October 27, 2023

TERRA

TERRA (*imporT ExpoRt netwoRk Analysis*) is a tool built to enable exploratory analysis of open data from Eurostat sources on international trade through dynamic and interactive tools. The system enables exploration of phenomena related to the dynamics of global value chains (GVCs). The advantage of this new economic organization is well-known: firms gain economic benefits through foreign direct investment or by outsourcing production, relocating some production stages to countries where high specialization or an advantageous labor market create more opportunities. However, the GVC structure has proven to be highly susceptible to shock transmissions and supply chain disruptions associated with geo-political events or epidemiological crises as in the case of Covid-19. In this context, through Graph Analysis, TERRA offers researchers and policy makers the opportunity to explore the dynamics of trade flows, with the possibility of focus on specific products and transport modes, tracing the critical phases of recent years. It also makes it possible to simulate flow disruptions or closures of specific logistics hubs or transport routes, giving a way to outline possible scenarios of modification or relocation of global chains capable of mitigating the risk of transmission shocks (changes in bilateral relations between countries, logistics or transport investments, increased foreign investment, etc.).

TERRA presents graphic sections that illustrate the evolution of trade flows not only in trade volumes, but also in terms of the composition of the basket of traded goods.

The dashboard can be accessed at the following link:

https://www.terra.istat.it

European Big Data Hackathon

The European Big Data Hackathon is an international competition (hackathon) organized by Eurostat as part of the *New Techniques and Technologies for Official Statistics* (NTTS) conference. Teams of experts (data scientists, researchers, methodologists, domain experts, etc.) from different European statistical institutes participate in the competition with the aim of implementing innovative products that integrate traditional data sources and Big Data sources.

As part of the competition, teams must produce a product that responds to a *policy question* related to a pressing issue in the European context (e.g., COVID-19) and/or a statistical problem (integration of Big Data sources, use of new data collection tools, increasing the quality of outputs of certain production processes, etc.).

The team that represented Istat (Team-Istat) made the first prototype of TERRA during the competition held virtually on February 26 - March 4, 2021. Team-Istat achieved **first place in the competition**. More details about the hackathon can be found at the following link:

https://ec.europa.eu/eurostat/cros/BD_Hackathon2021_en

The product presentation is available on Vimeo, in the video we refer to TERRA, in name we had given to the dashboard during the competition.

Data sources used and methodology

TERRA processes monthly about one billion records on foreign trade in goods produced by the 27 member countries according to harmonized methodologies publicly available on Eurostat's COMEXT database. The information base provides official estimates of trade flows in monetary value and physical quantities at the highest granularity in temporal resolution (monthly frequency), characteristics of traded product, trading partner countries, mode of transport.

The main functionalities implemented in TERRA allow for the analysis of the impact of shocks in the means of transportation and the effects of disruptions in cross-country trade relations for specific products with *social network analysis* techniques, implemented in Python, offering a set of indicators proper to *graph analysis*.
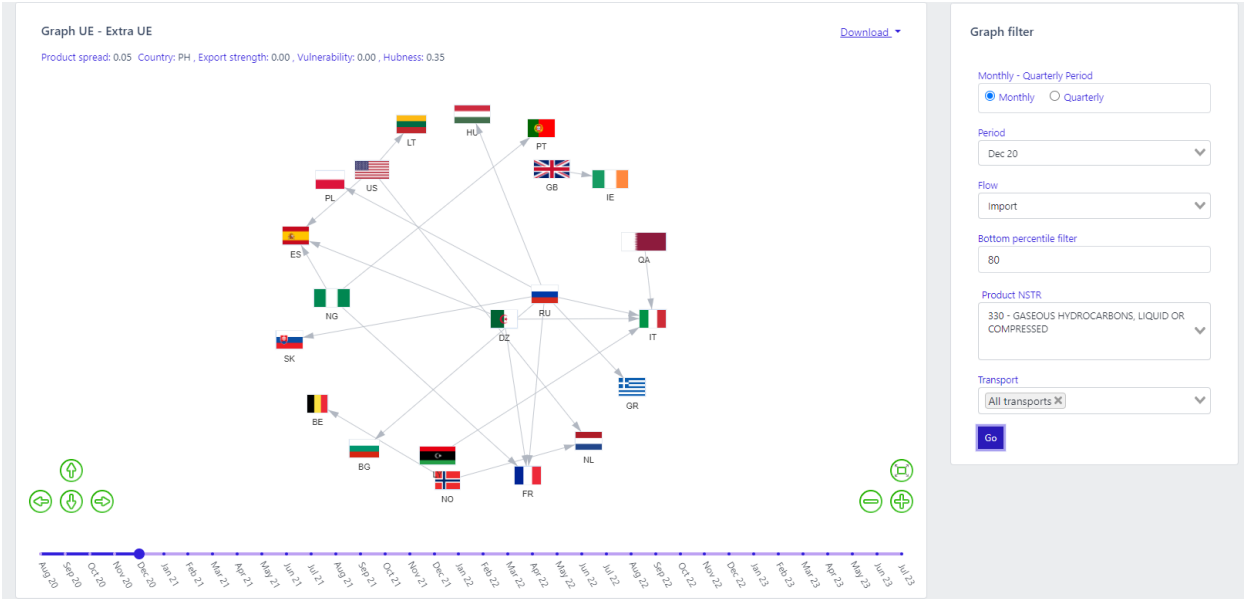

Graph regarding gas imports in December 2020

Interactive map

The interactive map is one of the components of TERRA that allows visualization of "Economic and International Trade Indicators" of EU countries. The map allows you to view the trend changes, on a 2019 basis, in imports and exports for each EU country.

The visualization of countries in the geographic map has a dual mode of representation: one through "Circular Markers," positioned according to the coordinates that identify that given country, and the other through the application of a layer of "Features geojson," which highlight the geographic boundaries of each individual country. In addition, a "time-lapse" feature is available in the TERRA map, using a cursor, to display monthly trend changes in international trade over a given time period.
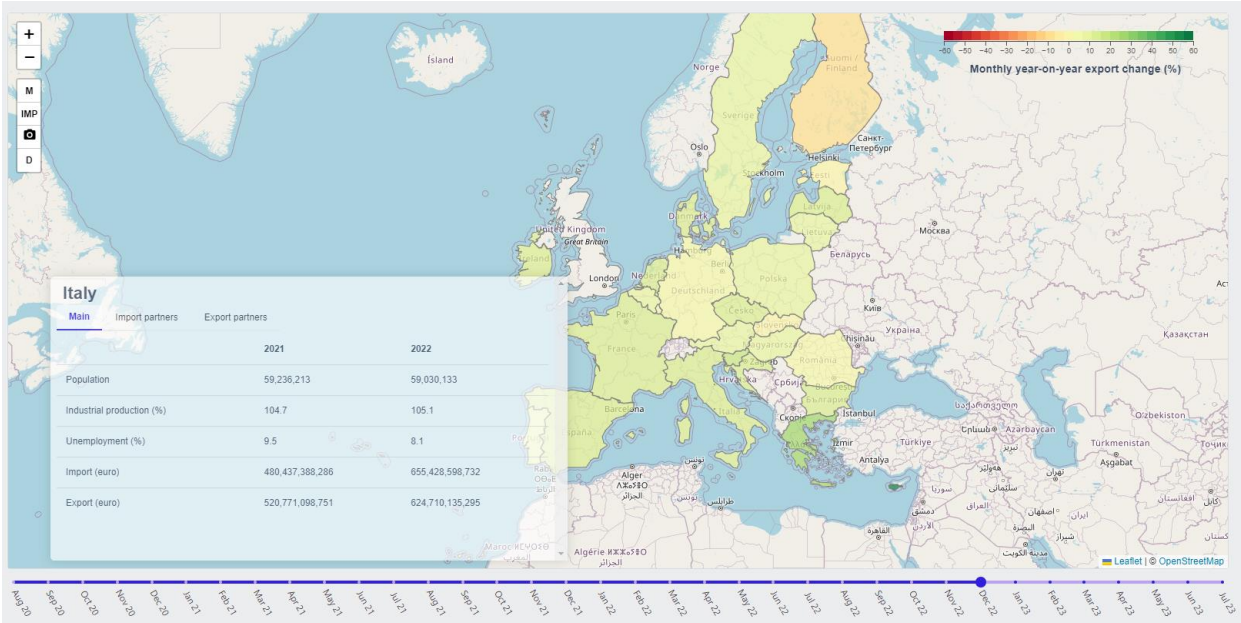
Map relating to the trend change in exports to December 2022

Graph Analysis

The *graph analysis* sections allow visualization of graphs representing international trade through two panels:

- by product (NSTR classification) and mode of transport from COMEXT source, together with relevant global and local measures detailing the structure of trade relations between EU countries those in the non-EU area (*trade between EU countries and trade between non-EU countries are excluded*)

- international trade by product (CPA classification 2.1) from COMEXT source, together with relevant global and local measures detailing the structure of trade relations from EU countries to/from each trading partner country (*trade between non-EU countries is excluded*)

Panels allow the construction of graphs representing the structure of international trade relations. In addition to graph visualization, centrality measures are calculated, which add quantitative information about the role each country plays within the network.

The panels are interactive and offer the ability to apply different filters and see how the graph structure and related metrics change accordingly, giving the opportunity to explore different scenarios:

- **Monthly-Three Monthly Period:** selects the relevant time window, monthly or quarterly.
- **Reference period:** selects the reference period to which the data represented by the graph refer (a specific month/year or quarter/year).
- **Flow:** select "import" or "export," which means whether the data are taken from the database of declared imports or declared exports from EU countries.
- **Bottom Percentile Filter:** with respect to a selected network of trades among countries relating to the filters set by the user (Period, Flow, Product and Means of Transport), the "Bottom Percentile Filter" allows to remove a certain percentage of minor exchanges (in terms of Euros) from the visualization. With respect to the series of data sorted in ascending order, this filter (an integer value between 0 and 100) represents the trades below a chosen percentile which are removed from the graph. By selecting 10, the 10% of the minor trades are removed from the graph and the 90% of the major trades are displayed. Selecting 0 the dashboard displays all exchanges.
- **Products NSTR/CPA 2.1 - 3 digits:** selects data against the traded product, the user can select a single product, or all products considered together. In the "Graph EU - Extra EU" panel, products are listed according to the "NSTR" classification, and in the "Graphs EU - World" panel according to the "CPA 2.1 - 3 digits" classification.
- **Means of transport:** selects data with respect to the means of transport used in the exchange. Means of transport are "unknown," "sea transport," "rail transport," "road transport," "air transport," "postal consignments," "fixed transport facilities," "water transport," "own propulsion" (this filter is available only in the "EU - Extra EU graphs" panel). Thus, the application allows exploratory analysis, monitoring of the international trade network and detection of changes.

Another feature provided by the application is the ability to do scenario analysis by visualizing the effects that the disruption of one or more trade relationships between countries has on the structure of the international trade network. Scenario analysis can be done by eliminating all links in a given country, eliminating a single link between two countries, or a specific means of transportation.
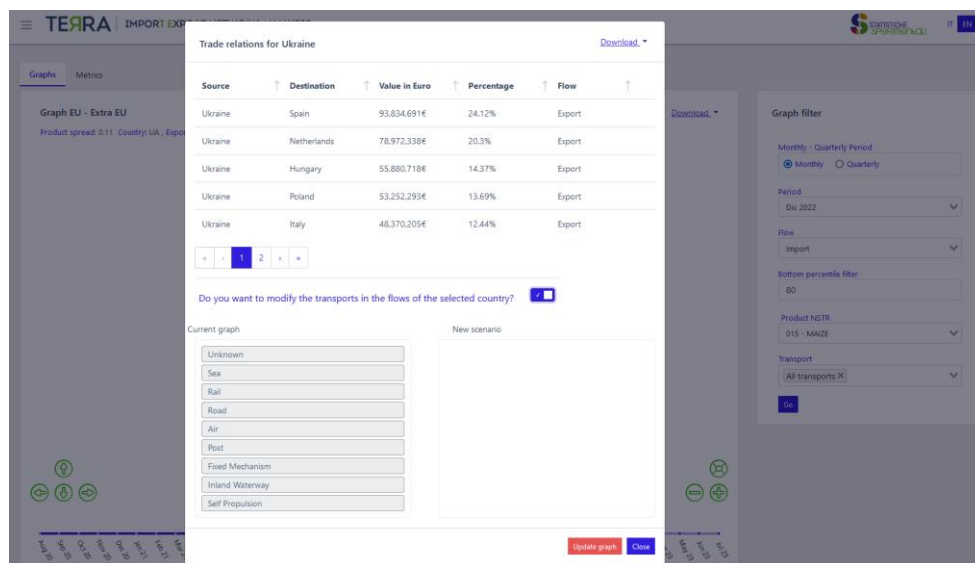
Scenario analysis regarding the import of corn into Ukraine as of December 2022

Time series

This section allows visualization of series in level and in change of trade flows between countries in value and quantity by individual product category, while providing some tools for series analysis, QQ Norm Plot and autocorrelation function.

Monthly data are fed from the COMEXT dataset from the PRODUCTS folder of the Eurostat bulk download. The data are updated monthly. The most recent month displayed in this section, represents the most up-to-date data available and appears in the dashboard header.

The goal of this section of the dashboard is to provide users with a tool that can find and visualize a large amount of data quickly and easily. TERRA manages and combines many monthly datasets and allows the selection of individual monthly time series under investigation by the user. TERRA collects and manages 1,375,704 time series representing the level of imports and exports of 33 Products for each of 27 European countries against 192 partners and all world destinations, in euros or kg both raw and annual changes.

The user has a set of filters available to choose a single data set to display with a graph. The filters are as follows:

- **Type of series:** raw data series or trend change series (value at month t minus the value in the same month of the previous year).
- **Data type:** in value or quantity.
- **Flow:** Import or Export.
- Country**:** EU country.
- **Partner:** EU and non-EU country.
- **Products:** 2-digit CPA product classification (classification can be found in the Annex Classifications).

The main graph also shows the mean and standard deviation for the selected series.
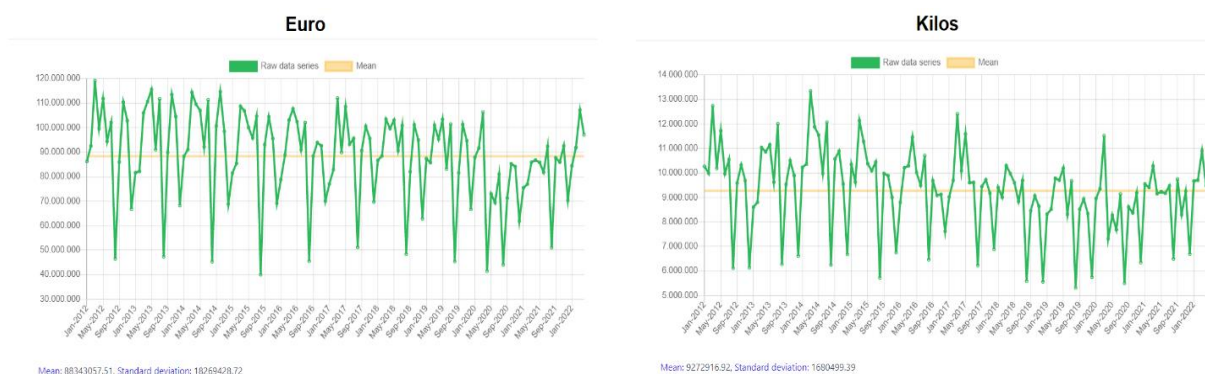
Historical series in monetary value and quantity related to Italian textile exports to Germany
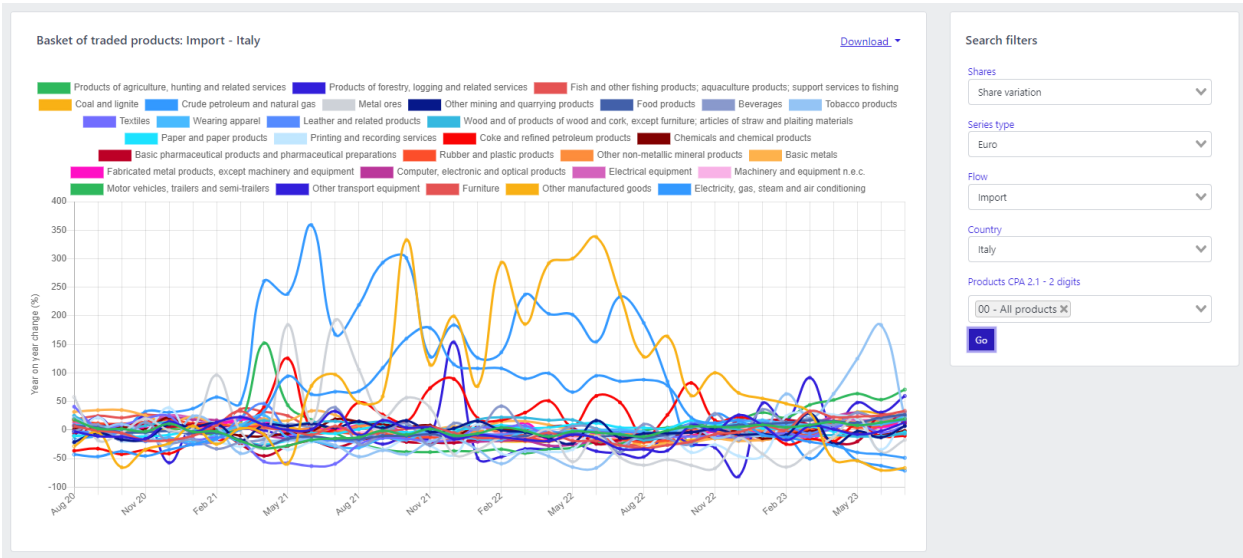
BASKET OF TRADED PRODUCTS

The graphic section on the basket of traded products depicts monthly trend changes in the shares of specific types of exported or imported products, defined according to the two-digit breakdown of the CPA 2.1 classification, for each Member Country.

The interest of the section lies in the possibility of monitoring which types of products are mainly in demand during periods of market imbalance associated with times of crisis and subsequent economic recovery.

In the panel there is a form on the right that allows the following fields to be selected:

- **Variation:** in value or quantity.
- Country**:** EU country.
- **Product:** the product of interest, according to the two-digit CPA 2.1 classification. The user can select a set of products or can select the "All products" product. In this case, the application will present all products in the graph.
- **Flow:** Import or Export.

It is possible to deselect the products of interest by clicking on the relevant labels shown at the top of the chart itself. The user can export the graph in different formats jpg, png, pdf by clicking the "Export" button. In addition, one can download the data shown in the graph in csv and json formats, again by pressing the "Download" button.

Basket of traded products: Import - Italy

Download ▾

Legend:
- Products of agriculture, hunting and related services
- Products of forestry, logging and related services
- Fish and other fishing products; aquaculture products; support services to fishing
- Coal and lignite
- Crude petroleum and natural gas
- Metal ores
- Other mining and quarrying products
- Food products
- Beverages
- Tobacco products
- Textiles
- Wearing apparel
- Leather and related products
- Wood and of products of wood and cork, except furniture; articles of straw and plaiting materials
- Paper and paper products
- Printing and recording services
- Coke and refined petroleum products
- Chemicals and chemical products
- Basic pharmaceutical products and pharmaceutical preparations
- Rubber and plastic products
- Other non-metallic mineral products
- Basic metals
- Fabricated metal products, except machinery and equipment
- Computer, electronic and optical products
- Electrical equipment
- Machinery and equipment n.e.c.
- Motor vehicles, trailers and semi-trailers
- Other transport equipment
- Furniture
- Other manufactured goods
- Electricity, gas, steam and air conditioning

Search filters

Shares
Share variation

Series type
Euro

Flow
Import

Country
Italy

Products CPA 2.1 - 2 digits
00 - All products ✕

Go

Change in the basket of products imported from Italy