INSTITUTO NACIONAL DE ESTADISTICA

Trade in Value Added (TiVA) Dashboard

Methodology

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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.

Final demand:

18. Total domestic value added, by country of final demand, linked to the final demand of these countries.
19. Domestic value added by industry and country of final demand, linked to the final demand of these countries.
20. Total foreign value added by country, linked to Spain's final demand.

21. Total domestic employment, by country of final demand, linked to the final demand of these countries.
22. Domestic employment by industry and country of final demand, linked to the final demand of these countries.
23. Bilateral value added balance linked to final demand between Spain and each country.

Exposure:

24. Total domestic value added, by partner country, exposed to the demand of these countries.
25. Total domestic value added, by partner country, exposed to the demand of these countries (final, intermediate and indirect demand).
26. Domestic value added by industry and partner country, exposed to the demand of these countries.

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 FIGARO tables present the global economy broken down into 50 economies and 64 sectors. The 50 economies considered include the 27 EU countries plus 22 non-EU countries, as well as one economy representing "the rest of the world." The 64 sectors correspond to the NACE Rev. 2 classification, disaggregated to the A*64 level.

The Leontief model allows for the estimation of the output required to meet a demand flow (whether for intermediate or final use). From this output, the value added, employment, or emissions associated with the flow are obtained by multiplying the output by the corresponding value added, employment, or emissions coefficients for each industry and country.

The variables analysed are value added (measured in millions of current euros and relative to other aggregates such as GDP), employment (measured in the number of salaried workers plus self-employed workers and relative to total employment), and greenhouse gas emissions (measured in thousands of tons of CO2 equivalent and relative to total emissions).

As mentioned, the estimates of the impacts of foreign trade on these variables (value added, employment, and emissions) are based on the Leontief inverse, which relates demand flows to production. Starting with a demand flow (for example, Spanish exports) in a specific economy (for example, the Spanish economy), the production necessary in that economy to satisfy that flow can be calculated. Once production is calculated, the associated value added, employment, or emissions can be calculated by multiplying production by the corresponding coefficients. In this way, the value added, employment,

or emissions generated by Spanish exports can be calculated. These indicators can be easily broken down by the sector in which the phenomenon occurs and by the use of the flow: total, intermediate use (detailed by country and industry), or final use (detailed by country and type).

In the analysis of international trade in terms of value added rather than in terms of the total value of products, double counting of value added must be eliminated when exported goods are processed abroad, return to the country of origin, and are then re-exported. For example, if Spain supplies automotive components to Germany, where cars are manufactured and then exported back to Spain, which are finally exported to France, the value added of the automotive components would be counted twice: first for exports to Germany and then for exports to France.

To avoid double counting, the local Leontief inverse is used when conducting an analysis that incorporates export flows for intermediate use.

Therefore, depending on the demand flow considered, either the local or global Leontief inverse is used. Thus, for the analysis of total exports (including intermediate use plus final use) the local inverse is used, and for the analysis of exports for final use only, the global inverse is used.

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.

Note that, to properly identify the flows and matrices, we need a notation with 4 indices (country, industry) x (country, industry). The country is shown as a superscript and the branch as a subscript. Thus, if we are referring to the entire coefficient matrix A of dimension (50, 64) x (50, 64) = 3200 x 3200, it is not necessary to use indices. However, if we want to refer to the coefficients of the submatrix formed by Spain and France, we would write e $A^{ES\,FR}$, which would have dimension 64 x 64. If we also want to refer to the coefficients of the column of industry i of that submatrix, we would write $A_{\cdot,i}^{ES\,FR}$, where the subscript "$\cdot, i$" indicates "all rows of column i."

The local Leontief inverse is denoted by L^r, where r is the country under consideration. This matrix has an associated complementary inverse, which we denote by $C^{(r)}$, allowing us to estimate the output abroad generated by the exports of the country r.

In our case, r = Spain, and therefore we only consider the matrices $L^{ES}\ and\ C^{(ES)}$, in addition to the global inverse matrix according to the calculated indicators.

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

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

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.

4.2 INDICATORS BASED ON TOTAL EXPORTS

Indicators based on total exports include indicators of domestic value added, external value added, employment, and CO2 emissions. In all these cases, the flow of total exports is considered, that is, both exports for intermediate use and for final use.

Using the matrices and vectors above, the (64 x 1) vector of production by industry in Spain derived from Spanish exports can be calculated:

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

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 coefficients 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 coefficient is calculated for each industry-country.

Value added, employment and emissions are obtained from the inner product of the corresponding coefficient 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 = $v \cdot P$
- Employment = $w \cdot P$
- Emisions = $g \cdot P$

Where the coefficient 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 value added coefficient vector 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

4.3 INDICATORS BASED ON FINAL DEMAND

Unlike the previous indicators, in this case we consider only flows for final use.

Indicators based on final demand are calculated similarly to the above, although the global inverse Leontief matrix is used instead of the local one, since in these cases the phenomenon of double counting of added value does not affect the calculation of the indicator.

4.4 TRADE EXPOSURE INDICATORS

Trade exposure indicators combine aspects of previous indicators based on exports and final demand. The objective of the indicator is to estimate the total dependence of one economy on another, that is, to estimate the value added of an economy that depends on the (intermediate and final) demand of another economy. The trade exposure indicator is composed of the sum of four flows.

1. Exports to the partner country for final use.
2. Exports to the partner country for intermediate use which are transformed and end up as final use in the partner country.
3. Exports to the partner country for intermediate use which are transformed and end up as final use in third country.
4. Exports to third countries for intermediate use that are transformed and end up as final use in the partner country.

The sum of flows 1, 2, and 3 corresponds to exports destined for the counterpart country.

The sum of flows 1, 2, and 4 corresponds to exports destined for final demand in the counterpart country (directly or through third countries).

The sum of all four flows corresponds to exports destined for the counterpart country (including exports to the counterpart country that are subsequently destined for final consumption in third countries).

The method for calculating the value added generated by the above flows is the same as for the other indicators: the vector of value added coefficients must be multiplied by the local inverse Leontief matrix and by the corresponding flow vector, resulting in a scalar. If it is desired to disaggregate the scalar by branch of activity in the reference country, then the vector of value added coefficients must be diagonalized. If it is desired to disaggregate by export sector, the export flow vectors must be diagonalized. The analytical expression of the indicator as the sum of the four flows is:

- Indicator = $\sum_{i=1}^{4} v^{ES} L^{ES} f_i$

The details for calculating each flow are as follows:

- $f_1 = y_{final\ use}^{ES\ q}$
- $f_2 = A^{ES\ q} B^{q\ w} y_{final\ use}^{w\ q}$
- $f_3 = A^{ES\ q} B^{q\ w} y_{final\ use}^{w\ t}$
- $f_4 = A^{ES\ t} B^{t\ w} y_{final\ use}^{w\ q}$

Where the indices are ES = Spain, w = all countries, t = third countries, q = partner country

5 DISSEMINATION OF INFORMATION

The results are available in graphical and tabular format.

Gradually, more indicators will be added 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 organizing the information into potential fields and sections to facilitate access and interpretability.

5.1 DISSEMINATION SCHEDULE

The publication of the statistics was made in July 2026 with data for the years 2010 to 2024.

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 reference period t-2.

ANNEX. FORMULAS OF THE INDICATORS

NUMBER	INDICATOR	FORMULAS
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
18	Total domestic value added, by country of final demand, linked to the final demand of these countries.	$v^{ES} B^{ES} y^{ES,s}$ s = país de consumo
19	Domestic value added by industry and country of final demand, linked to the final demand of these countries.	$\langle v^{ES}\rangle B^{ES} y^{ES,s}$ s = país de consumo
20	Total foreign value added by country, linked to Spain's final demand.	$v^{t} B^{t} y^{t,ES}$ t = país que genera el valor añadido
21	Total domestic employment, by country of final demand, linked to the final demand of these countries.	$w^{ES} B^{ES} y^{ES,s}$ s = país de consumo
22	Domestic employment by industry and country of final demand, linked to the final demand of these countries.	$\langle w^{ES}\rangle B^{ES} y^{ES,s}$ s = país de consumo
23	Bilateral value added balance linked to final demand between Spain and each country.	$indicador\ 18 - indicador\ 20$
24	Total domestic value added, by partner country, exposed to the demand of these countries.	$\Sigma_{i=1}^{4} F_i^{s}$ s= país de contrapartida
25	Total domestic value added, by partner country, exposed to the demand of these countries (final, intermediate and indirect demand).	F_i^{s} i=1,...,4 (tipología de flujo) s= país de contrapartida
26	Domestic value added by industry and partner country, exposed to the demand of these countries.	$\langle \Sigma_{i=1}^{4} F_i^{s} \rangle$ s= país de contrapartida