INSTITUTO NACIONAL DE ESTADISTICA

International Trade in Value-Added Indicators Dashboard

Methodology

experimental

July 2025

Index

1 INTRODUCTION

The **International Trade in Value Added (TiVA) Indicators Dashboard** is part of the strategic line (10) of the next PEN 2025-2028, which states "*the national publication of a globalisation dashboard, of the Extended Origin-Destination Tables and of the International Trade in Value Added (TiVA) Indicators.*"

The indicators are calculated based on national accounting aggregates contained in the FIGARO tables published by Eurostat, which are themselves compiled from the results of the national accounts of each country, with adjustments applied for reconciliation. It is, therefore, an excellent example of institutional cooperation and the reuse of information generated within the European statistical system.

2 INTERNATIONAL AND EUROPEAN CONTEXT

The development of multiregional input-output (MRIO) models and trade in value-added indicators (TiVA) has been driven by the growing economic globalisation and the complexity of international value chains. Organisations such as the OECD and the European Commission have led the development of these models, aiming to provide a more accurate picture of the economic interdependencies between countries and regions.

These tools allow mapping these interconnections, tracking not only the total value of trade exchanges but also the value added at each stage of production. This information is crucial for formulating more effective economic policies, as it allows identifying how countries actually contribute to the creation of global value, and not just measuring gross trade, which often hides the role of countries in international supply chains.

Thus, in the mid-2000s, the OECD began developing databases and methodologies to calculate trade in terms of value-added, using international input-output matrices. The ICIO (Inter-Country Input-Output) tables are available in two versions: one with 76 countries and the rest of the world (Regular ICIO), and another extended version (Extended ICIO), with 76 countries, China, and Mexico, and sectoral disaggregation by activity. It is this latter format that serves as the basis for calculating and publishing TiVA indicators, which the OECD has incorporated into its regular product catalogue since 2013. This provides economic policy makers with a more refined tool to analyse global economic interdependencies and design more effective trade and development policies.

In fact, the OECD is the driving force behind the methodology for TiVA indicators, which can be developed from MRIO models. This methodology has also been employed by EUROSTAT and other national statistical offices for the development and publication of these indicators.

In the European context, the FIGARO project (Full International and Global Accounts for Research in Input-Output Analysis) by Eurostat develops MRIO tables that integrate economic data from EU Member States and the rest of the world. It is the result of cooperation between Eurostat and the Joint Research Centre (JRC), becoming official European statistics in 2021 and providing annual results for each year t, referring to year t-2 since 2010. EUROSTAT also accompanies the dissemination of FIGARO with a Globalisation dashboard.

It is also worth mentioning other similar initiative developed by other international bodies, such as the IMF's MARIO project (Multi-Analytical Regional Input-Output Models) or the MRIO tables (ADB MRIO) compiled by the Asian Development Bank and by ECLAC as well.

The widespread development of multiregional computational models by various international entities also requires a new effort for harmonisation and convergence on a global data framework needed to feed the various MRIO-TiVA initiatives. This is what is being pursued under the GIANT acronym (Global Input-Output AccouNTs), an initiative promoted by: United Nations Economic Commission for Latin America and the Caribbean (ECLAC), United Nations Economic Commission for Africa (ECA), European Commission (Eurostat and JRC), IMF, OECD, Asian Development Bank (ADB), and World Trade Organization (WTO).

3 RESEARCH AREAS

3.1 POPULATION SCOPE

The indicators to be included in this experimental statistics refer to the entire national economy, in terms of the European System of National and Regional Accounts 2010 (ESA 2010)[1]. They also refer to the impact of Spain's foreign trade flows on the rest of the world.

3.2 GEOGRAPHIC SCOPE

The indicators refer to the national economic territory, defined in terms of ESA 2010.

Some of them examine the impact of foreign trade on the rest of the world (also in ESA 2010 terms) and the influence of other countries' international trade on the Spanish economy.

3.3 TEMPORAL SCOPE

These are annual reference indicators, starting from 2010.

3.4 STUDY AND CLASSIFICATION VARIABLES

The panel consists of the indicators listed below, although new indicators will be gradually incorporated once their compilation is tested and the interpretability is facilitated, through a more refined dissemination strategy:

[1] *Regulation (EU) 549/2013, regarding the European System of National and Regional Accounts of the EU of 2010.*
https://www.boe.es/buscar/doc.php?id=DOUE-L-2013-81250

Domestic value added:

1. Domestic value added by industry, embodied in total Spanish exports.
2. Total domestic value added embodied in exports of each industry in Spain.
3. Total domestic value added, by importing country, embodied in total Spanish exports.
4. Direct domestic value added, embodied in exports of each industry in Spain. (Value added generated in the same industry)
5. Indirect domestic value added, embodied in exports of each industry in Spain. (Value added generated in other industries)
6. Total domestic value added, by exporting country, embodied in total exports of other EU-27 countries.
7. Total domestic value added embodied in total exports of other EU-27 countries, relative to total Spanish exports. (Forward participation)
8. Total domestic value added embodied in Spanish exports of services, relative to total Spanish exports of services.
9. Total domestic value added embodied in Spanish exports of goods, relative to total Spanish exports of goods.

Foreign value added:

10. Total foreign value added by country, embodied in total Spanish exports.
11. Total foreign value added embodied in total Spanish exports, relative to total Spanish exports. (Backward participation)
12. Total foreign value added by country, embodied in Spanish imports from these countries. (EU-27 data)

Employment:

13. Domestic employment by industry, embodied in total Spanish exports.
14. Total domestic employment embodied in exports of each industry in Spain.
15. Total domestic employment, by importing country, embodied in total Spanish exports.

Emissions:

16. Total domestic greenhouse gas emissions generated by Spanish exports by industry.
17. Foreign greenhouse gas emissions by country, generated by total Spanish imports.

4 CALCULATION METHODOLOGY

The compilation of the indicators to be included in the panel is carried out within the conceptual framework of the current national accounts systems (System of National Accounts, SNA 2008 and ESA 2010).

The source of information is FIGARO, developed and published by EUROSTAT in collaboration with the Joint Research Centre Directorate-General (JRC DG) of the European Commission.

The application of the Leontief model allows for the estimation of the production required to meet a given demand within a multiregional system of 50 economies and 64 economic sectors. From production, the value added, employment or emissions associated with that production are obtained by multiplying by the corresponding indices for each sector.

The 50 economies considered include the 27 EU countries, 22 other non-EU countries and 1 additional "economy" which includes all other countries. The 64 sectors correspond to the NACE Rev. 2 classification with breakdown at A*64 level.

The variables analysed are value added (measured in millions of current euros), employment (measured in number of employees plus self-employed persons) and greenhouse gas emissions (measured in thousands of tonnes of CO2 equivalent).

The estimates of the impacts of foreign trade on the aforementioned variables (value added, employment and emissions) are based on the Leontief inverse, which links demand flows with production. For this purpose, the demand flow used is the export vector (including exports for intermediate consumption and final demand). The Leontief inverse used is what we call the local inverse, which refers to the inverse considering internal flows of each country and we represent it as L^r where r is the country under consideration. In addition, to estimate the foreign production generated by Spanish exports, we use the matrix $C^{(r)}$ which considers all flows outside country r, in our case, r = Spain. Given that the indicators presented here refer to Spain, only the matrices referring to L^{ES} y $C^{(ES)}$ are considered.

4.1 MATRICES AND VECTORS

The Leontief inverse matrices are calculated from the technical coefficient matrices:

$$A = a_{ij}^{rs} = \frac{c_{ij}^{rs}}{x_j^s}$$

Where c_{ij}^{rs} are the *intermediate consumption* of sector j in country s supplied by sector i in country r. On the other hand, x_j^s is the production of sector in country s.

This four-indices notation (country, sector) × (country, sector) yields a coefficient matrix A of dimension (50, 64) × (50, 64) = 3,200 × 3,200. The Leontief inverse matrices L^{ES} y $C^{(ES)}$ discussed above are computed as follows:

$$L^{ES} = (I_{64x64} - A^{ES})^{-1}$$

$$C^{(ES)} = \left(I_{3136x3136} - A^{(ES)}\right)^{-1}$$

Where A^{ES} is the sub-matrix (64 x 64) formed by the Spain rows and the Spain columns of the matrix A, and $A^{(ES)}$ is the sub-matrix formed by the rows and columns of the rest

of the countries (i.e. what remains in A after eliminating the Spain rows and the Spain columns) which has a dimension of (49; 64) x (49; 64) = 3,136 x 3,136.

In addition, we consider the square sub-matrices $C^{(ES)rs}$ of dimension 64x64 formed by the rows of country r and the columns of country s from the matrix $C^{(ES)}$, with r and s other than Spain.

According to the specialized literature, the elements of the A matrix are called *coefficients,* and the elements of the Leontief matrices are called *multipliers*

On the other hand, we must consider a number of vectors to complete the calculations.

The export vector is represented by the expression e_{ij}^{rs}, where r is the exporting country, s is the importing country, i is the sector of the exporting country and j is the use of the importing country. Thus, the scalar $e_{1\,final}^{ES\,FR}$ would represent the exports from Spanish's sector 1 for final consumption in France. The vector of e^{ES} would represent Spanish exports, sector by sector, and would have dimensions 64 x 1.

From these matrices and vectors, we can calculate the sectoral production vector (64 × 1) in Spain derived from Spanish exports:

$$P^{ES} = L^{ES} \cdot e^{ES}$$

In a slightly more complex way, we can calculate the sectoral production vector (64 × 1) in country t generated by Spanish exports:

$$P^{t} = \sum_{z \neq ES} C^{(ES)tz} A^{z\,ES} L^{ES} e^{ES}$$

With the above formulas, the production that a country has to carry out to supply the exports it makes is calculated. The next step is to calculate the value added, employment and greenhouse gas emissions associated with such production. To do this, we need to obtain the so-called *multipliers* of each variable, which are calculated as the quotient between the value of the observed variable (value added, employment and emissions) and total production. This quotient or *multiplier* is calculated for each branch-country.

Value added, employment and emissions are obtained from the inner product of the corresponding multiplier and the previously calculated production. Bellow, we omit the superscript that would indicate the specific country for which the aggregate is calculated, for the sake of clarity in the formulas.

– Value added = v P
– Employment = w P
– Emissions = g P

Where the multiplier vectors are obtained by means of:

– v = value added per country-sector/ total country-sector production
– w = employment per country-sector / total country-sector production
– g = emissions per country-sector / total country-sector production

The above expressions result in one scalar per country. However, indicators are usually presented with details of the specific sector where the impact is generated or the specific sector causing the impact. For example, the value added in the "industry" sector in Spain generated by total Spanish exports, or the value added in Spain generated by exports from the "industry" sector. In both cases, a vector of dimension 64 x 1 is needed.

This is achieved by diagonalising the production multiplier or the export vector, respectively. (We indicate the diagonalised vector by means of square brackets ⟨ ⟩). The *diagonalization of a vector* consists of defining a square matrix with the values of the vector on the main diagonal and zeros on the rest of the cells.

– $\langle v^{ES} \rangle L^{ES} e^{ES}$: Value added in Spain by sector, generated by total Spanish exports.

– $v^{ES} L^{ES} \langle e^{ES} \rangle$: Total value added in Spain generated by each sector's exports.

We could also obtain both results simultaneously by diagonalising both vectors: $\langle v^{ES} \rangle L^{ES} \langle e^{ES} \rangle$ the result would be a matrix (64 x 64) in such a way that the sum of columns vertically would give the first approach and the sum of rows horizontally would give the second approach.

A detail of the above formulas with corresponding demonstrations can be found in **Arto, I., Dietzenbacher, E., & Rueda-Cantuche, J. M. (2019).** Measuring bilateral trade in terms of value added. Luxembourg: Publications Office of the European Union.

Available at: https://publications.jrc.ec.europa.eu/repository/handle/JRC116694

5 DISSEMINATION OF INFORMATION

The results are available in graphical and tabular format.

Gradually, more indicators will be added in order to complete the statistical description of the Spanish economy's connection with global value chains and the economic interdependence between countries, as well as its impact on economic growth, employment, and environmental sustainability. This progressive incorporation of more indicators will entail redesigning the panel, and organising the information into potential fields and sections to facilitate access and interpretability.

5.1 DISSEMINATION SCHEDULE

The first publication of the statistics was made in July 2025 with data for the years 2010 to 2023.

The indicators will be updated annually to coincide with the publication of the FÍGARO results by EUROSTAT, which in principle are published in July. The results published in each year t will cover up to reference period t-2.

ANNEX. FORMULAS OF THE INDICATORS

NUMBER	INDICATOR	FORMULAE
1	**Domestic value added by industry, embodied in total Spanish exports.**	$\langle v^{ES}\rangle L^{ES} e^{ES}$
2	**Total domestic value added embodied in exports of each industry in Spain.**	$v^{ES} L^{ES} \langle e^{ES}\rangle$
3	**Total domestic value added, by importing country, embodied in total Spanish exports.**	$v^{ES} L^{ES} e^{ES,s}$ s = país importador
4	**Direct domestic value added, embodied in exports of each industry in Spain. (Value added generated in the same industry)**	Diag ($\langle v^{ES}\rangle L^{ES} \langle e^{ES}\rangle$), vectorizado
5	**Indirect domestic value added, embodied in exports of each industry in Spain. (Value added generated in others industries)**	$v^{ES} L^{ES} \langle e^{ES}\rangle - VA\ directo$
6	**Total domestic value added, by exporting country, embodied in total exports of other EU-27 countries.**	$\sum_{z \neq s} v^{ES} C^{(s)\,ES,z} A^{z,s} L^{s} e^{s}$ s = país exportador
7	**Total domestic value added embodied in total exports of other EU-27 countries, relative to total Spanish exports. (Forward participation)**	$\frac{suma\ indicador\ 6}{suma(e^{ES})}$
8	**Total domestic value added embodied in Spanish exports of services, relative to total Spanish exports of services.**	$v^{ES} L^{ES} e^{ES}_{servicios} / suma\,(e^{ES}_{servcios})$ (Poner ceros en exportaciones de ramas de bienes)
9	**Total domestic value added embodied in Spanish exports of goods, relative to total Spanish exports of goods.**	$v^{ES} L^{ES} e^{ES}_{bienes} / suma\,(e^{ES}_{bienes})$ (Poner ceros en exportaciones de ramas servicios)
10	**Total foreign value added by country, embodied in total Spanish exports.**	$\sum_{z \neq s} v^{t} C^{(ES)\,t,z} A^{z,ES} L^{ES} e^{ES}$ t = país que genera el valor añadido
11	**Total foreign value added embodied in total Spanish exports, relative to total Spanish exports. (Backward participation)**	$\frac{suma\ indicador\ 10}{suma\,(e^{ES})}$
12	**Total foreign value added by country, embodied in Spanish imports from these countries. (EU-27 data)**	$v^{t} L^{t} e^{t,ES}$ t = país que genera el valor añadido
13	**Domestic employment by industry, embodied in total Spanish exports.**	$\langle w^{ES}\rangle L^{ES} e^{ES}$
14	**Total domestic employment embodied in exports of each industry in Spain.**	$w^{ES} L^{ES} \langle e^{ES}\rangle$
15	**Total domestic employment, by importing country, embodied in total Spanish exports.**	$w^{ES} L^{ES} e^{ES,s}$ s = país importador
16	**Total domestic greenhouse gas emissions generated by Spanish exports by industry.**	$g^{ES} L^{ES} \langle e^{ES}\rangle$
17	**Foreign greenhouse gas emissions by country, generated by total Spanish imports.**	$g^{r} L^{r} e^{r,ES}$ r = país emisor gases efecto invernadero