Cosmopolitics - Graph Analysis

We used “Monthly COMEXT data by Means of Transport” to build the graph of international trade relations and use standard graph measures to characterize the relations structures.

International Trade Relations

We built different graphs according to different values of several filters, implemented in the “International Trade Relations” Panel of the released dashboard. The filters are:

- “Period”: indicates the time period of interest to build the graph. Graph can show international trades of a specific month or a specific year.
- “Percentage”: indicates the percentage of all trades we want to take into account in the graph. It is an integer taking values from 0 to 100. Once the percentage value is selected the data are filtered according to the following procedure (Ref 1): all the amounts traded between countries (all edges) are listed in a descending order, then the cumulative sum is calculated along the list. All the trades associated to a cumulative sum above the percentage value, taken as threshold, are filtered out. This means that small trading amounts are considered in the graph only when “percentage” takes an high value.
- “Transport”: indicates the means of transport taken into account in the data used to build the graph. The possible means of transport are the ones in the Comext database, that is “unknown”, “sea”, “rail”, “road”, ”air”, “post”, “fixed mechanism”, “inland waterway”, “self propulsion”. The graph is build considering all the means of transportation or only a subset of them.
- “Product”: the graph is build considering only a single product of interest or all of them together.
- “Flow”: is a filter that can take only two values, “Import” or “Export”, and the visualized graph would represent the corresponding trades, that is data coming from ..database in the case of “Import” value and data coming from ..database in the case od “Export” value.
- “Weight”: is a boolean filter that can be either “True” or “False”. In the “False” case the built graph will be unweighted while in the “True” case the built graph will be a weighted graph where the weights values are the amounts associated to the trades.

Once all the filters are instantiated a graph is built and visualized. Countries are identified by their flags and their relative positions are given by the “Spring layout algorithm” implemented in the Networkx library.
Moreover, several centrality measure are calculated and displayed in the dashboard:

- “Product spread”: it matches the density of the graph and represents how much the product is spread through the graph.
- "vulnerability": it is calculated as 1 - the indegree centrality for each country. The vulnerability conveys the message that a country receiving a product from several countries is less dependent on singles countries with respect the product supply.
- “exportation strength”: it matches the outdegree centrality for each country.
- "hubness":it matches the betweenness centrality of the countries.

Through the implementation of the above analysis and filtering in the dashboard, is it possible to visualize different graphs and measures for several combination of filters values.
Furthermore, it is possible to delete one or more links from the graph and see how it and its measures change. That allows to detect changes and to evaluate effect of actions in scenario analysis.

Another functionality useful for scenarios analysis is performed as described in the following:
imagine a country that imports a product from a specific country decides to suspend the trading relationship with it. The function gives suggestion of other countries exporting the same product as possible alternative partners.

For graphs based on importation data it is in fact possible to select an existing link between an exporting country and an importing country. Considering the importing country as the reference country, the function finds its possible partner alternative as follows:
The function finds the list of all countries in the graph that are roots, meaning that are original exporting countries of the product as having a zero indegree centrality value. For each root country it gives:

- its outdegree centrality value. It shows how many different exporting partners the given root country already has.
- the shortest path between the given root country and the reference country existing in the given graph.
- the shortest path between the given root country and the reference country existing in the global graph of all the traded product.

Those information can be useful to evaluate new possible trade partners.

Another output of our work is an animation showing how the trading graph of all product changes over time. In particular between February 2020 and March 2020 it shows the "Brexit" effect, with the change of the relative position of the Great Britain in a more peripheral area of the graph with respect the European countries.

Graph on COMEXT and ITGS integration

The same approach is used in the section "Graph on COMEXT and ITGS integration". The analysis is based on the integration between COMEXT (full) COMEXT (transport) and ITGS_reference, this allows navigate products a t a high level of disaggregation (the analysis is focused on medical products) at maximum time resolution, and gaining information about both country of origin and consignment. We build the graph taking into account Origin and Destination countries.

All the graph analysis and calculations are performed through the Python Networkx Library.

References:

1) L. De Benedictis, S. Nenci, G. Santoni, L. Tajoli, C. Vicarelli "Network Analysis of World Trade using the BACI-CEPII dataset." CEPII Document de travail N 2013 – 24 August.