INSTITUTO NACIONAL DE ESTADISTICA

International Trade in Value Added Indicators Dashboard (TiVA)

Technical Project

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Contents

1 Identification of the statistical operation

The *International Trade in Value Added Indicators Dashboard* is to be found in the Inventory of Statistical Operations (code 30801).

These statistics have been published experimentally since 2025, following approval by the Board of Directors on 3-4 December 2024.

Starting in 2026, it will be published on the INE website as a new statistical product, in the same way as other similar products.

2 Origin of the demand and grounds for its need

Globalisation has transformed the production and distribution of goods and services, creating complex networks of economic interconnection and fragmenting production chains beyond national borders. Measuring global value chains is essential for understanding the economic and social interdependence between countries. Hence the importance of having data that allows for the evaluation of these phenomena and, with it, the identification of both the benefits and challenges faced by countries and companies, and understanding key dynamics of international trade.

The analysis of global value chains allows for the forecasting of risks in the face of geopolitical changes with the potential impact on supply chains, such as those recently experienced during the pandemic or conflicts in Ukraine and the Middle East. The identification of the links in these chains is also crucial for addressing issues such as economic inequality and environmental sustainability.

These needs of analysis, associated with increasing economic globalisation and the complexity of international value chains, have driven the development of multi-regional input-output models (MRIO) and trade in value added indicators (TiVA). 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. To be specific, the OECD is the driving force behind the methodology for TiVA indicators, which has also been employed by EUROSTAT and other national statistical offices for the development and publication of these indicators.

These tools allow these interconnections to be mapped, 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.

The spirit of several of the Sustainable Development Goals is closely aligned with the need for a better understanding of global trade dynamics, the distribution of value throughout production chains, and the impact of globalisation on sustainable development. Some goals can be highlighted; for example: Goal 8.2, *achieve higher levels of economic productivity through diversification, technological modernisation, and innovation,* from SDG 8, *Decent work and economic growth*, which involves the efficient use of resources in global value chains; Goal 9.3 *Increase access of small industries and other businesses, particularly in developing countries, to financial services, including affordable credit, and their integration into value chains and markets*, from

SDG 9, *Industry, innovation, and infrastructure*; Goal 10, *apply the principle of special and differential treatment for developing countries, particularly the least developed countries, in accordance with the agreements of the World Trade Organisation,* from SDG 10, *Reduced inequalities*, as fair and equitable participation in global trade is essential to reduce inequalities between countries; or Goal 17.10, *Promote a universal, rules-based, open, non-discriminatory, and equitable multilateral trading system under the World Trade Organisation framework,* from SDG 17, *Alliances to achieve the goals*, which focuses on fair and equitable trade. In general, the use of trade in value-added indicators can contribute to a better understanding of the actual contributions of countries to global trade.

In Spain, one of the inspiring strategic lines of the 2025-2028 National Statistics Plan, (10) 'Statistics on globalisation', aims to respond, in general, to these new demands for information with regard to the phenomenon of economic globalisation. Some recently developed projects, such as the *Company Statistics by Group Membership*, the *Global Value Chain Statistics* or the *International Trade in Services Statistics by Mode of Supply* and *by Company Characteristics* are completing the catalogue of official Spanish statistics in this area, shaping this strategy.

In addition, the creation of the Large Cases Unit (LCU) at the INE has been a milestone in adopting new approaches for measuring globalisation and the statistical description of large multinational groups, both in business statistics and in macroeconomic synthesis statistics. Order ETD 378/2022 for the creation of the LCU assigns a wide range of transversal functions to the new Division, that address the challenge of measuring globalisation from different approaches and areas. In particular, it entrusts the analysis of all available information related to the key aspects of globalisation.

The specialisation and expert knowledge acquired by the LCU in the use of MRIO models and, in general, in the measurement of globalisation, makes it possible to address certain strategic lines set out in the statistical plans (for example, the current National Statistical Plan establishes as one of its strategic lines *"The national publication of International Trade in Value Added (TiVA) indicators."*

Specifically, this project proposes the compilation and dissemination of an International Trade in Value Added Indicators Dashboard (TiVA) focused on the Spanish economy. Its calculation is based on the application of the Leontief model to the multi-regional input-output framework provided by the FIGARO tables published by EUROSTAT, which are themselves prepared from the results of the national accounts of each country. It is, therefore, an excellent example of institutional cooperation and the reuse of information generated within the European and international statistical system.

The Panel has already been published by the INE as experimental statistics since 2025, covering a first set of indicators. The interest shown by domestic users and various international forums in this INE initiative, together with the expert knowledge acquired by the LCU in the analysis of multi-regional models and in the compilation of these indicators—complex in terms of their preparation, interpretation, and dissemination—suggest moving forward with their development and publication as a new statistical product. This will contribute to the dissemination of this type of analytical tool among a more general audience and, at the same time, satisfy the growing demand of more expert users in the field by including new indicators in the Panel.

3 Project objectives

The *International Trade in Value Added Indicators Dashboard* (TiVA) aims to assess the impact on domestic (or rest of world's) economic activity of the Spanish economy's participation in global value chains from different perspectives, such as the value added generated, the related employment, or the emission of green house gases. All of this within the framework of the national accounts system and in consistency with the macroeconomic aggregates of Spain's National Accounting.

These indicators allow us to analyse, for example, the added value or employment generated in the domestic economy by our exports, or those generated in foreign economies by our imports. They also allow us to quantify what part of the value of these exports is the added value or domestic or foreign employment and in which country it is finally consumed, as well as the impact of our foreign trade in terms of greenhouse gas emissions.

This information makes it possible to identify how countries actually contribute to the creation of global value, and not just measure gross trade, which often conceals the role of countries in international supply chains.

4 Type of operation

This is a statistical operation of synthesis and analysis, whose results are presented both in levels (aggregate results) and in the form of variation indices and ratios with respect to domestic macroeconomic aggregates.

5 Content

5.1 POPULATION UNDER STUDY

The indicators refer to the national economy as a whole. They also refer to the impact of Spain's foreign trade flows on the rest of the world.

5.2 GEOGRAPHICAL OR TERRITORIAL SCOPE

The indicators refer to the national economic territory.

Some of them will refer to the impact of the domestic economy's foreign trade on the rest of the world.

5.3 REFERENCE PERIOD OF THE DATA

These are annual reference indicators, starting from 2010. This is, therefore, a structural operation.

5.4 STUDY AND CLASSIFICATION VARIABLES

The statistics include a list of indicators to assess the impact on the domestic (or the rest of the world's) economic activity of Spain's participation in global value chains from different perspectives, such as the value added generated, the related employment, or the emission of polluting gases or the degree of exposure to and dependence on international demand and production.

Thus, the indicators included in the panel are classified into various sections:

– Internal added value:

  The domestic value added in exports allows for a more accurate understanding of the real impact of international trade on the Spanish economy. This indicator reflects the value generated internally, both directly and throughout the production chain, which is incorporated into exported goods and services. Its analysis is essential to understand the country's productive structure and its integration into global value chains. Furthermore, it allows the identification of the sectors that contribute most to economic growth through foreign trade.

  The indicators use added value and exports as variables of study. They describe the added value produced in Spain that is contained in the exports of the national economy. In other words, what part of the total value of these exports has been produced in Spain.

  The classification variables used are the branch of activity of the domestic economy, and the country of origin/destination and use (final demand/intermediate demand) of the exports.

– External value added:

  External value added in exports offers a key perspective on the open and interdependent nature of the Spanish productive fabric. This indicator quantifies the proportion of value generated in other countries that is included in products exported from Spain, revealing the degree of international fragmentation of production. Their study allows for the evaluation of the economy's exposure to global supply chains and an understanding of how domestic industries include foreign inputs in their processes. Furthermore, it allows the identification of sectors that rely most heavily on imported components to compete in foreign trade.

  The indicators use value added, exports, and imports as variables of study. They describe the value added produced abroad that is contained in the exports of the domestic economy and in the imports of Spain. In other words, what part of the total value of Spain's exports and what part of the total value of Spain's imports has been produced abroad.

  The classification variables used are the country of origin/destination of the import/export and the use (final demand/intermediate demand) of the imports/exports.

– Employment:

  Employment generated by exports offers a key perspective on the link between foreign trade activity and the Spanish labour market. These indicators quantify the number of employed people who depend, directly or indirectly, on international demand for goods and services produced in Spain, highlighting the role of foreign

trade as a driver of job creation. Their analysis allows us to assess the sensitivity of employment to changes in trade flows and to understand how different productive sectors contribute to employment through their integration into global markets. Furthermore, it allows the identification of economic sectors with the greatest capacity to translate export growth into job opportunities.

The indicators use employment (in terms of employed people) and exports as study variables. They describe the employment of the domestic economy linked to the production of exported goods and services.

The classification variables used are the branch of activity of the domestic economy and the country of destination of the exports.

– CO2e emissions:

Greenhouse gas emissions associated with exports offer a key perspective on the environmental impact of foreign trade on the Spanish economy. This indicator quantifies the amount of emissions generated, directly or indirectly, throughout the production processes intended to meet the international demand for goods and services. Its analysis allows us to assess the climate footprint of the export model and understand how different sectors contribute to emissions based on their specialisation and energy intensity. Furthermore, it allows for the identification of opportunities to move towards a more sustainable international integration through the decarbonisation of value chains.

The indicators use as study variables the greenhouse gases emitted (Tons of CO2 equivalent) and the imports/exports of Spain. They describe the emissions of polluting gases generated in Spain/in the rest of the world by the production of goods and services exported/imported by Spain.

The classification variables used are the branch of activity of the domestic economy and the country of origin/destination of imports/exports.

In the study variables, the variables that are the fundamental focus of the statistics are mentioned, and those variables that are collected only for the purpose of analysing the former are included as classification variables. The geographical classification variable is not specified as such because it is already referenced at the level of disaggregation. Only if the geographical classification is not the standardised one (national, regional, provincial, municipal or lower) but another division of the territory, is the classification in question be specified.

5.5 BASIC STATISTICS

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 2022 and providing annual results for each year t, referring to year t-2. Currently, the result series is available from 2010.

Additionally, the results of employment, production, and value added by activity sector from Spain's National Accounts are used, as well as the gas emissions from the Air Emissions Accounts, produced by the INE.

Eurostat publishes most of the indicators included in the panel for all EU countries within a set of globalisation indicators (*Macroeconomic Globalisation Indicators*[1]*),* but it does so in a flat file format for download by specialised users, without including any tabulation or viewing tools.

In addition to the tabular and graphical display of indicators relating to the Spanish economy, the Panel adds the following indicators, which are calculated by the INE itself:

- CO2e emissions linked to Spain's exports and imports.
- The total domestic value added contained in the total exports of other EU-27 countries, as a percentage of total exports from Spain (*Forward participation*).
- The total external value added contained in Spain's total exports, as a percentage of Spain's total exports *(Backward participation).*
- The indicators expressed in terms relative to domestic macroeconomic aggregates (GDP/Value Added and employment by branch of activity).

6 Characteristics of the project

The compilation of the indicators to be included in the panel is carried out within the conceptual framework of the current national accounts systems (SEC 2010, in the case of Spain).

The application of the Leontief model to the MRIO tables of FIGARO allows us to estimate the production required to meet a given demand within a multi-regional 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.

[1] https://circabc.europa.eu/ui/group/cec66924-a924-4f91-a0ef-600a0531e3ba/library/c0c0efc4-27bc-41f4-8de6-f309446559e7?p=1

6.1 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 specialised literature, the elements of matrix A 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:

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

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

Value added, employment and emissions linked to exports in each case are obtained from the domestic 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 ⟨ ⟩). Diagonalising a vector consists of defining a square matrix with the vector values on the main diagonal and zeros in the rest of the entries.

– $\langle v^{ES} \rangle L^{ES} e^{ES}$: 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

7 Dissemination plan and frequency

7.1 DISSEMINATION PLAN

The results are available in graphical and tabular format. The results will be accompanied by their corresponding methodology and metadata, as well as a press release to facilitate their interpretation. This material is essential to facilitate the interpretability of the indicators and clarify the possible limitations of those indicators in the analysis.

7.2 DISSEMINATION FREQUENCY

The results published in each year t will cover up to reference period t-2.

Experimentally, 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, always in coordination with the publication of the FIGARO results by Eurostat.

8 Implementation schedule

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

The Dashboard is scheduled to be published on the INE website in July 2026, with data referring to 2024 and the update of the series available up to 2023, all in accordance with the results of FÍGARO.

This product is included in the Inventory of Statistical Operations (IOE) and will be disseminated annually.

9 Cost estimation

As this is a summary operation, the associated costs correspond to the personnel costs involved in drawing up the account. Therefore, these would be Chapter 1 expenses, estimated at 36,000 euros annually, according to the methodology for estimating budget appropriations and the investment programme of the 2025-2028 National Statistical Plan (PEN).