Received: 15 February 2023 | Revised: 5 October 2023 | Accepted: 16 October 2023

DOI: 10.1111/pirs.12760

FULL ARTICLE

The European regions in the global value chains: New results with new data

Miguel Ángel Almazán-Gómez[1] | Carlos Llano[2] | Julián Pérez[3] | Giovanni Mandras[4]

[1]Departamento de Análisis Económico, Universidad de Zaragoza, Zaragoza, Spain

[2]Departamento de Análisis Económico, Universidad Autónoma de Madrid, Madrid, Spain

[3]Departamento de Economía Aplicada, Universidad Autónoma de Madrid, Madrid, Spain

[4]European Commission-Joint Research Centre, Seville, Spain

Correspondence
Miguel Ángel Almazán-Gómez, Departamento de Análisis Económico, Universidad de Zaragoza, Zaragoza, Spain.
Email: malmazan@unizar.es

Funding information
Programme from the Autonomous Community of Madrid, Grant/Award Number: H2019/HUM-5761 (INNOJOBMAD-CM); Department of Science, University and Knowledge Society of the Government of Aragon, Grant/Award Number: S40_23R; Ministry of Science and Innovation of the Spanish government, Grant/Award Number: PID 2019-106822RB-I00; European Observation Network for Territorial Development and Cohesion (ESPON), Grant/Award Number: IRIEproject

Abstract

This article contains the methodology and main results related to the update and extension of the widest inter-regional input–output tables for the entire EU27, UK and the European Free Trade Association (EFTA) countries. This work continues the outstanding effort developed in the past years regarding the estimation and analysis of different multiregional input–output (MRIO) databases at the country level (world input–output database, EXIOBASE, ICIO, FIGARO, etc.) and the MRIO tables developed for the European Union (EU) at the NUTS2 level. The main contribution consists of updating and extending the current EUREGIO collection to obtain a EUREGIO table for 2017, which will be referred (NUTS-2 Rev.2016) for all the EU27 + UK + EFTA countries and will be embedded in the new FIGARO multicountry 2017. Such effort was developed in the context of the ESPON-IRIE project. This article summarises the methodology used and compares the results obtained with the ones of the main benchmarks, providing an analysis of the national and regional participation in the global value chains (GVCs). The main results suggest that, on average, 65% of value added is embodied in the goods and services sold to the same NUTS-2 region, 16% is embodied in the ones sold to regions in the same country and the remaining 20% is exported (to other

countries). Exploring the heterogeneity within these figures can also be seen that the variety is higher across regions than across sectors. Our analysis suggests that, to a large extent, the heterogeneous participation of EU27 + UK + EFTA regions in the GVCs is explained by their sectoral structure more than by the regional idiosyncratic characteristics. Such results open the floor for the correct design of industrial policies, embedded in the smart specialisation paradigm.

KEYWORDS
Europe, FIGARO, global value chains, multiregional input–output tables, trade

JEL CLASSIFICATION
F13, F14, R15

1 | INTRODUCTION

Today, more than ever, the production of goods and services implies the concatenation of different processes; each one of them is allocated to a large number of territories, whether countries or regions (Johnson & Noguera, 2012; Timmer et al., 2013). One of the consequences of this fragmentation of the value chain is that the economic analysis with a focus on a territory should amplify the scope, not just considering variables related to what is being produced in that specific location but also the trade relationships that this specific location has, upstream and downstream, with other regions providing the required inputs or the ones demanding their output to be used in further transformations.

A growing literature is emphasising the relevance of measuring the *participation* of a given territory (region) in these global value chains (GVCs) (De Backer & Miroundot, 2014; Gereffi, 1999; Hagemejer & Ghodsi, 2017; Hummels et al., 2001; Koopman et al., 2010; Kummritz et al., 2017; Los et al., 2015).

One of the main limitations of this type of analysis is the availability of solid multiregional input–output (MRIO) datasets, which enable us to cover a wide range of sectors and countries. In this sense, the publication of several MRIO databases at the country level revolutionised the input–output (IO) literature (Lenzen et al., 2013; Merciai & Schmidt, 2018; Remond-Tiendrez & Rueda-Cantuche, 2019; Stadler et al., 2018; Tukker & Dietzenbacher, 2013; Wood et al., 2014). These different IO tables have been widely used in the applied literature to analyse international trade flows and the globalisation of value chains (Antràs & Chor, 2018; Antràs & Gortari, 2020; Arto et al., 2019; Arto et al., 2014; Espinosa-Gracia et al., 2023; Los et al., 2015; Timmer et al., 2013; Xu & Dietzenbacher, 2014).

In this line, the European Commission (EC), in collaboration with EUROSTAT, published, on 26 May 2021, under the FIGARO project, a large and quasi-official series of country-to-country (C2C) IO tables, with a full-fledged coverage of countries and sectors for 2010–2017 [64 sectors and most of the EU27 + UK + European Free Trade Association (EFTA) countries] and a projection for 2018 and 2019 (with 21 sectors).

In addition to that, efforts have been made recently to generate equivalent collections of MRIO tables at the NUTS-2 level in Europe. To the best of our knowledge, the largest available dataset on interregional flows for the EU28 at the NUTS-2 level covers the period from 2000 to 2010 (Thissen et al., 2018). In addition, there is a non-public table for the year 2013 (Chen et al., 2018). This table, henceforth EUREGIO-2013, consists of a larger sectoral disaggregation: 64 economic sectors (and coincident with FIGARO ones).

In the context of the previous effort made in the generation of different MRIO tables for the European Union (EU) at the NUTS-2 scale, the goal of this paper is twofold: (i) to describe the methodology used for updating and

extending geographically the last EUREGIO-2013 to obtain a new EUREGIO table for 2017, referring to the regions (NUTS-2 Rev.2016) of all the EU27 + UK + EFTA entities, nested in the recently published FIGARO multi-country dataset; and (ii) to offer new insights into regional participation in GVCs.

The new dataset (hereinafter EUREGIO-2017) described here is expected to be used in the development of impact evaluation analysis, as all kinds of policy and research in the field of international economics and regional economics. The methodology applied has been developed in coordination with the EC, in search of the best possible interconnection between the EUREGIO-2013 and the new EUREGIO-2017. The main contributions and the steps to develop the EUREGIO-2017 are as follows: (i) translating the EUREGIO-2013 to the NUTS2-2016 definition; (ii) the inclusion of the region-to-region (R2R) relations for two additional countries: Iceland and Liechtenstein; (iii) embedding the R2R flows in the FIGARO table for 2017; and (iv) the use of bi-proportional adjustment methods for obtaining regional figures coherent with countries' figures from FIGARO main totals.

Then, to characterise EUREGIO-2017, we compare the results obtained with the ones of the main benchmarks [world input–output database (WIOD), FIGARO, EUREGIO-2013], providing a first analysis based on the national and regional participation in the GVCs, using the measurement proposed by Los et al. (2015).

The results obtained are remarkable, refreshing the knowledge about the intersectoral relations at the NUTS-2 level and identifying strong relations within Europe and with the rest of the world. Our analysis of the regional participation in the GVCs suggests that, on average, 65% of value added (VA) is embodied in the goods and services sold to the same NUTS-2 region, 16% is embodied in the ones sold to regions in the same country and the remaining 20% is exported (to other countries). We also conclude that the different participation of each region is mainly explained by its sectoral structure more than by its regional specificities.

The structure of the rest of the paper is as follows. In Section 2 we revise the background regarding the generation of MRIO tables for Europe and the literature on the measurement of participation in GVCs. Section 3 describes the methodology used to estimate the new EUREGIO-2017, covering each one of the steps followed and offering a different analysis comparing the results with the main benchmarks (WIOD, FIGARO at the country level and EUREGIO-2013 at the regional level). Next, Section 4 analyses the participation in GVCs at the country and regional levels, and the final section concludes.

2 | BACKGROUND

2.1 | European MRIO frameworks at the NUTS-2 level

As commented, the publication of several C2C MRIO databases revolutionised the IO literature (Tukker & Dietzenbacher, 2013). Of special interest is the first WIOD, which was developed for a project from the EU's Seventh Framework Programme.

Currently, WIOD offers two different releases that include different countries and consider different sector definitions. The first one is the release of 2013, which covers 27 EU countries and 13 other major countries in the world for the period 1995–2011; this first release considered 35 different industries (Dietzenbacher et al., 2013). In the second release, published in 2016 (Timmer et al., 2015, 2016), the WIOD project provided tables that cover the period 2000–2014. These include detailed IO relationships for 28 EU countries, and 15 additional large economies. This second release considers 56 industries.

In parallel, there are alternative sets of interconnected IO tables at the national level: EORA, EXIOBASE, FIGARO and ICIO-OECD (Lenzen et al., 2013; Merciai & Schmidt, 2018; OECD (Organisation for Economic Co-operation and Development), 2018; Remond-Tiendrez & Rueda-Cantuche, 2019; Stadler et al., 2018; Wood et al., 2014).

The FIGARO project aims to produce intercountry tables based on the European System of Accounts (ESA 2010) methodology (Eurostat, 2013). The tables are developed by the Joint Research Centre (JRC) in close collaboration with other institutions (OECD, Eurostat, etc.). Initially, the FIGARO project developed C2C MRIO tables for the

years 2010 and 2015 and included only EU28 countries and USA and Japan. When WIOD abandoned the project to produce annual tables, the FIGARO project took over. Then, in May 2021, the first series of FIGARO MRIO was made public, including a large and official set of C2C MRIO tables, with a full-fledged coverage of countries and sectors for 2010–2017 (64 sectors and most of the EU27 + UK + EFTA countries) and a projection for 2018 and 2019 (with 30 sectors). The FIGARO dataset includes most of the countries included in the EUREGIO-2017 and serves as a reference framework for the elaboration of EUREGIO-2017.

Regarding the multiregional IO tables elaborated at the NUTS-2 level,[1] as commented, the main contributions are the 2000–2010 series elaborated by the EC in a close collaboration with the Netherlands Environmental Assessment Agency (Chen et al., 2018; Thissen et al., 2018). In this work, the authors describe a methodology able to produce a full set of interregional supply-and-use tables (SUTs), covering the EU28 and 13 industries (goods and services). The main characteristics of these tables are as follows:

1. The application of an equivalent set of national SUTs borrowed from the Eurostat. The interconnection of a nation's SUTs by means of international trade flows (BACI-CEPII), once exports and import flows between countries have been standardised (mirror analysis, coherence between FOB and CIF and clean-up of re-exportation flows).
2. Regionalisation of standardised interlinked national SUTs (top-down approach), mainly with gross VA figures at the regional level (NUTS-2) for each region in the EU28 sample.
3. The use of such information (as prior) – instead of the pure nonsurvey approach described in the previous step – for a reduced number of regions in Europe, where survey-based IO tables are available.
4. Interconnecting these regional input-output tables through intersectoral and interregional relationships involves the creation of origin-destination (OD) matrices. These matrices are estimated using a combination of linear and nonlinear optimization techniques, initiated from a custom set of prior information. For goods, this prior information is derived from interregional truck flow data from Eurostat, while for services, it is based on interregional passenger air travel data from MIDT (Marketing Information Data. Transfer).

A critical point at the time of producing NUTS-2-level IO tables is the election of the C2C framework used as a reference. In Chen et al. (2018), it was the WIOD, while in Thissen et al. (2018), it was the Eurostat SUTs. We use FIGARO, due to the sectoral disaggregation and the perfect matching with most of the NUTS-2 data available in EUROSTAT.

A second critical point in all previous efforts regarding the estimation of NUTS-2-level tables is the estimation of a set of OD matrices at the R2R level, which enables us to link every pair of regions in the system. Although the literature reports few attempts to generate pan-European interregional flows in ambitious and isolated EU projects (ETIS, ETIS-PLUS), the most complete and interesting exercises of estimating are the ones conducted to elaborate the EUREGIO series previously mentioned, which developed different datasets on bilateral trade between European NUTS-2 regions. The first estimate covered 59 product categories for the year 2000 (Thissen, Diodato, & van Oort, 2013; Thissen, van Oort, et al., 2013). The dataset was extrapolated for 2010 (Thissen et al., 2015) and 2013 (Thissen et al., 2019). This extrapolation uses regional and national information for the years 2010 and 2013 from Eurostat and a non-linear optimisation procedure to obtain the most likely OD matrix between regions starting from a prior and subject to the constraints imposed by the regional and national figures from Eurostat and the WIOD.

[1]In recent days, our attention has been drawn to an effort in the development of a Python code aimed at constructing MRIO tables for NUTS-2 regions (Huang & Koutroumpis, 2023). This work was published on 18 April 2023, along with a link to the code (designated as version 6). At that juncture, we procured the code and results, discovering that they solely generated an intermediate input matrix. We revisited the code on 20 September 2023. This time the code (version 10) generates an MRIO table. Unfortunately, the summation of rows and columns does not yield equal totals. So, at least for the moment, we discard this attempt to develop MRIO tables at the NUTS-2 level as a valid data source.

Thus, to the best of our knowledge, the largest available dataset on R2R MRIO tables for the EU28 covers the period 2000 to 2010 (and the year 2013) with a larger sectoral disaggregation. Then, the EUREGIO-2013, in combination with NUTS-2 data from the EUROSTAT, served as the point of departure for our own contribution through this work.

3 | METHODOLOGY AND DATA

3.1 | The IO framework

IO tables are the basis of the IO framework. An IO table consists of at least three sets of elements: the intermediate inputs matrix, the final demand matrix and the VA matrix (for the sake of simplicity, we include in this explanation the net taxes on products in the VA matrix).

The first set of elements is the matrix of intermediate inputs, which we will call **Z**. In single-region input–output (SRIO) frameworks, this matrix has an *n*-by-*n* dimension (where *n* represents the number of sectors taken into account). The Z_{ij} elements represent the purchases made by sector *j* of sector *i*. Therefore, the intermediate input matrix represents sectoral interdependencies. In MRIO frameworks, the intermediate input matrix (**Z**) depicts a block matrix with $\mathbf{Z^{rs}}$ matrices that capture the interindustry relations between regions *r* and *s*. Then, each submatrix $\mathbf{Z^{rs}}$ is an *n*-by-*n* matrix, where *n* is the number of sectors accounted. The on-diagonal matrices ($\mathbf{Z^{rr}}$) capture the domestic intermediate flows (intraregional intermediate flows). By contrast, all off-diagonal matrices ($\mathbf{Z^{rs}} \forall r \neq s$) contain the interindustry interregional flows, where Z_{ij}^{rs} is the value of the production generated by sector *i* in region *r* that is being used as intermediate input by sector *j* in region *s* (interregional interindustry flow).

The second set of elements is the final demand matrix, which we will call **Y**. In SRIO frameworks, this matrix has an *n*-by-*f* dimension (where *f* represents the number of final demand agents considered). The Y_{id} elements represent the purchases made by agent *d* of sector *i*. In the same way as the intermediate inputs matrix, in MRIO frameworks, the final demand matrix (**Y**) depicts a block matrix with $\mathbf{Y^{rs}}$ matrices that capture the industry final-use relations between regions *r* and *s*. Then, each submatrix $\mathbf{Y^{rs}}$ is an *n*-by-*f* which elements in the off-diagonal matrices are $Y_{id}^{rs} \forall r \neq s$ depict the imports that make the agent *d* of region *s* from industry *i* of region *r*; meanwhile, the on-diagonal matrices ($\mathbf{Y^{rr}}$) capture the domestic final demand.

Finally, the third set of elements is the VA matrix. In SRIO frameworks, it is usually represented as matrix **V**. In SRIO frameworks, VA matrix contains the components of the VA of each sector, so their dimension depends on the VA components considered and the number of sectors. Considering 'net taxes', 'compensation of employees' and 'gross operating surplus', the dimension of this matrix is 3-by-*n* in SRIO frameworks and 3-by-*nR* in MRIO frameworks, where *R* is the number of regions considered. Figure 1 shows the way to represent these elements. As can be seen, Figure 1 shows a set of elements that are not mentioned yet. The gross output vector of each industry x_i^r is represented by an *n*-by-*nR* vector and is met whenever that $\sum_{sj} Z_{ij}^{rs} + \sum_{sd} Y_{id}^{rs} = x_i^r$ and $\sum_{ri} Z_{ij}^{rs} + \sum_{cj} V_{cj}^{s} = x_j^s$. Note that, although taxes less subsidies on products and CIF/FOB adjustment are not part of the VA, we include them in the **V** for an easier representation of the framework.

3.2 | Main data sources

The main sources to obtain the necessary input data to develop this work are the following three: EUROSTAT regional figures of production (VA); FIGARO MRIO tables at the country level; and the EUREGIO-2013 IO table (with NUTS-2 defined in 2010). In addition, some complementary sources are needed, which are produced by some national and regional statistical offices whose data are not available in EUROSTAT.

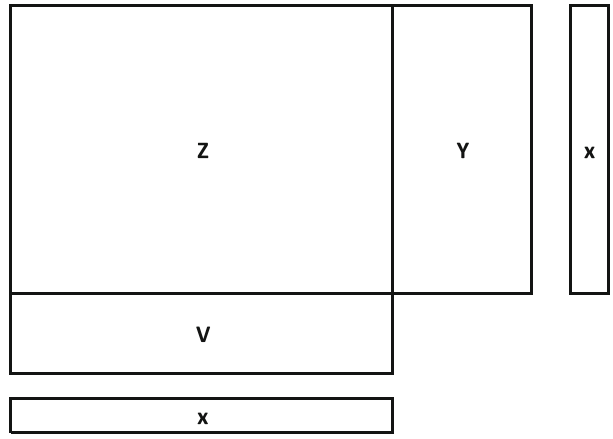

FIGURE 1 Scheme of an input–output table. *Source*: Authors' own work.

Note that at the time of starting the work, 2017 was the last year with official data at the NUTS-2 level for most countries in EUROSTAT, and it is the last year for which FIGARO included a highly disaggregated C2C IO tables. FIGARO tables cover the period from 2010 to 2017 with the most standard sectoral disaggregation and the period from 2018 to 2019 with more aggregated projections. At this stage, we adopt 2017 FIGARO's multicountry IO table as the C2C benchmark (hereinafter FIGARO-2017).

EUROSTAT provides, for most regions, the basic socio-economic data at the NUTS-2 level required to assure a certain level of coherence between the final tables and the official regional statistics. Unfortunately, the regional information published is very scarce and highly aggregated. The key socioeconomic data we used from EUROSTAT at the NUTS-2 level are the VA at the sectoral level. Such variable is split into groups of 11 sectors (A, B_E*, C, F, G_I, J, K, L, M_N, O_Q and R_U) (see Table A.1 in the Annex), where 14 groups of sectors appear (note that there are three redundant aggregates marked in bold); B_E* is calculated subtracting the value of manufacturing (sector C) from the aggregate B_E. This sectoral level of detail, although not particularly deep, covers the whole economy. Also, there are no missing values. Such a low level of sectoral disaggregation contrasts with the 64 sectors provided by the FIGARO's dataset at the C2C level. Moreover, as is common in most of the EU countries, EUROSTAT does not provide additional information for regions on the demand side of the economy. Hopefully, the regional VA aggregated at the national level fits perfectly with the FIGARO table, except for Norway's data.

The EUREGIO-2013 offers the benchmark for the general layout of the 2017 version and offers a good *before* downscaling the trade of C2C data observed in the FIGARO tables to the R2R NUTS-2 level. It is necessary to remark, however, that the EUREGIO-2013 table used the 2010 definition of NUTS-2, so any use of such a table requires a previous transformation to the 2016 NUTS-2.

As mentioned earlier, not all socioeconomic data for the EFTA countries and regions are available in EUROSTAT. Data for Switzerland and Liechtenstein are not covered. In the case of Switzerland, we retrieve the data from its Federal Statistical Office (FSO) (https://www.bfs.admin.ch/bfs/en/home.html). Liechtenstein does not account for a statistical office, so we used the World Bank data.

3.3 | Extending FIGARO-2017 to cover all EFTA countries

FIGARO-2017 considers the 45 countries listed in Table A.2 (Annex) but not all with the same sectoral disaggregation. The economies of the EU27, the UK and the United States are depicted by 64 sectors; meanwhile, the rest of the economies are split just into 30 sectors. The sector descriptions and the matching between the different sectoral

aggregations are reported in Table A.3 (Annex), where it is shown how Iceland and Liechtenstein[2] are not included in FIGARO's original dataset, while the sectoral disaggregation of Norway and Switzerland is different from the rest. The available FIGARO's sectoral disaggregation for Norway and Switzerland was extended to the 64 sectors using the sectoral structure of these countries in the EUREGIO-2013. For the case of Iceland, we also retrieved the sectoral economic interactions from the EUREGIO-2013 and rescaled them to 2017 values using the sectoral VA data from EUROSTAT.

Before using FIGARO's database, a deep process of revision was applied, finding some problematic figures that do not fit with the required C2C framework and the theoretical IO model to be used. Thus, some figures had to be re-estimated after finding empty cells or incongruent (i.e., negative) values. Details are available upon request.

3.4 | Reshaping the EUREGIO-2013 table

As commented, the EUREGIO-2013 table has been used as a key reference in the updating–extending process of this task. The first step was to put the table in the same level of disaggregation as the FIGARO 64 reference tables. To do so, the disaggregation of the widest EUREGIO-2013 version of the table for the 65 sectors was aggregated to the 64 FIGARO's sectors, by aggregating L68A + L68B = L68. As mentioned, there were two other issues to tackle: first, to translate the interregional relations defined in terms of the 2010-NUTS definition into the 2016-NUTS definition used in the IRIE project; and, second, the inclusion of Liechtenstein data. Once all these aspects are accomplished, the EUREGIO-2013 table is ready to be used as a prior to obtain the updated–extended EUREGIO-2017 table, now rooted in the FIGARO's data, including all the R2R flows of the EU27 + UK + EFTA countries. The strategy to address these issues and to update to 2017 is described in the following subsections.

3.5 | Mapping old-to-new regions

In this work, the NUTS-2 2016 definition has been adopted, while the EUREGIO-2013 adopts the NUTS-2 2010 definition. The definitions of NUTS from 2010 and 2016 differ significantly. So, to go from the 2010 definition to the 2016 definition, we have proceeded as follows.

First, we have identified each region of the definition of 2016 (henceforth, new regions) with one region of the definition of 2010 (henceforth, old regions), and, then, the values of each row and column in the EUREGIO-2013 table are preliminarily assigned to the mapped new regions. The mapping is the one depicted in Table A.4 (Annex). In this step, we also identify the regions of EU27 + UK + EFTA countries with the regions in the EUREGIO-2013. Note that, as commented, preliminarily, Liechtenstein is treated as a Switzerland region.

As can be seen in Table A.4, most *old regions* have only one *new region* associated. When this occurs, the *new region* and the *old region* are the same or, at most, it just implies a slight variation at the NUTS-3 level but with no impact on the NUTS-2-level definition. However, some *old regions* are associated with more than one *new region*, having to split the data of these regions into two or more regions. These cases are highlighted in Table A.4, using darker cell colours. This is the case, as an example, of Croatia (HRV), which must be divided into two regions (HR03 and HR04). For such disaggregation, we have computed sectoral proportions: the weight that each sector in each

[2]The objective of this paper is to develop an MRIO table that considers EU27 + UK + EFTA countries. So Liechtenstein must appear. However, no official data from any Liechtenstein institution were obtained. So Liechtenstein's GDP data were obtained from the World Bank database, and the sectoral composition of the VA divided into six macro-sectors has been obtained from the Knoema Database (knoema.com). To split these six values into the 64 sectors used for all the EU27 + UK + EFTA countries, we used the distribution of the sectoral VA of Switzerland's closest region, namely, St Gallen. We have also used St Gallen's data as priors for estimating the interindustry relationships of Liechtenstein with the rest of the countries listed in the FIGARO tables.

new region has over the corresponding *old region* assigned in the mapping process. These weights are applied to the *new regions*. Then, the result is a balanced EUREGIO-2013 table by the 2016 definition of NUTS-2.

The weights used are based on EUROSTAT's VA. Other sources have been considered; however, the information was not available for all regions, or they led to discrepancies when compared with official data. This is the case with the Labour Force Survey (EU-LFS microdata) and the Amadeus Bureau van Dick database. Note that the VAs at the NUTS-2 level used for these proportions are available for 11 macro-sectors (A, B_E*, C, F, G_I, J, K, L, M_N, O_Q, R_U from 'nama_10r' series) and are not available for Switzerland nor Liechtenstein. Switzerland figures have been obtained aggregating the cantons data obtained from the Switzerland FSO number je-e-04.02.06.02; they are grouped at eight macro-sectors (A, BCF, DEPQ, GHIJ, K, LMNRS, O, T). For Liechtenstein, we have used the data from the Knoema database previously mentioned. Note that this process affects only the dark-coloured cell regions identified in Table A.4. The resulting table is a version of the EUREGIO-2013 table with the NUTS-2 defined in the 2016 Rev. and with the inclusion of Liechtenstein.

Once the EUREGIO-2013 has been harmonised with the sectoral and regional categories that will be included in the final 2017 version and once the national aggregate figures from the FIGARO-2017 dataset are also set in the corresponding layout, it is now possible to develop a standard exercise of updating an IO table using any of the techniques available in the literature to assure the corresponding bi-proportional adjustment of each cell subject to the total constraints by rows and columns. In this case, we have used the GRAS algorithm described in the following section.

3.6 | The GRAS algorithm

To harmonise and update the tables, we apply the improved version of the GRAS algorithm of Lenzen et al. (2007). The GRAS algorithm is an updating method developed by Junius and Oosterhaven (2003), commonly used to balance tables, which consists of a generalisation of the RAS method (Stone & Brown, 1962). GRAS is an improvement with respect to the RAS, since it allows the updating of non-squared tables and, in addition, accounts for the existence of negative elements, both in the original table and in the data to be adjusted.

The maximisation problem of Junius and Oosterhaven (2003) is Max: $\sum_j \sum_i |x_{ij}| ln \frac{x_{ij}}{a_{ij}}$, and we use the improved version of Lenzen et al. (2007), whose optimisation problem is Max: $\sum_j \sum_i |a_{ij}| \frac{x_{ij}}{a_{ij}} ln\left(\frac{x\_ij/a\_ij}{e}\right)$; both subject to $\sum_i x_{ij} = u_i; \sum_j x_{ij} = v_j; \sum_i u_i = \sum_j v_j; \forall i,j$. where x_{ij} is the new component of the table placed in row i and column j and a_{ij} is the old component, also known as 'prior', v_j is the new sum by rows of column j and u_i is the new sum by columns of row i.

3.7 | Obtaining the 2017 figures: Vectors and matrices

As mentioned, the **V** matrix is composed of the valued-added vector (**v**) (B1G in FIGARO nomenclature), the taxes less subsidies on products vector (D21X31) and the CIF–FOB adjustment vector (CIF–FOB). The VA vector includes compensation of employees (D1), gross profit (B2A3G) and net taxes on production (D29X39). Here we focus on the VA vector and not on its components, due to the lack of information on such components at the NUTS-2 level and for all third countries in the FIGARO's table. So, in this step, the **V** matrix is composed of three vectors.

The VA vector is the key economic variable we use to update the EUREGIO-2013 table. Note that we have the VA vector at the NUTS-2 level considering only 11 sectors (EUROSTAT) and the country VA for the 64 sectors (from FIGARO and EUROSTAT). Then, we allocate the country values (S_64) using the regional shares. As an example, let us assume a country with three regions where the primary sector (A) weighs 20% in region 1, 35% in region 2 and 45% in region 3. Then all VA of sector A at the country level (A01, A02 and A03) is driven to the regions in those

proportions. If the VA of sector A01 at the country level is €250 million, then the VA of sector A01 in region 1 is €50 million (0.2 × 250), the VA of sector A01 in region 2 is €87.5 million and the VA of sector A01 in region 3 is €112.5 million. We discard the use of the VA from EUREGIO-2013 as priors, given the existing inconsistencies between such values and the current official values for that year.

The allocation of taxes on products, the CIF/FOB adjustment and gross output vectors, from the country level from FIGARO to the NUTS-2 level, respond to the resulting shares of the VA allocation. In the same way, we determine the total intermediate inputs used vector ($\sum_{ri} Z_{ij}^{rs}$). Doing this, we assume that the productive structure of each sector in each region is the same as the one in the corresponding country using FIGARO. At this point, we have no other better information to make different assumptions.

The MRIO framework depicts a global economy where supply equals demand. So, at this point, we have estimated the gross output vector (**x**), which is a transposable vector that accounts for the sum by rows of **Z** and **V** $\left(x_j = \sum_i Z_{ij} + \sum_c V_{cj}\right)$ at the same time as the vector that accounts for the sum by columns of all elements in **Z** and **Y** $\left(x_i = \sum_j Z_{ij} + \sum_f Y_{if}\right)$. In our table, the total amount of the intranational trade of intermediate inputs matrix ($\sum Z_{ij}^{rs}$) (when **r** and **s** belong to the same country) has been adjusted to the FIGARO structure. For each element, we retrieve from FIGARO the weights of intermediate inputs and the final demand distinguishing between domestic (same country) and foreign demands. Those proportions have been imposed, resulting in four column vectors that we will use as column objective values to update **Z** and **Y** matrices. We have also taken the domestic and foreign shares for the intermediate inputs used by each sector and the final demand components, resulting in four row vectors that will be used as row objective values to update **Z** and **Y** matrices. These four row vectors and four column vectors are used to apply the GRAS algorithm over the correspondent four groups of data where the priors are obtained from the EUREGIO-2013.

The GRAS algorithm is applied four times, as depicted in Figure 2, where an example of three countries is offered for illustrative proposes: white cells represent matrices of zeros. Note that each country has a different number of regions. Grey cells in **Z** matrix represent submatrices of 64 × 64 sectors, $\mathbf{Z^{rs}}$ where *r* indicates the origin region and *s* indicates the destination region. Grey cells in **Y** matrix also represent submatrices, in this case, of 64 sectors by four final demand components, $\mathbf{Y^{rs}}$ where *r* indicates the origin region and *s* indicates the destination region. The priors used are the ones from the amended EUREGIO-2013 table. The **u** and **v** vectors that represent the objective values of the sums by rows and columns in the GRAS algorithm are depicted in Figure 2 using grey cells. In the case of the domestic matrices, grey cells represent the intranational trade of each country. As mentioned, the domestic vectors (upper schemes in Figure 2) have been calculated, taking proportions from the FIGARO table: if in the FIGARO table, a specific sector of a country uses 60% of intermediate inputs from the same country (domestic intermediate inputs), then the value of **z_dom_row_sum** vector for this sector in all regions of this country will also be the 60% of **z_row_sum**. Note that **z_row_sum** = **z_dom_row_sum** + **z_int_row_sum**.

The same strategy has been applied for columns in **Z** and **Y** matrices. Note that the calculated vectors using the proportions do not lead to a feasible solution because the row vectors do not add up to the same amount as their corresponding column vectors. So column vectors have been recalculated using the remaining weights of all elements in the column when it was possible. When the calculus drives to a negative figure over a column vector, that figure remains and then the row vector is adapted. The domestic vectors and the domestic matrices have been obtained previous to the international trade matrices, so they condition the international trade vectors (**z_int_row_sum**, **z_int_col_sum**, **y_int_row_sum**, **y_int_col_sum**).

Our approach faced several constraints that allowed further improvements. First, the data used as constrained at the country level from FIGARO are not complete, so the new tables could not take them as a fixed cell-by-cell constraint. We used the EUREGIO-2013 dataset as prior for the updating process. This can be seen as a drawback but at the same time as a virtue since it will provide a smoother transition from the current version of the EUREGIO series and the new update.

Table 1 shows the correlation between the intermediate matrices of the EUREGIO-2017 and 2013. Here, we can see large correlations between the patterns of intraregional (same region) and intranational trade of goods and

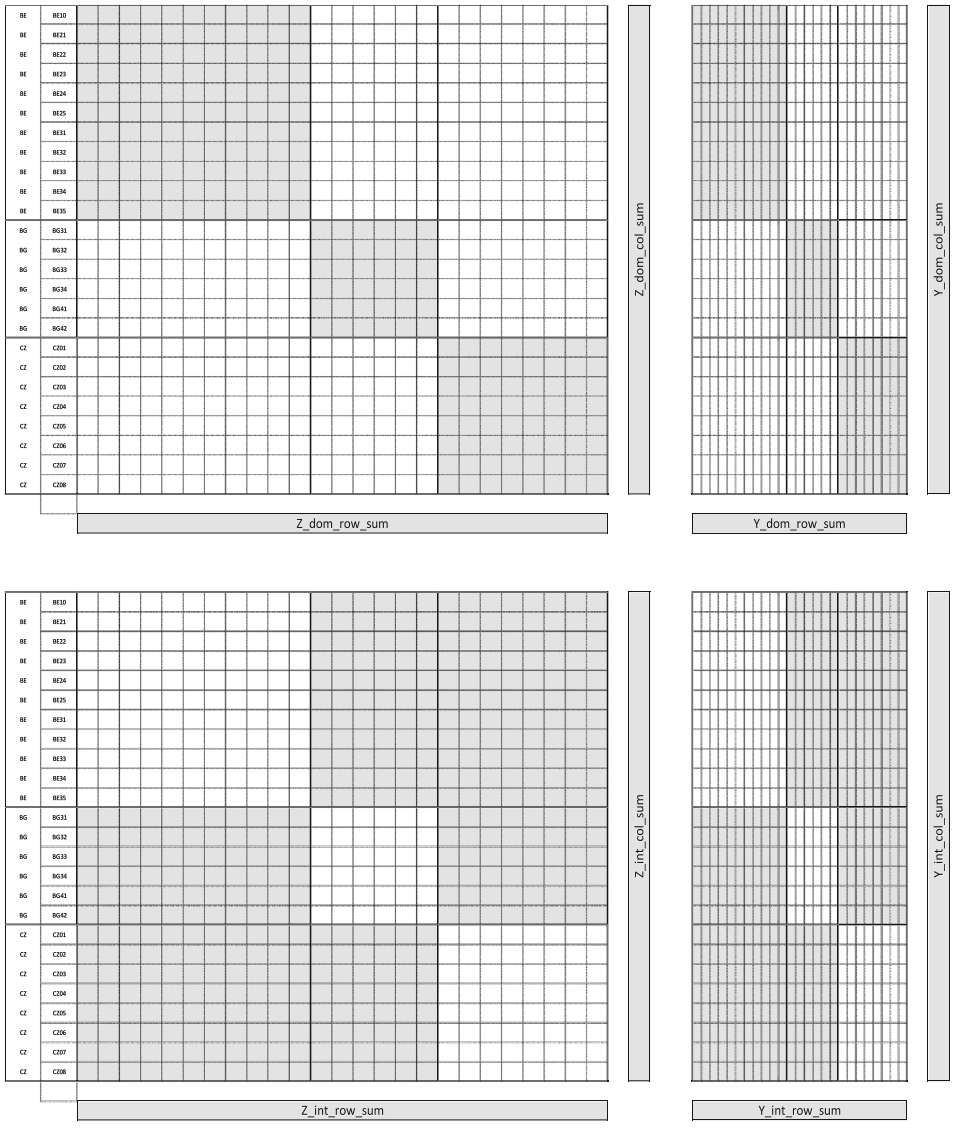

FIGURE 2 Scheme of vectors and matrices used to obtain the EUREGIO-2017 table. *Source*: Authors' own elaboration.

TABLE 1 Correlation between EUROIO-2013 and EUROIO-2017.

	Same region	Intranational trade	Exports
Goods	0.754	0.873	0.494
Services	0.672	0.778	0.511

Source: Authors' own calculation.

services. The weights of exports have the lowest correlation coefficients. Note that, as we mentioned in this section, international trade is constrained by the FIGARO figures. So this lower correlation could have been caused because FIGARO and EUREGIO-2013 applied different procedures to estimate the international trade flows. The comparison

of the distribution of the sales of goods and services is available upon request; the distribution of sales of goods and services is similar but not equal in both tables.

4 | IO MODELLING AND GVCS' PARTICIPATION

Let us start by describing the IO model. From the MRIO table (Section 3.1), note that intermediate inputs and final demand are equal to gross output (Equation 1). Then dividing each element of the intermediate inputs matrix (Z_{ij}^{rs}) by the gross output of the sector j of the region s (x_j^s), we obtain the so-called matrix of technical coefficient in matrixial form: $\mathbf{A} = \mathbf{Z}\hat{\mathbf{x}}^{-1}$. Each element of this matrix (A_{ij}^{rs}) informs us about the requirements that have the industry j of region s from the industry i of region r to produce an output of 1 monetary unit (€1 million, in our case). So Equation 1, where $\mathbf{e}$ is an all-ones vector of appropriate dimension, can be rewritten as Equation 2, which is also equivalent to Equation 3, where $(\mathbf{I}-\mathbf{A})^{-1} = \boldsymbol{L}$ is the well-known Leontief's inverse.

$$\mathbf{x} = \mathbf{Z}\mathbf{e} + \mathbf{y} \tag{1}$$

$$\mathbf{x} = \mathbf{A}\mathbf{x} + \mathbf{y} \tag{2}$$

$$\mathbf{x} = (\mathbf{I}-\mathbf{A})^{-1}\mathbf{y};\ \ \mathbf{x} = \mathbf{L}\mathbf{y} \tag{3}$$

The literature on participation in the GVCs includes algorithms that measure the backward linkages of one's production in the whole chain and also discusses whether such measures are only partial (De Backer & Miroundot, 2014; Koopman et al., 2010). There is also an increasing line of research related to the position of countries and regions in the downstream–upstream axis of production, suggesting that, since the upstream stages of production are associated with the most sophisticated and complex activities, regions should try to upgrade their position in such scale (Hagemejer & Ghodsi, 2017; Hummels et al., 2001; Kummritz et al., 2017).

In this work, we follow Bolea et al. (2022) who defined the participation of a region in GVCs as the portion of the total VA that is embodied–exported and modified the version of Los et al. (2015), where the participation of a region in GVCs is defined as the share of value added embodiment (VAE) in exports over the world total. The version of Bolea et al. (2022) takes into account the region's size (Duarte et al., 2022; Espinosa-Gracia et al., 2023), and we consider it more useful for our purpose.

To calculate GVCs' participation, the first step is to define **VAE** as the value-added embodiment matrix that is calculated as shown by Equation 4. Each component of the VAE matrix, $\mathbf{VAE}_{ij}^{rs}$, means the VA generated by sector i of region r that ends embodied in the final demand of sector j of region s. Note that hats (^) in Equation 4 depict diagonalised vectors and $\mathbf{v}$ is the vector of VA ($\sum_{cj} V_{cj}^s = v_j^s$ or in matrixial notation $\mathbf{v} = \mathbf{e}'\mathbf{V}$).

$$\mathbf{VAE} = \hat{\mathbf{v}}\hat{\mathbf{x}}^{-1}(\mathbf{I}-\mathbf{A})^{-1}\hat{\mathbf{y}} \tag{4}$$

Then, doing zeros in the diagonal matrices ($r = s$), the resulting matrix identifies the 'exported' VAE. Los et al. (2015) name this new matrix **FVAE**. Then, the **FVAE** matrix is used to calculate the portion of VAE exported by each region over the total VA generated in each region (aggregating matrices at the regional level). We also compute the portion of traded VA by groups of countries. In this way, the results show the participation in the GVCs identifying if the VA generated ends in a final product of a EU28 + EFTA country or not. By doing so, we distinguish between GVCs and the EU28 + EFTA value chain, in the same way as others have focused on the European, NAFTA or Asian GVCs (Los et al., 2015).

TABLE 2 Participation in GVCs at the country level.

Country	FIGARO (%)	EUREGIO-2017 (%)	Absolute difference (%)
Luxembourg	41.5	49.3	7.80
Saudi Arabia	37.1	14.6	22.50
Ireland	34.5	24.5	10.00
Malta	27.1	45.8	18.70
Norway	25.7	19.0	6.70
Estonia	25.5	27.8	2.30
Netherlands	24.4	23.3	1.10
Hungary	24.3	33.1	8.80
Czechia	23.8	28.7	4.90
Belgium	23.1	22.1	1.00
Slovenia	22.4	19.3	3.10
Cyprus	22.1	23.2	1.10
Lithuania	21.9	20.6	1.30
Slovakia	21.4	24.4	3.00
Latvia	21.3	17.0	4.30
Switzerland	21.3	23.4	2.10
Bulgaria	20.9	19.1	1.80
Austria	19.1	20.1	1.00
Denmark	18.3	19.8	1.50
Poland	18.1	18.1	0.00
Korea	17.7	22.4	4.70
Russian Federation	17.5	12.4	5.10
Germany	17.5	14.6	2.90
Finland	16.8	17.3	0.50
South Africa	16.6	16.4	0.20
Canada	15.6	12.2	3.40
Sweden	15.3	13.0	2.30
Romania	14.7	16.4	1.70
United Kingdom	14.0	10.7	3.30
Australia	13.9	9.7	4.20
Portugal	13.4	19.0	5.60
France	12.8	14.8	2.00
Indonesia	12.0	10.3	1.70
Mexico	11.7	12.9	1.20
Italy	11.7	13.5	1.80
Spain	11.5	11.9	0.40
Croatia	11.5	18.8	7.30
Turkey	10.6	10.5	0.10
Japan	8.6	8.4	0.20
Greece	8.5	13.0	4.50
India	8.3	12.0	3.70

TABLE 2 (Continued)

Country	FIGARO (%)	EUREGIO-2017 (%)	Absolute difference (%)
Brazil	8.2	7.8	0.40
China	7.9	11.6	3.70
Argentina	6.0	5.3	0.70
United States	5.7	6.4	0.70

Abbreviation: GVC, global value chains.
Source: Authors' own calculation.

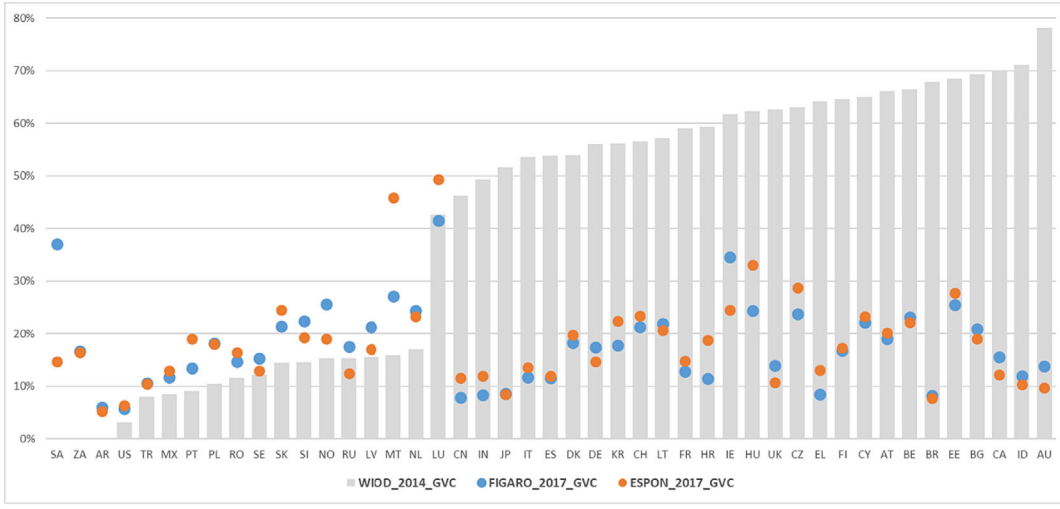

FIGURE 3 Country participation in global value chains (GVCs). World input–output database (WIOD) and FIGARO versus EUREGIO-2017. *Source*: Authors' own elaboration based on FIGARO and WIOD.

4.1 | Comparative analysis: The EUREGIO-2017 versus FIGARO, WIOD and EUREGIO-2013

The aim of this section is to analyse the participation in the GVC indicator obtained in the new EUREGIO-2017 table aggregated at the country level, so it can be confronted with an equivalent exercise using the FIGARO (2017) and the WIOD (2014). We also include a similar analysis comparing the results obtained at the regional level for the EUREGIO-2017 and the previous EUREGIO-2013 table.

In Table 2, we compare the GVCs' participation at the country level based on FIGARO versus EUREGIO-2017 tables. The table is ranked by FIGARO figures. As can be seen, except for Saudi Arabia, Malta and Ireland (in bold), the figures by country are similar, as it is shown by a correlation coefficient of 0.85, with absolute differences below 7%, which computes an average of 2.7%.

The percentage of the VAE exported can be seen, in a more visual way in Figure 3, which shows the participation in GVCs at the country level implicit in the FIGARO, EUREGIO-2017 and WIOD tables for the last year available, i.e., 2014; here, the data are raked by WIOD. The differences between EUREGIO-2017 and FIGARO-2017 tables are quite low, which can be interpreted as the regionalisation process did not induce significant bias in country-aggregated indicator. Nevertheless, comparison with WIOD results is less favourable, with a set of countries where

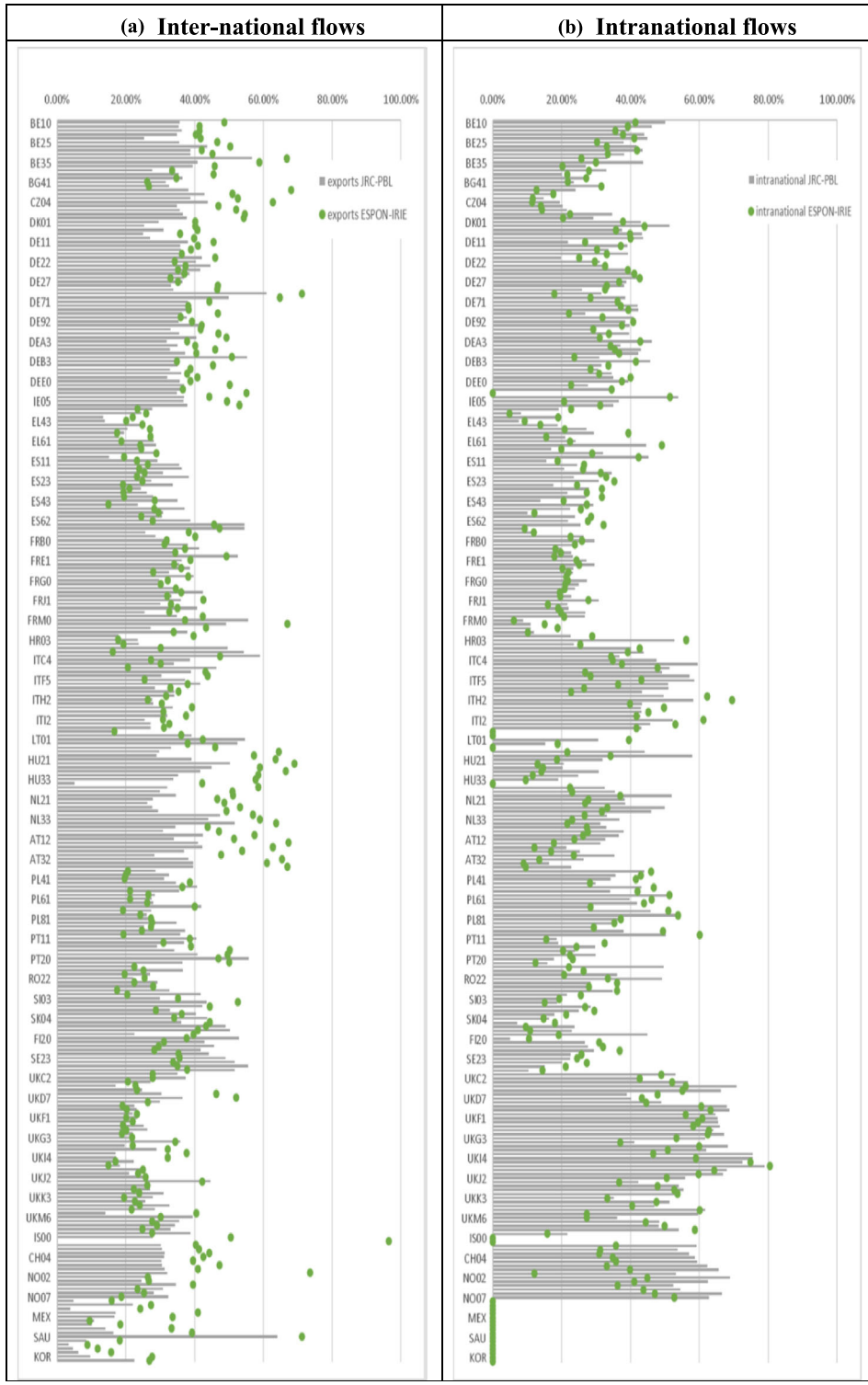

FIGURE 4 Regional differences between the EUREGIO-2013 versus EUREGIO-2017. *Source*: Authors' own elaboration.

the GVCs indicator is larger in FIGARO and EUREGIO-2017 tables, including some European economies, while the majority of EU28 + EFTA countries clearly show lower values in our tables compared to WIOD.

Complementarily, Figure 4 shows the regional shares of exports from each region to the rest of the world and to the rest of the regions in the same country, using the EUREGIO-2013 and EUREGIO-2017 tables. Values are quite similar for the intranational flows (Panel B), except for some Italian and Polish regions, as well as Finish and Swedish ones where exporting flows are larger in EUREGIO-2017 than in EUREGIO-2013. On the contrary, Norwegian and Swiss regions, joint with some Netherlands and Austrian ones, show lower international shares in our estimated table.

When we look at the international flows (Panel A), differences are clearly larger, and even when the general pattern is quite similar, some regions show high discrepancies. This is the case of some Swiss regions where export shares estimated in the EUREGIO-2017 table are more than double of the EUREGIO-2013 estimations. It is also interesting to note that figures for the Netherlands, Austria and Hungary are mostly larger in the EUREGIO-2017 table, while very few regions present lower shares than those of the EUREGIO-2013 table.

4.2 | Regional participation in GVCs: A focus on the EUREGIO-2017

In this section, we go deeper into the regional participation in the GVCs described before using the EUREGIO-2017-table. We now focus on the share of the total VA of each region and the sector that ends in the same region (domestic), the rest of the country (interregional) and the rest of the world (international).

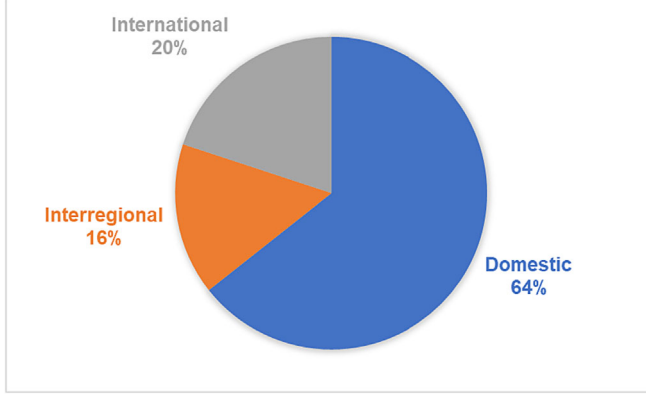

FIGURE 5 Average shares of value added. *Source*: Authors' own elaboration.

TABLE 3 Relative dispersion of VA shares by industries and regions: EUREGIO-2017.

	Domestic (%)	Interregional (%)	International (%)
By sectors	0.051	0.041	0.060
By regions	0.194	0.068	0.157

Note: Differences between second and third quartile.
Abbreviation: VA, value added.
Source: Authors' own elaboration.

TABLE 4 Ranking of the highest shares of interregional VAE: EUREGIO-2017.

Region	Region name	Sector	Sector name	VAE (%)
NO02	Innlandet	C19	Manufacture of coke and refined petroleum products	68.1
NO06	Trøndelag	C19	Manufacture of coke and refined petroleum products	65.6
NO03	Sør-Østlandet	C19	Manufacture of coke and refined petroleum products	64.7
NO07	Nord-Norge	C19	Manufacture of coke and refined petroleum products	60.5
PL92	Mazowiecki regionalny	N79	Travel agency, tour operator reservation service and related activities	56.8
UKI6	Outer London – South	D	Electricity, gas, steam and air conditioning supply	52.2
NO05	Vestlandet	C19	Manufacture of coke and refined petroleum products	51.9
HU12	Pest	K65	Insurance, reinsurance and pension funding, except compulsory social security	51.7
NO05	Vestlandet	C21	Manufacture of basic pharmaceutical products and pharmaceutical preparations	50.2
UKM9	Southern Scotland	D	Electricity, gas, steam and air conditioning supply	49.6
IE04	Northern and Western	S94	Activities of membership organisations	49.6
UKI6	Outer London – South	C10–12	Manufacture of food products; beverages and tobacco products	48.9
UKI5	Outer London – East and North East	D	Electricity, gas, steam and air conditioning supply	48.6
UKI5	Outer London – East and North East	C10–12	Manufacture of food products; beverages and tobacco products	48.5
UKE3	South Yorkshire	D	Electricity, gas, steam and air conditioning supply	48.0
PL92	Mazowiecki regionalny	M73	Advertising and market research	47.9
NO04	Agder og Rogaland	C19	Manufacture of coke and refined petroleum products	47.0
UKI5	Outer London – East and North East	A02	Forestry and logging	46.8
PL92	Mazowiecki regionalny	J59_60	Motion picture, video, television programme production; programming and broadcasting activities	46.7
IE04	Northern and Western	H50	Water transport	45.3
UKM9	Southern Scotland	C10–12	Manufacture of food products; beverages and tobacco products	45.2
UKI5	Outer London – East and North East	N79	Travel agency, tour operator reservation service and related activities	45.1
UKI5	Outer London – East and North East	H51	Air transport	44.4
FRY4	La Réunion	K65	Insurance, reinsurance and pension funding, except compulsory social security	44.4
UKI6	Outer London – South	F	Construction	44.3
NO02	Innlandet	C20	Manufacture of chemicals and chemical products	44.3
UKI6	Outer London – South	H51	Air transport	44.3
UKM9	Southern Scotland	K65	Insurance, reinsurance and pension funding, except compulsory social security	44.1
UKI4	Inner London – East	A02	Forestry and logging	44.0
UKI6	Outer London – South	N79	Travel agency, tour operator reservation service and related activities	44.0

Abbreviation: VAE, value-added embodiment.
Source: Authors' own elaboration.

TABLE 5 Ranking of the highest shares of international VAE: EUREGIO-2017.

Region	Region name	Sector	Sector name	VAE (%)
CZ07	Střední Morava	C19	Manufacture of coke and refined petroleum products	90.0
CY00	Κύπρος	H51	Air transport	88.1
LI00	Liechtenstein	C19	Manufacture of coke and refined petroleum products	88.1
CZ01	Praha	C19	Manufacture of coke and refined petroleum products	88.0
LT01	Sostinės regionas	C19	Manufacture of coke and refined petroleum products	86.9
CZ05	Severovýchod	C19	Manufacture of coke and refined petroleum products	86.9
LT02	Vidurio ir vakarų Lietuvos regionas	C19	Manufacture of coke and refined petroleum products	86.4
MT00	Malta	K64	Financial service activities, except insurance and pension funding	86.4
NL41	Noord-Brabant	C19	Manufacture of coke and refined petroleum products	86.2
UKI5	Outer London – East and North East	C19	Manufacture of coke and refined petroleum products	85.1
NL42	Limburg (NL)	C19	Manufacture of coke and refined petroleum products	84.9
NL32	Noord-Holland	C19	Manufacture of coke and refined petroleum products	84.7
LU00	Luxembourg	C24	Manufacture of basic metals	84.6
UKD6	Cheshire	C19	Manufacture of coke and refined petroleum products	84.4
ES22	Comunidad Foral de Navarra	C19	Manufacture of coke and refined petroleum products	84.4
UKG3	West Midlands	C19	Manufacture of coke and refined petroleum products	84.3
NL34	Zeeland	C19	Manufacture of coke and refined petroleum products	84.3
NL23	Flevoland	C19	Manufacture of coke and refined petroleum products	84.3
NL11	Groningen	C26	Manufacture of computer, electronic and optical products	84.2
UKC2	Northumberland and Tyne and Wear	C19	Manufacture of coke and refined petroleum products	84.0
CZ06	Jihovýchod	C19	Manufacture of coke and refined petroleum products	83.9
UKI7	Outer London – West and North West	C19	Manufacture of coke and refined petroleum products	83.8
NL34	Zeeland	C26	Manufacture of computer, electronic and optical products	83.6
NL12	Friesland (NL)	C26	Manufacture of computer, electronic and optical products	83.6
UKI6	Outer London – South	C19	Manufacture of coke and refined petroleum products	83.5
NL23	Flevoland	C26	Manufacture of computer, electronic and optical products	83.4
NL13	Drenthe	C26	Manufacture of computer, electronic and optical products	83.4
NL42	Limburg (NL)	C26	Manufacture of computer, electronic and optical products	83.3
AT31	Oberösterreich	C19	Manufacture of coke and refined petroleum products	83.3
FI19	Länsi-Suomi	C19	Manufacture of coke and refined petroleum products	83.2

Abbreviation: VAE, value-added embodiment.
Source: Authors' own elaboration.

As it is shown in Figure 5, averaging across all 63 sectors (sector number 64 is excluded from this analysis: U-activities of extraterritorial organisations and bodies) and the 297 regions, 65% of VA ends in the own region, 20% is internationally exported (to other EU27–EFTA countries and no EU27–EFTA countries) and the remaining 16% of VA generated in each region ends in other regions in the same country.

Although these numbers serve as the first approximation, this average is not too illustrative given the large standard deviation observed in the shares within each of these categories, which accounts for 16% for the domestic values, 7.6% for the interregionals and 14.1% for the internationals. More interestingly, Table 3 shows the relative dispersions of the values by sectors and regions, revealing that they are higher among regions than among sectors for the three shares computed. Note that this not-evident result can be interpreted in terms of the relative dependence of each region to external shocks, which is directly linked to their own sectoral structure (regional product mix).

Focusing on the VAE exported to the rest of the regions and to the rest of the world, Tables 4 and 5 report the pairs of regions and sectors with the highest values. For the interregional shares, Table 4 identifies the following top-ranked activities: 'Refinery products' in four Norwegian regions (Innlandet, Trøndelag, Sør-Østlandet, Nord-Norge) accounts for the largest shares, while in the UK, 'Electricity production' along with 'Food and beverages industries' in several regions (Outer London – South, Southern Scotland, Outer London – South, Outer London – East and North East, Outer London – East and North East, South Yorkshire) also appears among the top position. 'Travel agencies' in Mazowiecki region (Poland) and in Outer London – East and North and Outer London – South, together

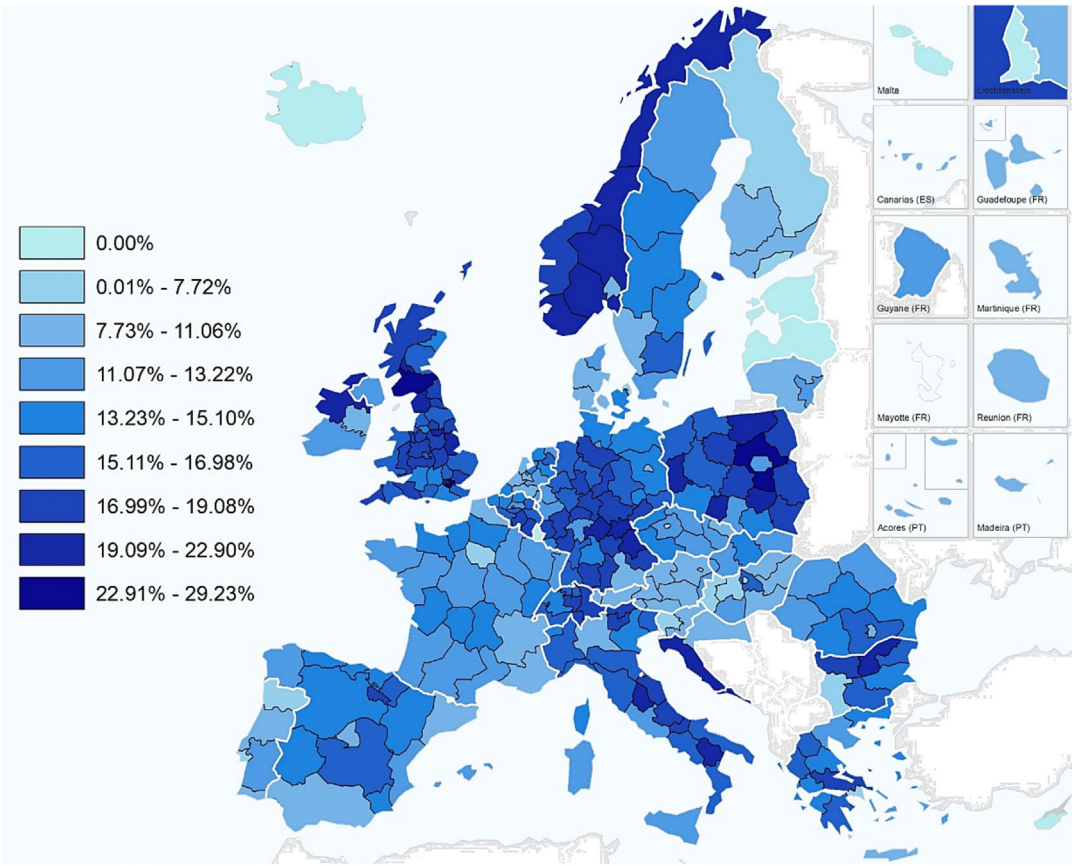

FIGURE 6 Share of regional value-added (VA) interregional exported. EUREGIO-2017. *Source*: Authors' own elaboration.

with 'Insurance services' in Pest (Hungary), La Réunion (France) and Southern Scotland (UK), also presents high shares on interregional VAE.

Regarding the international VAE, Table 4 shows how the 'Manufactures of coke and refined petroleum products' clearly dominates the top positions, with 21 regions out of the 30 largest values, followed by 'Computer, electronic and optic manufactures' in the Netherlands regions of Groningen, Zeeland, Friesland (NL), Flevoland, Drenthe and Limburg. Combining export shares with sectoral participation in each region, we can compute the percentage of regional VA that ends in interregional and international trade, as shown in Figures 6 and 7.

For the interregional exported VAE, the largest values do not account for more than 30% of regional VA, and they are located in the UK (Southern Scotland, Outer London – South, Outer London – East and North East, Inner London – East, South Yorkshire, Outer London – West and North West, West Central Scotland, Lincolnshire), Poland (Mazowiecki regionalny, Warmińsko-mazurskie, Lubuskie, Świętokrzyskie, Opolskie) and Norway (Sør-Østlandet, Innlandet, Trøndelag, Nord-Norge). Other important values are found in the Dutch region of Oberfranken, the Italian region of Basilicata and the northern and western Iris regions.

Regarding the international exported VAE, the largest values are obtained in Czechia (Moravskoslezsko, Střední Morava, Střední Čechy, Severovýchod, Severozápad, Jihozápad), Hungary (Közép-Dunántúl, Nyugat-Dunántúl, Észak-Magyarország, Pest, Észak-Alföld, Dél-Alföld) and, to a lesser extent, in the Netherlands (Zeeland, Limburg, Noord-Brabant), while the larger values are found in Liechtenstein (52.1%), Luxembourg (49.3%) and Malta (45.8%).

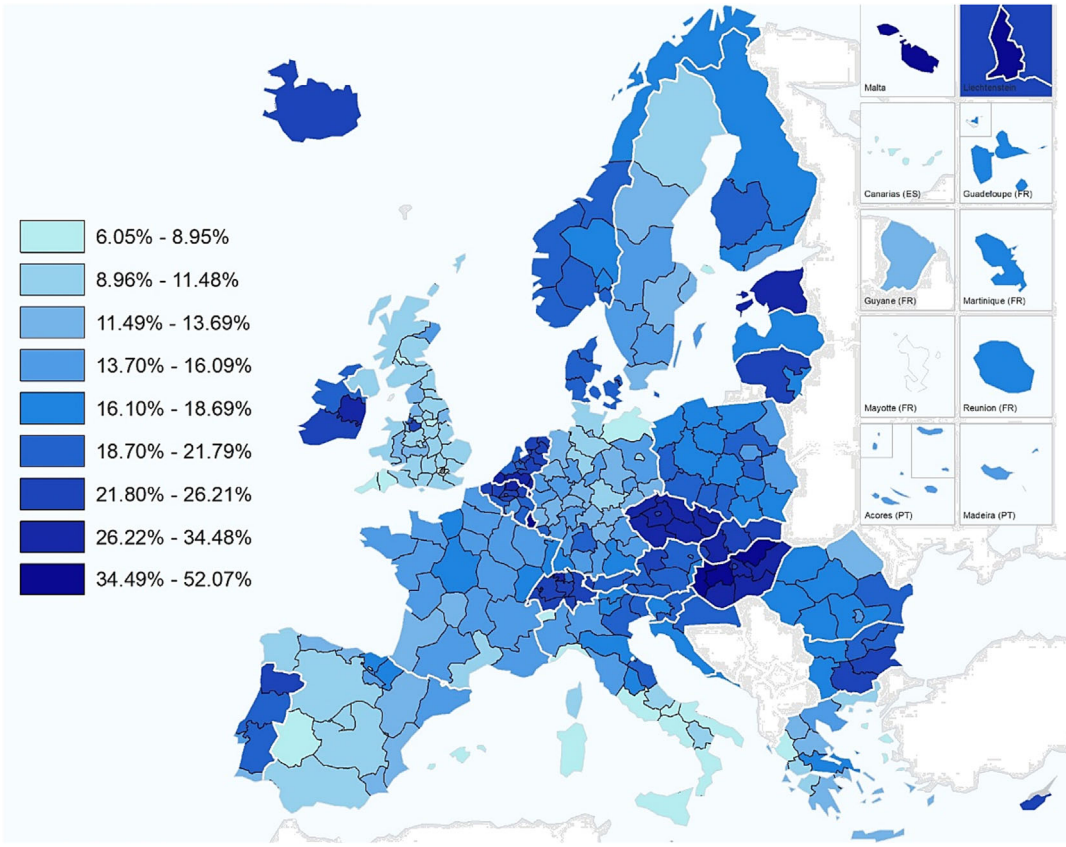

FIGURE 7 Share of regional value added (VA) international exported. EUREGIO-2017. *Source*: Authors' own elaboration.

On the contrary, among the 20th less-exposed regions, we found eight Italian regions, five UK regions, four Spanish, two Greek and one Finnish.

We will finish this section by presenting two additional maps where participation in GVCs is depicted. There, we show the percentage of the total VA generated by each region that is exported to the other regions (within its own country or to other EU27 + UK + EFTA regions) or countries. This is what we labelled before as the *participation in GVCs*, using the concept of VAE. Figure 8 shows the share of VA of each region that is exported to a different country; this is the standard way of accounting for the participation in the GVCs. However, focusing on the EU27 + UK + EFTA countries, we have accounted for a complementary measure capturing the regional participation in value chains mainly located in the EU27 + UK + EFTA space, what we label EU27 + UK + EFTA value chains. As can be seen in Figure 9, there are a few differences between this figure and Figure 8, suggesting that the VAE exported to the EU27 + UK + EFTA countries follows a similar pattern to the VAE exported in general, in line with previous studies (Los et al., 2015) that suggest that most of the GVCs are regional value chains (RVCs), using the capital R for region, to denote supranational groups of countries such as Europe, North America and South-East Asia. Having said that, some regions have a darker colour in Figure 8 than in Figure 9, suggesting that in these cases, the intersectoral linkages with non-European countries (United States, BRICs, etc.) are largely concentrated in some regions, while, in general, the rest mainly engage with other European regions.

To conclude, Figure 10a) shows the regional participation in value chains mainly concentrated in the EU27, without considering the UK and the UK + EFTA countries. Finally, in Figure 10b,) we focus on the regional participation of the value chains where the EU27 and the UK are involved. Logically, this map is a good starting point for the

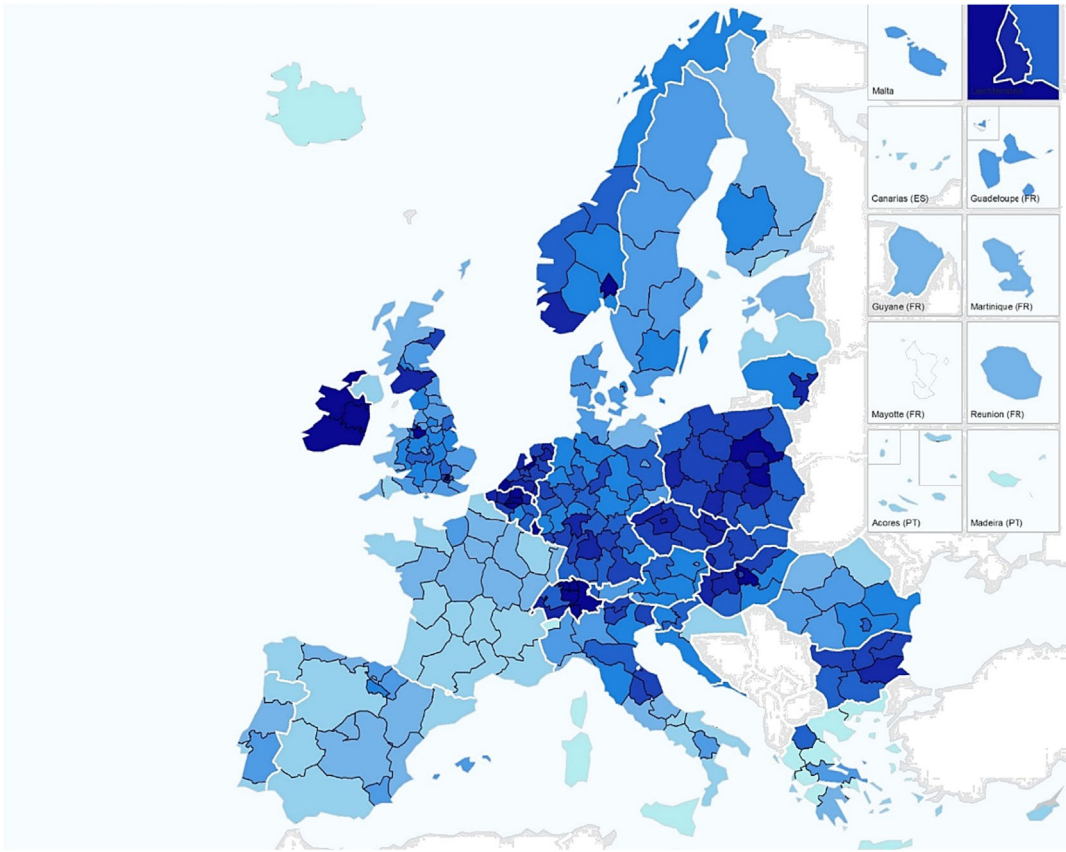

FIGURE 8 Participation in the global value chains. EUREGIO-2017. *Source*: Authors' own elaboration.

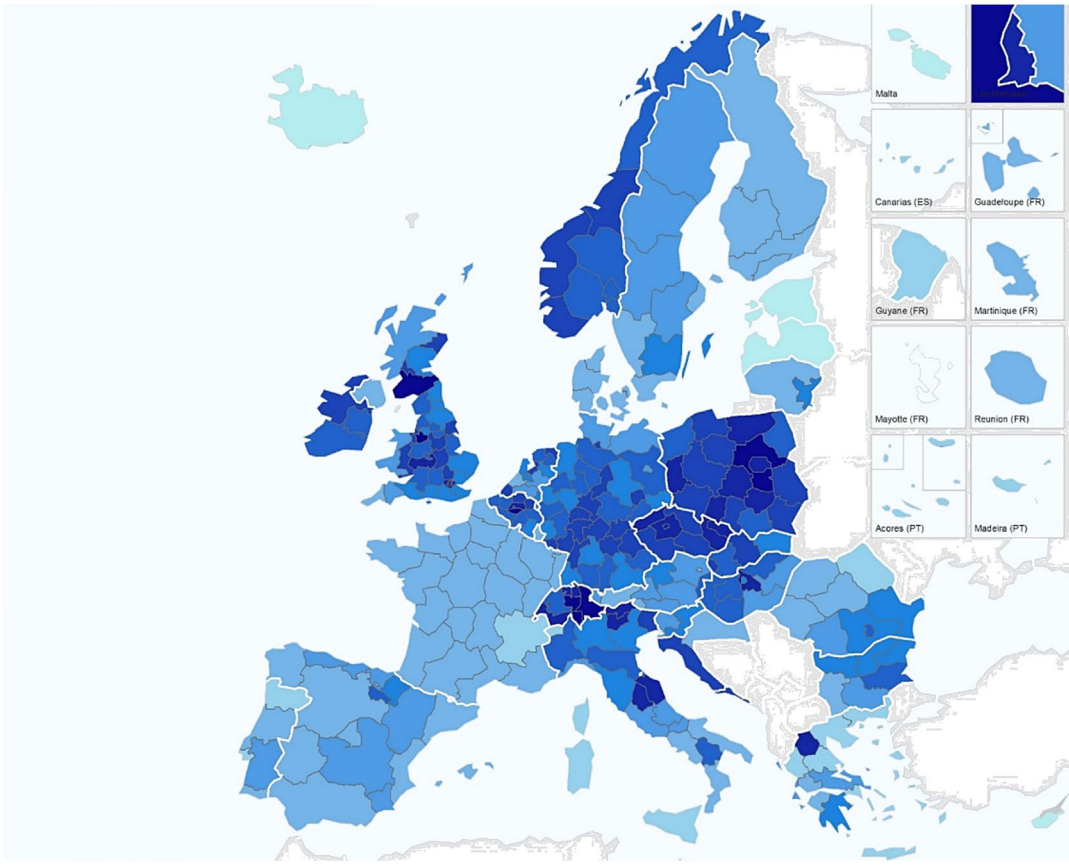

FIGURE 9 Participation in the EU27 + UK + EFTA countries' value chains. EUREGIO-2017. *Source*: Authors' own elaboration.

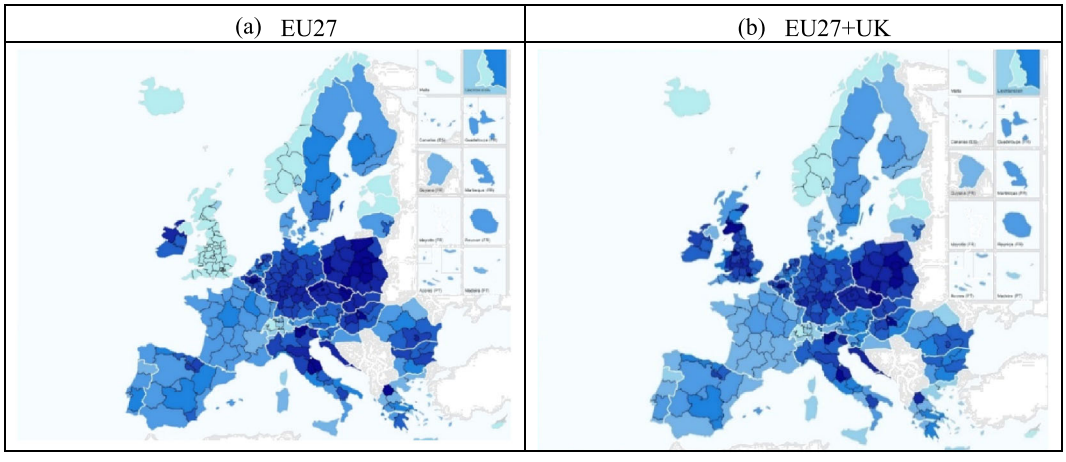

FIGURE 10 Participation in (a) EU27 versus (b) EU27 + UK value chain. EUREGIO-2017. *Source*: Authors' own elaboration.

discussion of the EU regions that are more exposed to any shock coming from the UK, starting with all the trade creation and deviation effects that BREXIT might introduce in the following years.

5 | CONCLUSIONS

This paper aims for two different goals: first, to revise the current series of the MRIO tables available in Europe to contextualise the methodology of updating and extending the new EUREGIO-2017 framework; and second, to analyse this new framework to characterise the European regions in terms of their participation in the GVCs.

The EUREGIO-2013, in combination with the FIGARO-2017 table and the figures available in the EUROSTAT at the NUTS-2 Level, served as the point of departure for this contribution. The resulting dataset (EUREGIO-2017) consists of 297 NUTS-2 regions (Rev.2016) covering all the EU27 countries and the UK, Norway, Iceland, Switzerland and Liechtenstein.

This work describes each step in the methodological process and compares the results obtained with the ones of the main benchmarks. Our results serve to refresh the knowledge about the intersectoral relations at the country level, identifying strong relations within Europe and with the rest of the world. Moreover, the analysis developed on the regional participation in the GVCs suggests that, on average, 65% of VA generated in each European region ends in its own region, 16% ends in the same country and the remaining 20% ends in other countries. There is heterogeneity within these figures, which is clearly higher when it is computed across regions than when it is computed across sectors, suggesting that the relative openness of each region is mainly explained through their sectoral structure.

This MRIO table supports the regional economic analysis by allowing the sectoral interdependencies between these regions to be observed, allowing, as has been demonstrated, the analysis of GVCs at the regional level. To the best of our knowledge, this table is the most updated table at the NUTS-2 level, despite referring to the year 2017, making it the best option for policy planning, allowing governments and policymakers to evaluate the economic impacts of various policies. In fact, this work opens new avenues for further applications in IO analysis, CGE modelling (Lecca et al., 2018; Thissen et al., 2014) and related approaches (Barbero et al., 2021). In addition, EUREGIO-2017, based on an environmental expansion, will allow the environmental impact assessment, helping to estimate and manage environmental footprints at the regional level.

The methodology used to construct the EUREGIO-2017 table is replicable. Therefore, this work lays the basis for the future development of a series of regional tables 2010–2020, based on the FIGARO tables currently published by EUROSTAT. In addition, we are working on the construction of compatible satellite accounts for employment and CO_2 emissions, which will be published in future works.

ACKNOWLEDGEMENTS

This article has been developed in the context of the ESPON IRIE Project: https://www.espon.eu/interregional-relations-europe-new-project-espon, developed by a big consortium during 2020–2022. We want to acknowledge the collaboration received from the EC–JRC and particularly from Andrea Comte and Jose Manuel Rueda-Cantuche, for their collaboration and insights. We also want to thank all comments received from all our colleagues from the IRIE project, the project officer in ESPON EGTC; Nicolas Rosignol from ESPON; and Xabier Velasco, the manager of the project at NASUVINSA. This paper was also developed in the context of another research project: the H2019/HUM-5761 INNOJOBMAD-CM Programme from the Autonomous Community of Madrid. Miguel Ángel Almazán-Gómez also wants to thank the Ministry of Science and Innovation of the Spanish government (PID 2019-106822RB-I00) and the Department of Science, University and Knowledge Society of the Government of Aragon (S40_23R).

ORCID

Miguel Ángel Almazán-Gómez https://orcid.org/0000-0003-4537-9619
Carlos Llano https://orcid.org/0000-0003-4854-6005

REFERENCES

Antràs, P., & Chor, D. (2018). *On the measurement of upstreamness and downstreamness in global value chains*. NBER WORKING PAPER SERIES Working Paper 24185. https://doi.org/10.3386/w24185, http://www.nber.org/papers/w24185

Antràs, P., & Gortari, A. (2020). On the geography of global value chains. *Econometrica*, *88*, 1553–1598. https://doi.org/10.3982/ECTA15362

Arto, I., Dietzenbacher, E., & Rueda-Cantuche, J.M. (2019). *Measuring bilateral trade in terms of value added, JRC working papers*. Publication Office of the European Union. https://doi.org/10.2760/639612

Arto, I., Rueda-Cantuche, J. M., Andreoni, V., Mongelli, I., & Genty, A. (2014). The game of trading jobs for emissions. *Energy Policy*, *66*, 517–525. https://doi.org/10.1016/j.enpol.2013.11.046

Barbero, J., Mandras, G., Rodríguez-Crespo, E., & Rodríguez-Pose, A. (2021). Quality of government and regional trade: Evidence from European Union regions. *Regional Studies*, *55*, 1240–1251. https://doi.org/10.1080/00343404.2021.1873934

Bolea, L., Duarte, R., Hewings, G. J. D., Jiménez, S., & Sánchez-Chóliz, J. (2022). The role of regions in global value chains: An analysis for the European Union. *Papers in Regional Science*, *101*, 771–794. https://doi.org/10.1111/pirs.12674

Chen, W., Los, B., McCann, P., Ortega-Argilés, R., Thissen, M., & van Oort, F. (2018). The continental divide? Economic exposure to Brexit in regions and countries on both sides of The Channel. *Papers in Regional Science*, *97*, 25–54. https://doi.org/10.1111/pirs.12334

De Backer, K., & Miroundot, S. (2014). Mapping global value chains. Paris. https://doi.org/10.18356/8ad97673-en

Dietzenbacher, E., Los, B., Stehrer, R., Timmer, M. P., & de Vries, G. (2013). The construction of world input–output tables in the WIOD project. *Economic Systems Research*, *25*, 71–98. https://doi.org/10.1080/09535314.2012.761180

Duarte, R., Espinosa-Gracia, A., Jiménez, S., & Sánchez-Chóliz, J. (2022). New insights on the relationship between the involvement of countries in global value chains, and intra- and inter-country inequalities. *Structural Change and Economic Dynamics*, *63*, 320–329. https://doi.org/10.1016/j.strueco.2022.11.001

Espinosa-Gracia, A., Almazán-Gómez, M. A., & Jiménez, S. (2023). CO_2 emissions and global value chains indicators:new evidence for 1995–2018. *Journal of Environmental Management*, *343*, 118239. https://doi.org/10.1016/j.jenvman.2023.118239

Eurostat. (2013). European system of accounts 2010, Luxembourg. Luxemburg: Publications Office of the European Union. https://doi.org/10.2785/16644

Gereffi, G. (1999). International trade and industrial upgrading in the apparel commodity chain. *Journal of International Economics*, *48*, 37–70. https://doi.org/10.1016/S0022-1996(98)00075-0

Hagemejer, J., & Ghodsi, M. (2017). Up or down the value chain? A comparative analysis of the GVC position of the economies of the new EU member states. *Central European Economic Journal*, *1*, 19–36. https://doi.org/10.1515/ceej-2017-0003

Huang, S., & Koutroumpis, P. (2023). European multi regional input output data for 2008–2018. *Sci Data*, *10*, 218. https://doi.org/10.1038/s41597-023-02117-y

Hummels, D., Ishii, J., & Yi, K.-M. (2001). The nature and growth of vertical specialization in world trade. *Journal of International Economics*, *54*, 75–96. https://doi.org/10.1016/S0022-1996(00)00093-3

Johnson, R. C., & Noguera, G. (2012). Accounting for intermediates: Production sharing and trade in value added. *Journal of International Economics*, *86*, 224–236. https://doi.org/10.1016/j.jinteco.2011.10.003

Junius, T., & Oosterhaven, J. (2003). The Solution of Updating or Regionalizing a Matrix with both Positive and Negative Entries. *Economic Systems Research*, *15*, 87–96. https://doi.org/10.1080/0953531032000056954

Koopman, R., Powers, W., Wang, Z., & Wei, S.-J. (2010). *Give credit where credit is due: Tracing value added in global production chains*. NBER WORKING PAPER SERIES Working Paper 16426. https://doi.org/10.3386/w16426, http://www.nber.org/papers/w16426

Kummritz, V., Taglioni, D., & Winkler, D.E. (2017) Economic upgrading through global value chain participation: Which policies increase the value added gains? (No. 8007), World Bank Policy Research Working Paper. Washington. https://doi.org/10.1596/1813-9450-8007

Lecca, P., Barbero, J., Christensen, M., Conte, A., Di Comite, F., Díaz Lanchas, J., Diukanova, O., Mandras, G., Persyn, D., & Sakkas, S. (2018). *RHOMOLO V3: A spatial modelling framework*. Publications Office of the European Union. https://doi.org/10.2760/671622

Lenzen, M., Moran, D., Kanemoto, K., & Geschke, A. (2013). Building EORA: A global multi-region input–output database at high country and sector resolution. *Economic Systems Research*, *25*, 20–49. https://doi.org/10.1080/09535314.2013.769938

Lenzen, M., Wood, R., & Gallego, B. (2007). Some Comments on the GRAS Method. *Economic Systems Research*, *19*, 461–465. https://doi.org/10.1080/09535310701698613

Los, B., Timmer, M. P., & de Vries, G. J. (2015). How global are global value chains? A new approach to measure international fragmentation. *Journal of Regional Science*, *55*, 66–92. https://doi.org/10.1111/jors.12121

Merciai, S., & Schmidt, J. (2018). Methodology for the construction of global multi-regional hybrid supply and use tables for the EXIOBASE v3 database. *Journal of Industrial Ecology*, *22*, 516–531. https://doi.org/10.1111/jiec.12713

OECD (Organisation for Economic Co-operation and Development). (2018). OECD input-output tables (IOTs). 2018 ed. [WWW Document]. http://oe.cd/icio

Remond-Tiendrez, I., Rueda-Cantuche, J. M. (2019). EU inter-country supply, use and input-output tables—Full international and global accounts for research in input-output analysis (FIGARO), statistical working papers (EUROSTAT). Luxembourg.

Stadler, K., Wood, R., Bulavskaya, T., Södersten, C.-J., Simas, M., Schmidt, S., Usubiaga, A., Acosta-Fernández, J., Kuenen, J., Bruckner, M., Giljum, S., Lutter, S., Merciai, S., Schmidt, J. H., Theurl, M. C., Plutzar, C., Kastner, T., Eisenmenger, N., Erb, K.-H., … Tukker, A. (2018). EXIOBASE 3: Developing a time series of detailed environmentally extended multi-regional input-output tables. *Journal of Industrial Ecology*, *22*, 502–515. https://doi.org/10.1111/jiec.12715

Stone, R., & Brown, A. (1962). A computable model of economic growth. In *A programme for growth*. Chapman and Hall.

Thissen, M., Di Comite, F., Kancs, D., Potters, L. (2014). Modelling inter-regional trade flows data and methodological issues in RHOMOLO, regional policy EU working papers. Bruselles. https://doi.org/10.2776/871154

Thissen, M., Diodato, D., & van Oort, F. (2013). *Integrated regional Europe: European regional trade flows in 2000*. PBL Netherlands Assessment Agency. https://doi.org/10.4337/9781782545163.00013

Thissen, M., Ivanova, O., Mandras, G., & Husby, T. (2019). European NUTS 2 regions: Construction of interregional trade-linked supply and use tables with consistent transport flows (no. JRC115439). Seville.

Thissen, M., Lankhuizen, M., & Jonkeren, O. (2015). *Multi-regional trade data for Europe in 2010*. PBL Netherlands Environmental Assessment Agency.

Thissen, M., Lankhuizen, M., van Oort, F., Los, B., & Diodato, D. (2018). EUREGIO: The construction of a global IO database with regional detail for Europe for 2000–2010. Tinbergen Institute Discussion Paper 2018-084/VI. https://doi.org/10.2139/ssrn.3285818, https://ssrn.com/abstract=3285818

Thissen, M., van Oort, F., Diodato, D., & Ruijs, A. (2013). *European regional competitiveness and smart specialization; place-based development in international economic networks*. Edward Elgar Publishing. https://doi.org/10.4337/9781782545163

Timmer, M. P., Dietzenbacher, E., Los, B., Stehrer, R., & 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. https://doi.org/10.1111/roie.12178

Timmer, M. P., Los, B., Stehrer, R., & de Vries, G. J. (2013). Fragmentation, incomes and jobs: An analysis of European competitiveness. *Economic Policy*, *28*, 613–661. https://doi.org/10.1111/1468-0327.12018

Timmer, M.P., Los, B., Stehrer, R., De Vries, G.J., de Vries, G.J., 2016. An anatomy of the global trade slowdown based on the WIOD 2016 release, GGDC research memorandum. Groningen.

Tukker, A., & Dietzenbacher, E. (2013). Global multiregional input–output frameworks: An introduction and outlook. *Economic Systems Research*, *25*, 1–19. https://doi.org/10.1080/09535314.2012.761179

Wood, R., Stadler, K., Bulavskaya, T., Lutter, S., Giljum, S., de Koning, A., Kuenen, J., Schütz, H., Acosta-Fernández, J., Usubiaga, A., Simas, M., Ivanova, O., Weinzettel, J., Schmidt, J., Merciai, S., & Tukker, A. (2014). Global sustainability accounting—Developing EXIOBASE for multi-regional footprint analysis. *Sustainability*, *7*, 138–163. https://doi.org/10.3390/su7010138

Xu, Y., & Dietzenbacher, E. (2014). A structural decomposition analysis of the emissions embodied in trade. *Ecological Economics*, *101*, 10–20. https://doi.org/10.1016/j.ecolecon.2014.02.015

SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

How to cite this article: Almazán-Gómez, M. Á., Llano, C., Pérez, J., & Mandras, G. (2023). The European regions in the global value chains: New results with new data. *Papers in Regional Science*, *102*(6), 1097–1126. https://doi.org/10.1111/pirs.12760

APPENDIX A.

TABLE A.1 Sectoral classification of the regional accounts data at NUTS-2 level.

Code	Nace Rev.2
A	Agriculture, forestry and fishing
B_E	Industry (except construction)
C	Manufacturing
F	Construction
G_J	Wholesale and retail trade, transport, accommodation and food service activities, and information and communication
G_I	Wholesale and retail trade, transport, accommodation and food service activities
J	Information and communication
K_N	Financial and insurance activities; real estate activities; professional, scientific and technical activities; administrative and support service activities
K	Financial and insurance activities
L	Real estate activities
M_N	Professional, scientific and technical activities; and administrative and support service activities
O_U	Public administration and defence, compulsory social security, education, human health and social work activities, and arts and entertainment activities
O_Q	Public administration, defence, education, human health and social work activities
R_U	Arts, entertainment and recreation; other service activities; and activities of household and extraterritorial organisations and bodies

Source: EUROSTAT.

TABLE A.2 Countries and sectors included in FIGARO IO table.

BE	Belgium	S_64	CH	Switzerland	S_30
BG	Bulgaria	S_64	NO	Norway	S_30
CZ	Czechia	S_64	RU	Russian Federation	S_30
DK	Denmark	S_64	TR	Turkey	S_30
DE	Germany	S_64	CA	Canada	S_30
EE	Estonia	S_64	MX	Mexico	S_30
IE	Ireland	S_64	AR	Argentina	S_30
EL	Greece	S_64	BR	Brazil	S_30
ES	Spain	S_64	ZA	South Africa	S_30
FR	France	S_64	AU	Australia	S_30
HR	Croatia	S_64	SA	Saudi Arabia	S_30
IT	Italy	S_64	ID	Indonesia	S_30
CY	Cyprus	S_64	CN	China	S_30
LV	Latvia	S_64	IN	India	S_30
LT	Lithuania	S_64	JP	Japan	S_30
LU	Luxembourg	S_64	KR	Korea (Republic of)	S_30
HU	Hungary	S_64	WRL_REST	Rest of the World	S_30
MT	Malta	S_64			
NL	Netherlands	S_64			
AT	Austria	S_64			
PL	Poland	S_64			
PT	Portugal	S_64			
RO	Romania	S_64			
SI	Slovenia	S_64			
SK	Slovakia	S_64			
FI	Finland	S_64			
SE	Sweden	S_64			
UK	United Kingdom	S_64			
US	United States of America	S_64			

Source: FIGARO project.

TABLE A.3 Sectors in FIGARO tables.

S_30	S_64	Description
A	A01	Crop and animal production, hunting and related service activities
	A02	Forestry and logging
	A03	Fishing and aquaculture
B	B	Mining and quarrying
C10–12	C10–12	Manufacture of food products, beverages and tobacco products
C13–15	C13–15	Manufacture of textiles, wearing apparel, leather and related products
C16–18	C16	Manufacture of wood and products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials
	C17	Manufacture of paper and paper products
	C18	Printing and reproduction of recorded media
C19	C19	Manufacture of coke and refined petroleum products
C20_21	C20	Manufacture of chemicals and chemical products
	C21	Manufacture of basic pharmaceutical products and pharmaceutical preparations
C22_23	C22	Manufacture of rubber and plastic products
	C23	Manufacture of other nonmetallic mineral products
C24_25	C24	Manufacture of basic metals
	C25	Manufacture of fabricated metal products, except machinery and equipment
C26	C26	Manufacture of computer, electronic and optical products
C27	C27	Manufacture of electrical equipment
C28	C28	Manufacture of machinery and equipment n.e.c.
C29_30	C29	Manufacture of motor vehicles, trailers and semitrailers
	C30	Manufacture of other transport equipment
C31–33	C31_32	Manufacture of furniture; other manufacturing
	C33	Repair and installation of machinery and equipment
D_E	D	Electricity, gas, steam and air conditioning supply
	E36	Water collection, treatment and supply
	E37–39	Sewerage, waste management, remediation activities
F	F	Construction
G	G45	Wholesale and retail trade and repair of motor vehicles and motorcycles
	G46	Wholesale trade, except for motor vehicles and motorcycles
	G47	Retail trade, except for motor vehicles and motorcycles
H	H49	Land transport and transport via pipelines
	H50	Water transport
	H51	Air transport
	H52	Warehousing and support activities for transportation
	H53	Postal and courier activities
I	I	Accommodation and food service activities
J58–60	J58	Publishing activities
	J59_60	Motion picture, video and television programme production; programming and broadcasting activities
J61	J61	Telecommunications

(Continues)

TABLE A.3 (Continued)

S_30	S_64	Description
J62_63	J62_63	Computer programming, consultancy and information service activities
K	K64	Financial service activities, except insurance and pension funding
	K65	Insurance, reinsurance and pension funding, except compulsory social security
	K66	Activities auxiliary to financial services and insurance activities
L68	L68	Real estate activities
M_N	M69_70	Legal and accounting activities; activities of head offices; management consultancy activities
	M71	Architectural and engineering activities; technical testing and analysis
	M72	Scientific research and development
	M73	Advertising and market research
	M74_75	Other professional, scientific and technical activities; veterinary activities
	N77	Rental and leasing activities
	N78	Employment activities
	N79	Travel agency, tour operator reservation service and related activities
	N80–82	Security and investigation, service and landscape and office administrative and support activities
O84	O84	Public administration and defence and compulsory social security
P85	P85	Education
Q	Q86	Human health activities
	Q87_88	Residential care activities and social work activities without accommodation
R_S	R90–92	Creative, arts and entertainment activities; libraries, archives, museums and other cultural activities; gambling and betting activities
	R93	Sports activities and amusement and recreation activities
	S94	Activities of membership organisations
	S95	Repair of computers and personal and household goods
	S96	Other personal service activities
T_U	T	Activities of households as employers and undifferentiated goods- and services-producing activities of households for own use
	U	Activities of extraterritorial organisations and bodies

Source: FIGARO project.

TABLE A.4 Mapping between regions in EUROIO2013 and NUTS-2 rev2016.

rev16	rev10	rev16	rev10	rev16	rev10	rev16	rev10	rev16	rev10	rev16	rev10
AT11	AT11	DE92	DE92	ES70	ES70	ITG1	ITG1	RO22	RO22	UKM6	UKM6
AT12	AT12	DE93	DE93	FI19	FI19	ITG2	ITG2	RO31	RO31	UKM7	UKM2
AT13	AT13	DE94	DE94	FI1B	FI1B	ITH1	ITH1	RO32	RO32	UKM8	UKM3
AT21	AT21	DEA1	DEA1	FI1C	FI1C	ITH2	ITH2	RO41	RO41	UKM9	UKM3
AT22	AT22	DEA2	DEA2	FI1D	FI1D	ITH3	ITH3	RO42	RO42	UKN0	UKN0
AT31	AT31	DEA3	DEA3	FI20	FI20	ITH4	ITH4	SE11	SE11	IS00	ISL
AT32	AT32	DEA4	DEA4	FR10	FR10	ITH5	ITH5	SE12	SE12	NO01	NOR
AT33	AT33	DEA5	DEA5	FRB0	FR24	ITI1	ITI1	SE21	SE21	NO02	NOR
AT34	AT34	DEB1	DEB1	FRC1	FR26	ITI2	ITI2	SE22	SE22	NO03	NOR
BE10	BE10	DEB2	DEB2	FRC2	FR43	ITI3	ITI3	SE23	SE23	NO04	NOR
BE21	BE21	DEB3	DEB3	FRD1	FR25	ITI4	ITI4	SE31	SE31	NO05	NOR
BE22	BE22	DEC0	DEC0	FRD2	FR23	LT01	LTU	SE32	SE32	NO06	NOR
BE23	BE23	DED2	DED2	FRE1	FR30	LT02	LTU	SE33	SE33	NO07	NOR
BE24	BE24	DED4	DED4	FRE2	FR22	LU00	LUX	SI03	SI01	CH01	CHE
BE25	BE25	DED5	DED5	FRF1	FR42	LV00	LVA	SI04	SI02	CH02	CHE
BE31	BE31	DEE0	DEE0	FRF2	FR21	MT00	MLT	SK01	SK01	CH03	CHE
BE32	BE32	DEF0	DEF0	FRF3	FR41	NL11	NL11	SK02	SK02	CH04	CHE
BE33	BE33	DEG0	DEG0	FRG0	FR51	NL12	NL12	SK03	SK03	CH05	CHE
BE34	BE34	DK01	DK01	FRH0	FR52	NL13	NL13	SK04	SK04	CH06	CHE
BE35	BE35	DK02	DK02	FRI1	FR61	NL21	NL21	UKC1	UKC1	CH07	CHE
BG31	BG31	DK03	DK03	FRI2	FR63	NL22	NL22	UKC2	UKC2	LI00*	CHE*
BG32	BG32	DK04	DK04	FRI3	FR53	NL23	NL23	UKD1	UKD1	ARG	ARG
BG33	BG33	DK05	DK05	FRJ1	FR81	NL31	NL31	UKD3	UKD3	AUS	AUS
BG34	BG34	EE00	EE00	FRJ2	FR62	NL32	NL32	UKD4	UKD4	BRA	BRA
BG41	BG41	EL30	EL30	FRK1	FR72	NL33	NL33	UKD6	UKD6	BRN	BRN
BG42	BG42	EL41	EL41	FRK2	FR71	NL34	NL34	UKD7	UKD7	CAN	CAN
CY00	CYP	EL42	EL42	FRL0	FR82	NL41	NL41	UKE1	UKE1	CHL	CHL
CZ01	CZ01	EL43	EL43	FRM0	FR83	NL42	NL42	UKE2	UKE2	CHN	CHN
CZ02	CZ02	EL51	EL11	FRY1	FR91	PL21	PL21	UKE3	UKE3	COL	COL
CZ03	CZ03	EL52	EL12	FRY2	FR92	PL22	PL22	UKE4	UKE4	CRI	CRI
CZ04	CZ04	EL53	EL13	FRY3	FR93	PL41	PL41	UKF1	UKF1	HKG	HKG
CZ05	CZ05	EL54	EL21	FRY4	FR94	PL42	PL42	UKF2	UKF2	IDN	IDN
CZ06	CZ06	EL61	EL14	HR03	HRV	PL43	PL43	UKF3	UKF3	IND	IND
CZ07	CZ07	EL62	EL22	HR04	HRV	PL51	PL51	UKG1	UKG1	ISR	ISR
CZ08	CZ08	EL63	EL23	HU11	HU10	PL52	PL52	UKG2	UKG2	JPN	JPN
DE11	DE11	EL64	EL24	HU12	HU10	PL61	PL61	UKG3	UKG3	KAZ	KAZ
DE12	DE12	EL65	EL25	HU21	HU21	PL62	PL62	UKH1	UKH1	KHM	KHM
DE13	DE13	ES11	ES11	HU22	HU22	PL63	PL63	UKH2	UKH2	KOR	KOR
DE14	DE14	ES12	ES12	HU23	HU23	PL71	PL11	UKH3	UKH3	MAR	MAR
DE21	DE21	ES13	ES13	HU31	HU31	PL72	PL33	UKI3	UKI1	MEX	MEX
DE22	DE22	ES21	ES21	HU32	HU32	PL81	PL31	UKI4	UKI1	MYS	MYS

(Continues)

TABLE A.4 (Continued)

rev16	rev10	rev16	rev10	rev16	rev10	rev16	rev10	rev16	rev10	rev16	rev10
DE23	DE23	ES22	ES22	HU33	HU33	PL82	PL32	UKI5	UKI2	NZL	NZL
DE24	DE24	ES23	ES23	IE04	IRL	PL84	PL34	UKI6	UKI2	PER	PER
DE25	DE25	ES24	ES24	IE05	IRL	PL91	PL12	UKI7	UKI2	PHL	PHL
DE26	DE26	ES30	ES30	IE06	IRL	PL92	PL12	UKJ1	UKJ1	RUS	RUS
DE27	DE27	ES41	ES41	ITC1	ITC1	PT11	PT11	UKJ2	UKJ2	SAU	SAU
DE30	DE30	ES42	ES42	ITC2	ITC2	PT15	PT15	UKJ3	UKJ3	SGP	SGP
DE40	DE40	ES43	ES43	ITC3	ITC3	PT16	PT16	UKJ4	UKJ4	THA	THA
DE50	DE50	ES51	ES51	ITC4	ITC4	PT17	PT17	UKK1	UKK1	TUN	TUN
DE60	DE60	ES52	ES52	ITF1	ITF1	PT18	PT18	UKK2	UKK2	TUR	TUR
DE71	DE71	ES53	ES53	ITF2	ITF2	PT20	PT20	UKK3	UKK3	TWN	TWN
DE72	DE72	ES61	ES61	ITF3	ITF3	PT30	PT30	UKK4	UKK4	USA	USA
DE73	DE73	ES62	ES62	ITF4	ITF4	RO11	RO11	UKL1	UKL1	VNM	VNM
DE80	DE80	ES63	ES63	ITF5	ITF5	RO12	RO12	UKL2	UKL2	ZAF	ZAF
DE91	DE91	ES64	ES64	ITF6	ITF6	RO21	RO21	UKM5	UKM5	ROW	ROW

Source: Authors' own elaboration.

DOI: 10.1111/pirs.12760

Resumen. Este artículo contiene la metodología y los principales resultados relacionados con la actualización y ampliación de las tablas *input–output* interregionales más amplias para toda la UE-27, el Reino Unido y los países de la Asociación Europea de Libre Comercio (AELC). Este trabajo continúa el notable esfuerzo realizado en los últimos años en relación con la estimación y el análisis de diferentes bases de datos multirregionales *input–output* (MRIO) a nivel de país (base de datos mundial *input–output*, EXIOBASE, ICIO, FIGARO, etc.) y las tablas MRIO desarrolladas para la Unión Europea (UE) a nivel NUTS-2. La principal contribución consiste en actualizar y ampliar la colección EUREGIO actual para obtener una tabla EUREGIO para 2017, a la que se hará referencia (NUTS-2 Rev.2016) para todos los países de la UE-27 + Reino Unido + AELC y que se integrará en la nueva FIGARO multipaís de 2017. Este esfuerzo se desarrolló en el contexto del proyecto ESPON-IRIE. Este artículo resume la metodología utilizada y compara los resultados obtenidos con los de las principales bases de referencia, y proporciona un análisis de la participación nacional y regional en las cadenas de valor mundiales (CVM). Los principales resultados sugieren que, por término medio, el 65% del valor añadido se incorpora en los bienes y servicios vendidos a la misma región NUTS-2, el 16% se incorpora en los vendidos a regiones del mismo país y el 20% restante se exporta (a otros países). Cuando se examina la heterogeneidad interna de estas cifras puede observarse también que la variedad es mayor entre regiones que entre sectores. El análisis sugiere que, en gran medida, la participación heterogénea de las regiones de la UE-27 + Reino Unido + AELC en las CVM se explica más por su estructura sectorial que por las características idiosincráticas regionales. Los resultados abren la puerta al diseño correcto de políticas industriales, integradas en el paradigma de la especialización inteligente.

抄録: 本稿では、EU27、英国、欧州自由貿易連合 (European Free Trade Association: EFTA)諸国全体の最も広範な地域間産業連関表の更新と拡張に関連する方法論と主な結果について述べる。本研究は、国レベルでの様々な多地域産業連関 (MRIO)データベース (世界産業連関データベース、EXIOBASE、ICIO、FIGARO等)とNUTS2レベルでの欧州連合(EU)のために開発されたMRIO表の推定と分析に関する、過去数年間で得られた大きな努力の成果を継続するものである。本研究の主な貢献は、現在のEUREGIOコレクションを更新および拡張して、2017年のEUREGIOテーブルを得ることである。このテーブルは、EU27+英国+EFTA諸国のすべての国の参考と (NUTS2 Rev.2016)され、新しいFIGAROマルチカントリー2017に組み込まれるものである。ESPON‐IRIEプロジェクトの一環でこうした取り組みが展開された。本稿では、グローバル・バリュー・チェーンへの各国・地域の参加状況を分析し、主要ベンチマークの結果と比較した。主な結果から、平均して付加価値の65%が同じNUTS2地域に販売される財とサービスで、16%が同じ国の地域に販売されるものになっており、残りの20%が (他国に)輸出されることが示唆される。以上の数字の異質性を調べると、多様性はセクター間よりも地域間で高いことが認められる。我々の分析から、EU27+英国+EFTA諸国のグローバル・バリュー・チェーンへの参加が不均一的であることは、ほとんどの部分が、地域の特異的特性よりもそのセクター構造によって説明されることが示唆される。以上のような結果から、スマート・スペシャリゼーションのパラダイムに組み込まれた産業政策の正しいデザインのための新たな場が提供される。