosterhaven (2003) for the development of the GRAS algorithm, a generalized RAS procedure that can address the negatives problem.

[36] The reasons for not putting more effort in this issue arise from the poor quality of the Belgian national SUT data on inventory changes at the product level as well as their absence in the Belgian regional accounts.

4. Results and conclusion

Table A.5 in the appendix shows the three new 'ESA 2010' regional make tables for 2010.

Table A.12 in the appendix shows the adjusted 'ESA 2010' use table in basic prices for 2010. The numbers in this table are consistent with both the new national use table in basic prices and the new regional account totals for intermediate use and production by industry.

The main conclusion of this work is that it was possible to update a detailed interregional SUT in ESA95 to a version in ESA2010 by applying a combination of specific and automatic adjustments. The specific adjustments accommodated partly for some important changes in the ESA rules as well as in the Belgian national accounts. Still, both in terms of number of cells as in terms of euros, most differences between the original and new SUT were resolved automatically.

The automatic adjustment process for the three regional make tables was a straightforward RAS procedure, using the elements of the national make table as product totals by industry and the production from regional accounts as industry totals.

The automatic adjustment process for the interregional use table in basic prices consisted of two series of RAS algorithms, where the first was designed to determine the region of destination of domestic production and imports and the second to determine the region of origin of domestic production. Starting point for the RAS was the interregional use table in basic prices after specific adjustments.

Both the use table of domestic production and the use table of imports have been updated. The resulting use tables of imports of the three Belgian regions sum to the new national use table of imports. Yet, like the ESA95 version of the interregional SUT for 2010, the industry totals of the use table of imports do not equal the import totals by industry in the regional accounts. This is because the latter include all imports of goods by a region, including those that are resold to be used in one of the other regions while a use table of imports only puts goods in the region and industry that uses them.

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Appendix

Table A.1 Old aggregated production table by region in ESA 95 (June 2015)
Billions of euro

Region	Product (*) \ industry	Primary & man-ufacturing ind.	Trade & trans-port industries	Other services	Total	% by region
Brussels	Goods	17.8	0.4	0.5	18.6	13.3%
	Trade & transport services	0.8	16.1	0.7	17.6	12.6%
	Other services	0.5	3.3	99.9	103.6	74.1%
Flanders	Goods	131.4	4.2	2.1	137.6	30.4%
	Trade & transport services	7.0	83.0	1.4	91.4	20.2%
	Other services	6.4	3.5	213.5	223.3	49.4%
Wallonia	Goods	38.4	0.6	0.7	39.8	25.4%
	Trade & transport services	1.5	22.1	0.4	24.1	15.4%
	Other services	3.0	1.2	88.4	92.6	59.2%
Extraregional area	Other services	0.0	0.0	0.3	0.3	100%
Total (Belgium)		206.8	134.3	407.9	748.9	

Source: Federal Planning Bureau (Interregional input-output table, June 2015)

(*) Goods include all products of agriculture, fishery other primary products and manufactured goods (CPA 01-32). Trade and transport activities also include repair of motor vehicles and warehousing & support activities for transportation as well as postal and courier activities (CPA 45-53). Other services include repair and installation of machinery and equipment (CPA 33), utilities (electricity, gas, water, waste: CPA 35-38), construction (CPA 43-45) and all other services (CPA 55-97).

Table A.2 Old (ESA 95) & new (ESA 2010) aggregated national production table and differences in absolute value before and after specific adjustments
Billions of euro

Version	Product (*) \ industry	Primary & man-ufacturing ind.	Trade & transport industries	Other services	Total	%
Old production table (ESA 95)	Goods	187.6	5.2	3.3	196.0	26%
	Trade & transport services	9.3	121.2	2.5	133.1	18%
	Other services	9.9	7.9	402.1	419.8	56%
	Total	206.8	134.3	407.9	748.9	
New production table (ESA 2010)	Goods	188.7	5.4	3.7	197.8	26%
	Trade & transport services	8.4	119.8	1.7	129.9	17%
	Other services	10.9	7.0	405.4	423.3	56%
	Total	208.1	132.2	410.8	751.1	
Sum of diff. in absolute value before specific adjustments	Goods	30.8	3.0	2.3	36.1	30%
	Trade & transport services	3.4	10.7	1.6	15.7	13%
	Other services	7.8	4.6	58.0	70.4	58%
	Total	42.0	18.3	61.9	122.2	
Sum of absolute diff. / old make table (%)		20.3%	13.6%	15.2%	16.3%	
Sum of diff. in absolute value after specific adjustments	Goods	26.1	2.4	1.8	30.3	32%
	Trade & transport services	2.7	8.0	1.6	12.2	13%
	Other services	3.8	2.6	45.5	51.9	55%
	Total	32.6	13.0	48.9	94.4	
Sum of absolute diff. / old make table (%)		15.7%	9.7%	12.0%	12.6%	

Source: Federal Planning Bureau (input-output tables 2013 and 2015)

(*) The same products as in table A.1.

Table A.3 Old and new regional production totals
Billions of euro

Version	Regions \ industry	Primary & manufacturing ind.	Trade & transport industries	Other services	Total	% by region
Old regional account totals (ESA 95)	Brussels	19.1	19.7	101.0	139.8	18.7%
	Flanders	144.7	90.7	217.0	452.4	60.4%
	Wallonia	43.0	23.9	89.6	156.5	20.9%
	Extraregional area	0.0	0.0	0.3	0.3	0.0%
Total Belgium (ESA 95)		206.8	134.3	407.9	748.9	
New regional account totals (ESA 2010)	Brussels	18.7	18.8	100.0	137.6	18.3%
	Flanders	146.3	89.4	219.9	455.6	60.7%
	Wallonia	43.1	24.0	90.6	157.6	21.0%
	Extraregional area	0.0	0.0	0.3	0.3	0.0%
Total Belgium (ESA 2010)		208.1	132.2	410.8	751.1	

Source: Regional Accounts (National Bank of Belgium, 2015 and 2016-2017)

Table A.4 Aggregated production table by region after specific adjustments (before RAS A)
Billions of euro

Region	Product (*) \ industry	Primary & manufacturing ind.	Trade & transport industries	Other services	Total	% by region
Brussels	Goods	17.7	0.4	0.4	18.5	13.1%
	Trade & transport services	1.0	16.0	0.9	17.9	12.6%
	Other services	0.9	1.9	102.1	104.9	74.3%
Flanders	Goods	131.5	4.4	2.4	138.3	30.3%
	Trade & transport services	6.7	81.7	1.6	89.9	19.7%
	Other services	8.0	3.7	216.3	228.1	50.0%
Wallonia	Goods	38.2	0.6	0.7	39.5	25.0%
	Trade & transport services	1.4	22.1	0.5	24.1	15.3%
	Other services	3.9	1.2	89.2	94.3	59.7%
Extraregional area	Other services	0.0	0.0	0.3	0.3	100.0%
Total (Belgium)		209.4	131.9	414.4	755.7	

Source: Federal Planning Bureau

Table A.5 Aggregated production table by region for 2010 in ESA 2010 (final result)
Billions of euro

Region	Product (*) \ industry	Primary & manufacturing ind.	Trade & transport industries	Other services	Total	% by region
Brussels	Goods	17.0	0.4	0.4	17.8	12.9%
	Trade & transport services	1.0	16.3	0.3	17.6	12.8%
	Other services	0.8	2.1	99.3	102.2	74.3%
Flanders	Goods	133.2	4.3	2.5	140.1	30.8%
	Trade & transport services	6.1	81.4	1.0	88.5	19.4%
	Other services	6.9	3.7	216.3	227.0	49.8%
Wallonia	Goods	38.5	0.6	0.8	39.9	25.3%
	Trade & transport services	1.4	22.1	0.4	23.8	15.1%
	Other services	3.2	1.2	89.5	93.9	59.6%
Extraregional area	Other services	0.0	0.0	0.3	0.3	100%
Total (Belgium)		208.1	132.2	410.8	751.1	

Source: Federal Planning Bureau

Table A.6 Old (ESA 95) & new (ESA 2010) aggregated national use table in basic prices (*) and differences in absolute value before and after specific adjustments
Billions of euro

Version & origin	Product \ industry	Primary & manu-facturing ind.	Trade, transport & services	Domestic final demand (**)	Exports	Total
Old use of domestic production (ESA 95)	Goods	35.9	23.4	25.4	111.3	195.9
	Trade & transport services	11.3	28.3	43.3	50.1	133.1
	Other services	22.1	150.2	205.4	41.8	419.4
Old use of imports (ESA 95)	Goods	77.7	18.2	37.5	68.5	201.9
	Trade & transport services	2.7	15.2	0.6	0.0	18.5
	Other services	10.1	27.4	3.3	5.1	45.9
Old national use total		159.7	262.8	315.5	276.8	1014.7
New use of domestic production (ESA 2010)	Goods	38.9	21.8	24.1	113.1	197.8
	Trade & transport services	15.2	28.0	46.8	39.9	129.9
	Other services	23.4	143.3	212.8	43.5	423.0
New use of imports (ESA 2010)	Goods	68.1	16.6	36.5	71.0	192.1
	Trade & transport services	3.4	16.4	0.3	0.0	20.1
	Other services	8.2	31.7	5.9	4.7	50.5
New national use total		157.1	257.8	326.3	272.2	1013.4
Absolute differences before specific adjust-ments: domestic pro-duction	Goods	14.3	8.1	8.6	19.3	50.3
	Trade & transport services	6.1	5.7	5.4	14.3	31.4
	Other services	9.3	55.1	29.9	7.6	101.9
Absolute differences before specific adjust-ments: imports	Goods	19.5	8.1	7.4	12.0	47.0
	Trade & transport services	1.3	3.1	0.2	0.0	4.6
	Other services	5.4	22.1	4.0	0.5	32.0
Total		55.9	102.2	55.6	53.6	267.3
Sum of differences / old use table (%)		35.0%	38.9%	17.6%	19.4%	26.3%
Absolute differences after specific adjust-ments: domestic pro-duction	Goods	11.2	7.0	5.7	0.0	23.9
	Trade & transport services	1.2	2.8	0.5	0.6	5.2
	Other services	7.8	38.8	9.4	3.3	59.3
Absolute differences after specific adjust-ments: imports	Goods	15.1	7.8	4.7	0.0	27.7
	Trade & transport services	1.3	3.1	0.2	0.0	4.6
	Other services	3.8	16.5	1.5	0.0	21.9
Total		40.4	76.1	22.1	3.9	142.6
Sum of differences / old use table (%)		25.3%	28.9%	7%	1.4%	14.0%

Source: Federal Planning Bureau (input-output tables, 2013 and 2015)

(*) excluding the extraregional area

(**) Domestic final demand consists of consumption expenditures by households, NPISH and government, gross capital stock formation and changes in inventories. Changes in inventories have been regionalised at the FPB, while respecting national totals.

Table A.7 Old (ESA 95) & new (ESA 2010) national primary inputs and changes in absolute value (*)
Billions of euro

Version	Input type	Primary & manu-facturing ind.	Trade, transport & services	Domestic final demand	Exports	Total
Old primary inputs (ESA 95)	Taxes less subsidies on products	1.3	7.6	29.2	0.2	38.2
	Value-added	45.8	271.5	-	-	317.3
New primary inputs (ESA 2010)	Taxes less subsidies on products	1.2	8.4	28.7	0.3	38.5
	Value-added	49.8	276.5	-	-	326.3
Sum of changes in absolute value	Taxes less subsidies on products	0.2	3.3	1.6	0.3	5.4
	Value-added	10.7	42.2	-	-	53.0
Sum of changes / old primary inputs (%)	Taxes less subsidies on products	19%	44%	5%	120%	14%
	Value-added	23%	16%	-	-	17%

Source: Value added: National Accounts (National Bank of Belgium 2013 and 2015), Taxes less subsidies by industry: Federal Planning Bureau (input-output tables 2013 and 2015)

(*) Excluding the value added in the extraregional area

Table A.8 Old and new regional totals for intermediate use and domestic final demand in basic prices
Billions of euro

Version	Region \ industry	Intermediate use Primary & manu-facturing ind.	Intermediate use Trade, transport & services	Domestic final demand (*)	Total	%
Old regional account totals (ESA 95)	Brussels	17.1	60.6	35.9	113.6	15.4%
	Flanders	112.0	153.8	186.8	452.5	61.3%
	Wallonia	30.6	48.4	92.8	171.8	23.3%
	Extraregional area	0.0	0.1	0.1	0.2	0.0%
Total Belgium (ESA 95)		159.7	262.9	315.6	738.2	
New regional account totals (ESA 2010)	Brussels	16.8	58.0	36.9	111.8	15.1%
	Flanders	110.8	151.7	193.2	455.7	61.4%
	Wallonia	29.5	48.0	96.5	174.0	23.5%
	Extraregional area	0.0	0.1	0.1	0.2	0.0%
Total Belgium (ESA 2010)		157.1	257.8	326.7	741.6	

Source: Regional Accounts (National Bank of Belgium, 2015 and 2016-2017) plus own transformation to basic prices.

Table A.9 Old and new regional totals for value added
Billions of euro

Version	Region \ industry	Primary & manufac-turing ind.	Trade, transport & services	Total	%
Old regional account totals (ESA 95)	Brussels	1.9	58.3	60.2	19.0%
	Flanders	31.8	149.8	181.6	57.2%
	Wallonia	12.1	63.3	75.4	23.8%
	Extraregional area	0.0	0.2	0.2	0.1%
Total Belgium (ESA 95)		45.8	271.7	317.5	
New regional account totals (ESA 2010)	Brussels	1.8	58.7	60.5	18.5%
	Flanders	34.6	153.1	187.8	57.5%
	Wallonia	13.3	64.7	78.0	23.9%
	Extraregional area	0.0	0.2	0.2	0.0%
Total Belgium (ESA 2010)		49.8	276.7	326.5	

Source: Regional Accounts (National Bank of Belgium, 2015 and 2016-2017)

Table A.10 Belgian Interregional Use Table in basic prices for 2010 (ESA 95) (*)
Billions of euro

		Brussels			Flanders			Wallonia			Exports	Total (sum)	Production & imports totals
Origin	Product	Intermediate use by primary & manufactur-ing ind.	Intermediate use by con-struction & services ind.	Final domestic demand (**)	Intermediate use by primary & manufactur-ing ind.	Intermediate use by con-struction & services ind.	Final domestic demand (**)	Intermediate use by primary & manufactur-ing ind.	Intermediate use by con-struction & services ind.	Final domestic demand (**)			
Brussels	Goods	1.2	0.6	0.7	0.9	0.7	1.0	0.2	0.4	1.4	11.6	18.6	18.6
	Trade & transport services	0.2	1.6	4.4	0.5	1.7	1.1	0.2	0.8	0.8	6.3	17.6	17.6
	Other services	0.7	24.6	20.4	3.2	12.1	14.4	1.5	5.2	6.4	15.1	103.6	103.6
Flanders	Goods	1.4	1.5	1.0	22.3	13.2	11.4	2.3	1.7	4.2	78.7	137.5	137.6
	Trade & transport services	0.3	1.9	0.9	7.1	14.9	23.5	0.8	1.7	1.5	38.7	91.4	91.4
	Other services	0.4	9.8	1.9	10.7	68.7	106.1	1.3	3.9	2.0	18.4	223.3	223.3
Wallonia	Goods	0.3	0.5	0.2	2.7	1.3	1.1	4.6	3.6	4.5	21.0	39.8	39.8
	Trade & transport services	0.1	0.8	0.3	0.7	1.7	0.7	1.4	3.2	10.1	5.1	24.1	24.1
	Other services	0.2	3.4	0.9	0.9	3.0	1.4	3.2	19.5	51.8	8.3	92.6	92.6
Imports	Goods	11.9	2.6	4.5	54.1	12.0	24.1	11.7	3.6	8.9	68.5	201.9	201.9
	Trade & transport services	0.1	2.0	0.0	2.1	12.4	0.3	0.5	0.9	0.3	0.0	18.5	18.5
	Other services	0.4	11.2	0.7	6.8	12.1	1.6	2.9	4.1	1.0	5.1	45.9	45.9
Taxes less subsidies on products		0.1	1.8	3.0	0.9	4.1	17.2	0.3	1.7	9.0	0.2	38.2	38.2
Value added		1.9	58.3	0.0	31.8	149.8	0.0	12.1	63.3	0.0	0.0	317.3	317.3
Total (sum)		19.1	120.7	38.9	144.7	307.7	203.9	43.0	113.5	101.8	277.0	1370.2	1370.3

(*) The numbers exclude the 0.3 billion euro used by the Belgian extra regional area (which includes the Belgian diplomatic and permanent army post abroad) (*)

(**) In table A.10 final domestic demand includes the consumption expenditures by non-residents in Belgium (6.9 billion euro) and excludes consumption expenditures by residents abroad (10.1 billion euro). This corresponds to the territorial concept of consumption in the national SUT but deviates from the consumption concept in the regional accounts, where the residential concept is followed.

Table A.11 Interregional use table 2010 in basic prices, after specific adjustments (before RAS B and C)
billions of euro

		Brussels			Flanders			Wallonia			Exports	Total (sum)	Production (RAS A) & imports totals
Origin	Product	Intermediate use by primary & manufacturing ind.	Intermediate use by construction & services ind.	Final demand	Intermediate use by primary & manufacturing ind.	Intermediate use by construction & services ind.	Final demand	Intermediate use by primary & manufacturing ind.	Intermediate use by construction & services ind.	Final demand			
Brussels	Goods	2.3	0.6	0.8	1.0	0.6	1.0	0.2	0.3	1.4	9.5	17.7	17.8
	Trade & transport services	0.3	1.5	4.8	0.8	1.6	1.1	0.2	0.9	0.8	5.7	17.6	17.6
	Other services	0.8	22.4	20.6	3.2	11.6	14.9	1.5	5.1	6.8	16.0	103.0	102.1
Flanders	Goods	1.4	1.5	1.0	23.1	13.4	11.6	2.3	1.6	3.3	81.8	141.1	140.1
	Trade & transport services	0.4	2.0	0.9	9.6	15.6	25.1	1.1	1.8	1.5	31.3	89.3	88.5
	Other services	0.4	9.6	1.9	11.0	67.7	110.2	1.4	4.0	2.1	19.0	227.5	227.0
Wallonia	Goods	0.3	0.5	0.2	2.7	1.3	1.1	4.6	3.6	4.5	21.8	40.6	39.9
	Trade & transport services	0.2	0.8	0.3	1.0	1.8	0.7	2.0	3.3	11.3	2.7	23.9	23.8
	Other services	0.1	3.2	1.1	0.9	2.8	1.5	3.2	19.4	53.5	9.2	95.0	93.9
Imports	Goods	9.9	2.7	4.8	52.8	11.9	24.9	11.6	3.6	9.5	71.0	202.6	192.1
	Trade & transport services	0.1	1.9	0.0	2.1	12.4	0.3	0.5	0.9	0.3	0.0	18.5	20.1
	Other services	0.5	11.4	0.9	5.5	12.6	3.3	2.7	4.3	1.5	4.7	47.5	50.5
Taxes less subsidies on products		0.1	2.1	3.0	0.9	4.5	16.8	0.3	1.8	8.8	0.3	38.5	38.5
Value added		1.8	58.7		34.6	153.1		13.3	64.7			326.3	326.3
Total (sum)		18.6	119.0	40.4	149.1	311.0	212.6	44.8	115.2	105.3	272.9	1389.0	1378.2
Total from Regional Accounts (2016 ESA 2010)		18.7	118.8	39.9	146.3	309.3	209.8	43.1	114.5	105.3	272.5	1378.2	

Table A.12 The adjusted interregional use table in basic prices for 2010 in ESA 2010, final result
billions of euro

		Brussels			Flanders			Wallonia			Exports	Total
Origin	Product	Intermediate use by primary & manufacturing ind.	Intermediate use by con-struction & services ind.	Final demand	Intermediate use by primary & manufacturing ind.	Intermediate use by con-struction & services ind.	Final demand	Intermediate use by primary & manufacturing ind.	Intermediate use by con-struction & services ind.	Final demand		
Brussels	Goods	2.5	0.6	0.7	1.1	0.6	0.9	0.3	0.3	1.3	9.6	17.8
	Trade & transport services	0.2	1.4	4.7	0.7	1.6	1.3	0.2	0.8	1.0	5.5	17.6
	Other services	0.8	21.9	20.3	3.5	11.4	15.5	1.6	4.9	6.9	15.3	102.1
Flanders	Goods	1.6	1.4	1.0	23.5	12.2	10.9	2.6	1.6	3.5	81.7	140.1
	Trade & transport services	0.4	1.6	0.9	9.6	15.4	24.9	1.1	1.6	1.7	31.4	88.5
	Other services	0.5	9.8	2.2	11.1	67.1	108.8	1.6	3.9	3.1	19.0	227.0
Wallonia	Goods	0.2	0.5	0.3	2.8	1.3	1.1	4.3	3.3	4.3	21.8	39.9
	Trade & transport services	0.2	0.8	0.3	1.0	1.7	0.7	1.8	3.2	11.3	3.0	23.8
	Other services	0.2	3.2	1.1	1.0	2.7	2.1	3.1	18.4	52.8	9.2	93.9
Imports	Goods	9.6	2.4	4.4	48.6	10.8	23.0	9.8	3.3	9.0	71.0	192.1
	Trade & transport services	0.1	2.4	0.0	2.6	12.8	0.2	0.6	1.2	0.1	0.0	20.1
	Other services	0.5	12.0	1.0	5.2	14.3	3.5	2.5	5.4	1.4	4.7	50.5
Taxes less subsidies on products		0.1	2.1	3.0	0.9	4.5	16.8	0.3	1.8	8.8	0.3	38.5
Value added		1.8	58.7		34.6	153.1		13.3	64.7			326.3
Total		18.7	118.8	39.9	146.3	309.3	209.8	43.1	114.5	105.3	272.5	1378.2