

Against gravity: Network models of the international trade

The organization of international trade: Export assortativity

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The views expressed do not necessarily reflect those of the BdI.

THE TWO PAPERS IN BRIEF

Main questions:

- From the macroeconomy to the international trade network (*Against gravity*):
 - Can we infer the network structure of international trade from partial information?
 - Can we do it from information that does not relate to trade in the first place?
- From the international trade network to the macroeconomy (*Export assortativity*):
 - Can we learn something from such a structure about the underlying economy?
 - Is this structure consequential for the economy?

FROM PARTIAL INFORMATION TO NETWORKS

Can we infer the network structure of international trade from partial information?

- Topology:
 - from degree distributions (number of trading partners);
 - maximum-entropy (binary configuration) and fitness models.
- Weight sequence:
 - from node “size” (total exports and total imports);
 - maximum-entropy (weighed configuration) and gravity models.

A fair comparison? Discrete vs continuous pair-wise matching.

FROM PARTIAL INFORMATION TO TRADE NETWORKS

Can we infer the ITN from information that does not relate to trade in the first place?

- **Network formation:** Maximum entropy from node-specific information, Random graphs from link probability, (S)ERGMs from global characteristics.
- **Trade network formation:** Gains from trade from differences in technology and in factor endowments, market power, institutions.
- **Gravity:** GDP and distance as proxies.

Why GDP and not other macroeconomic variables? Why linear and not something else?

THE MISSING FEATURES FOR POLICY

- **Why** these patterns and not others? Assortativity not a “coincidence.”
- **Which implications** of the (trade) network structure? Welfare and efficiency.
- **What discipline** for the comparisons? Eyeballing vs fit.

THE USE FOR INFERENCE OVER OBSERVATION

We do observe the ITN, so why should we try to infer it?

- Given countries' characteristics, to learn about the mechanics of trade network formation.
- Given the mechanism of ITN formation, to learn about countries' characteristics.

→ Need for a micro-founded, structural model to calibrate/estimate.

(→ Need to retain directionality.)

THE DESCRIPTION OF THE ITN

How can network theory help to describe international trade?

- Extract **additional information** on “classical” topics:
 - interdependence and complexity;
 - the role of directionality and of intensive vs extensive margins.
- Suggest **new issues**:
 - local-global dichotomy;
 - centrality and systemic relevance.
- **Visualization** techniques:
 - from physical space to topological space;
 - position as variable of interest and not mere mental map.

FROM THE ITN TO THE MACROECONOMY

Can we learn something about the underlying economy from the ITN structure?

Observation of ITN:

- Export price assortativity (EPA) is generally negative;
- Relative export density (RED) is generally positive;
- Both tend to zero over time.

Inference over the macroeconomy:

- Exports flow from countries with low prices to countries with high prices;
- Exports flow from specialized countries to unspecialized countries;
- Convergence.

FROM THE ITN TO THE MACROECONOMY

Theory: Competitiveness and comparative advantage, negative relation between EPA and RED.

Counterexample: Italy's low tech sector.

Check heterogeneity across

- country groups (geography, development);
- product technologies (level, energy, intermediates).

Rich countries and high technologies show a positive correlation.

→ Non-price factors.

THE USE FOR NETWORK THEORY IN TRADE

It seems we do not need a network perspective for the previous evidence. **What can we deliver that others cannot?**

For example: Quantify similarities across commercial partners by means of ITN's **Laplacian**: $\mathbf{L} \equiv \text{diag}(\mathbf{C}_D) - \mathcal{L}$.

- “Local” property:

$$\mathbf{x}^\top \mathbf{L} \mathbf{x} = \sum_{(i,j) \in \mathcal{L}} (x_i - x_j)^2,$$

the closer this value to 0, the more similar the partners.

- “Global” property:

the second-lowest eigenvalue of \mathbf{L} measures network's connectivity (the higher the eigenvalue, the more difficult to separate the ITN into disconnected components by selective elimination of trade links).

EXPORT ASSORTATIVITY AND EXPORT GROWTH

Is the ITN consequential for the macroeconomy?

Export growth regressions with Bayesian averaging of different specifications:

- no identification, no causality;
- counterintuitive predictions (government size, stock market capitalization, government effectiveness);
- positive correlation between EPA and export growth most likely the result of **integration in global markets** (convergence in prices and increase in exports): **endogeneity from omitted variable**.

AN EXAMPLE ON HOW TO COMBINE THE TWO PAPERS

Is the recent evolution of EPA and RED similar to what happened in the past?

- Previous “globalization” episode of the late 19th century.
- Partial trade data.
- How sensitive to partial observation of the ITN (or sampling) are EPA and RED measures?
- Need to infer the past ITN from other observables.

AGGREGATION AND HETEROGENEITY

- In both contributions, the authors aggregate and draw inference for the system as a whole.
- They lose the identity of agents and interactions.
- Macroeconomics: From representative agents to heterogeneous agents to **heterogeneous interactions** (Kirman, Kranton, Carvalho, Acemoglu, . . .).

OBSERVED NETWORKS AND UNDERLYING STRUCTURE

- Observed networks are a product of an interaction over a structure under temporary circumstances.
- Change the circumstance and the observed network is different.
- Does policy affect the circumstances or the interaction? We only observe the product of the two.
- We are interested to infer:
 - the invariant structure on which the interaction took place (the **structural** network);
 - the mechanism that connects variable circumstances to variable interactions (the observed **endogenous** network).

INTERNATIONAL TRADE AS A COMPLEX OBJECT

Nodes (and links):

- countries (import-export),
- industries/products (input-output),
- firms (import the input-export the output).

Combinations:

- Countries and industries: Hausmann and Hidalgo 2011.
- Firms and industries: diversification and vertical integration.
- Countries and firms: multinationals (Cravino & Levchenko 2015, Chaney 2014, Alfaro & Chen 2012).