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Slides - An investigation of interregional trade network structures: Evidence from the EU and US-Canada trade

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An investigation of interregional trade network structures:

Evidence from the EU and US-Canada trade

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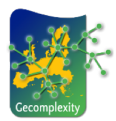


Outline

- Insights from a three-region footloose entrepreneur model
- Evidence from regional trade data:
  - US-Canada regional trade (McCallum, 1995; Anderson-vanWincoop, 2003)
  - Intra EU regional trade (Thissen *et al.*, 2015).
- Network Analysis.
  - Hints from the visualization of regional trade networks.
  - Node-level networks statistics: Centrality.
  - Local structures: Triadic census.
- Conclusions.

Part I

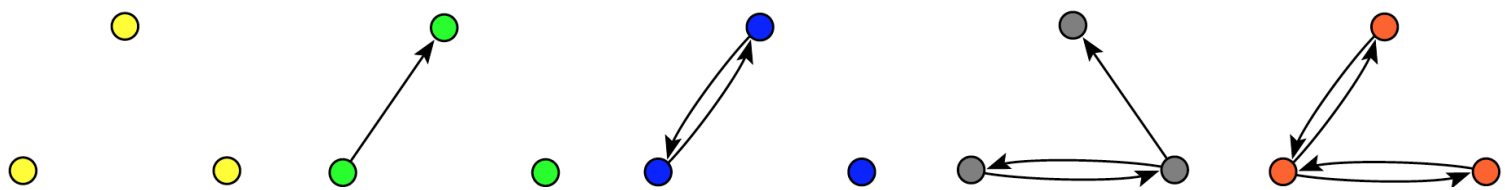
Theory

Insights from a *three-region footloose entrepreneur model*

- In standard NEG model (Krugman, 1991) all regions trade with each others, as long as trade costs are finite.
  - isoelastic demand
  - ad valorem, iceberg trade costs.
  - this outcome is orthogonal to empirical evidence
- In the linear demand version of the NEG model (Ottaviano, Tabuchi, and Thisse, 2002), this is not necessarily true.
  - In a two-region linear NEG model (Behrens, 2004, 2005, 2011), trade costs and the dimension of the local market may determine unconditional autarky and asymmetric patterns of trade, that is a one-directional flow from one region to the other, even in the presence of finite trade costs.
  - the size and density of the industrial sector, may induce differences in local prices; with lower prices in the larger market.
- Basile, Commendatore, De Benedictis and Kubin (2016) uses a linear demand three-region NEG model
  - to clarify the relationship between the intensity of competition, trade costs and the patterns of trade.
  - to identify a larger set of trade configurations other the three elementary ones that occur at the dyadic level between two regions (no trade, one-way trade from one region to the other, reciprocated two-way trade),
  - and to relate the model with characteristics of regional trade networks.

Insights from a *three-region footloose entrepreneur model*

- What the model predicts:
  - in the symmetric case, an integrated market (made of two regions) is more difficult to access than a non-integrated market (made of just one region) due to the higher level of competition;
  - for one of the two regions (or both) in the integrated market, it is easier to export towards a third region than the other way round;
- The model makes possible to envisage a specific sequence of links generation.
  - The first phase starts from the case of full autarky;
  - it proceeds to the creation of a one-directional link;
  - next, a bidirectional link between between two regions comes into existence;
  - then a further link towards a third region;
  - finally, a second bidirectional link opens the start of a similar second phase.



- Implicit in this sequence, is a corresponding reduction of trade costs.

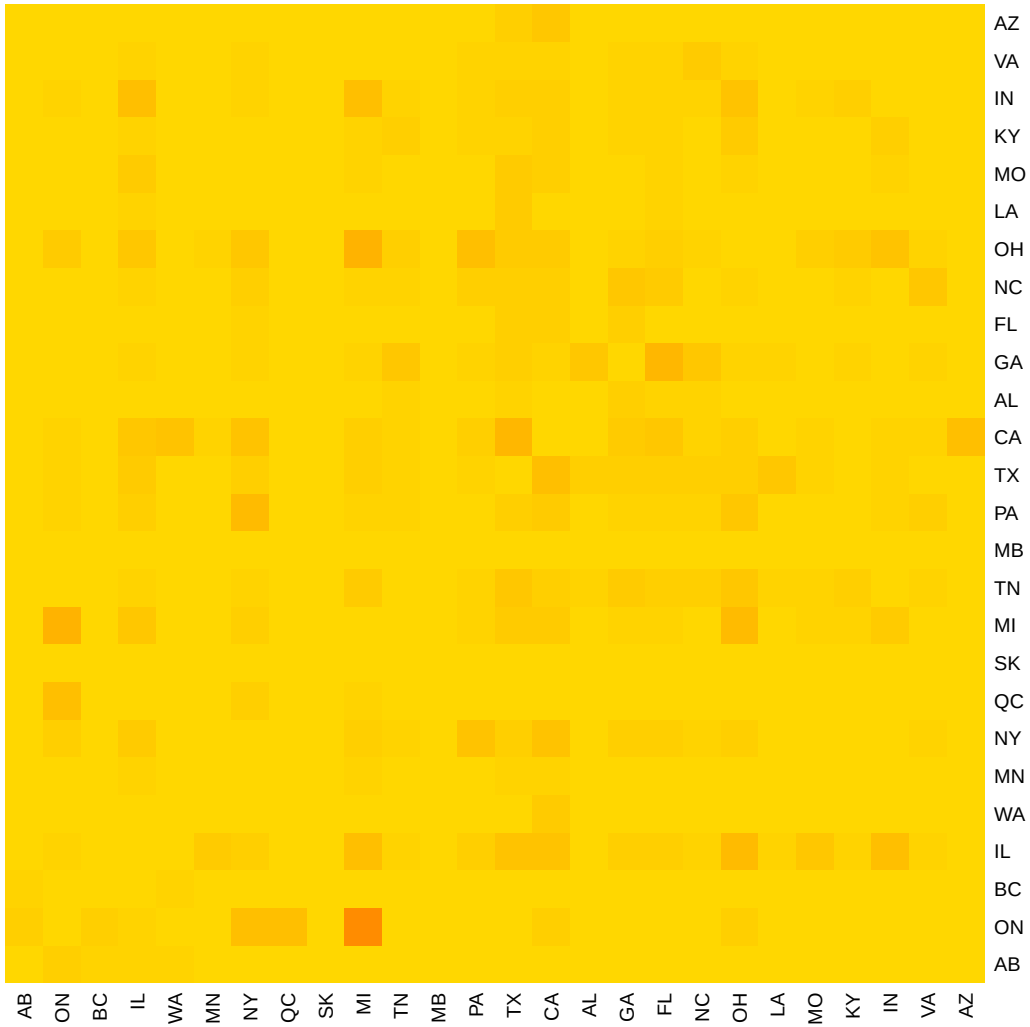
Part II

Regional trade data

Regional trade data

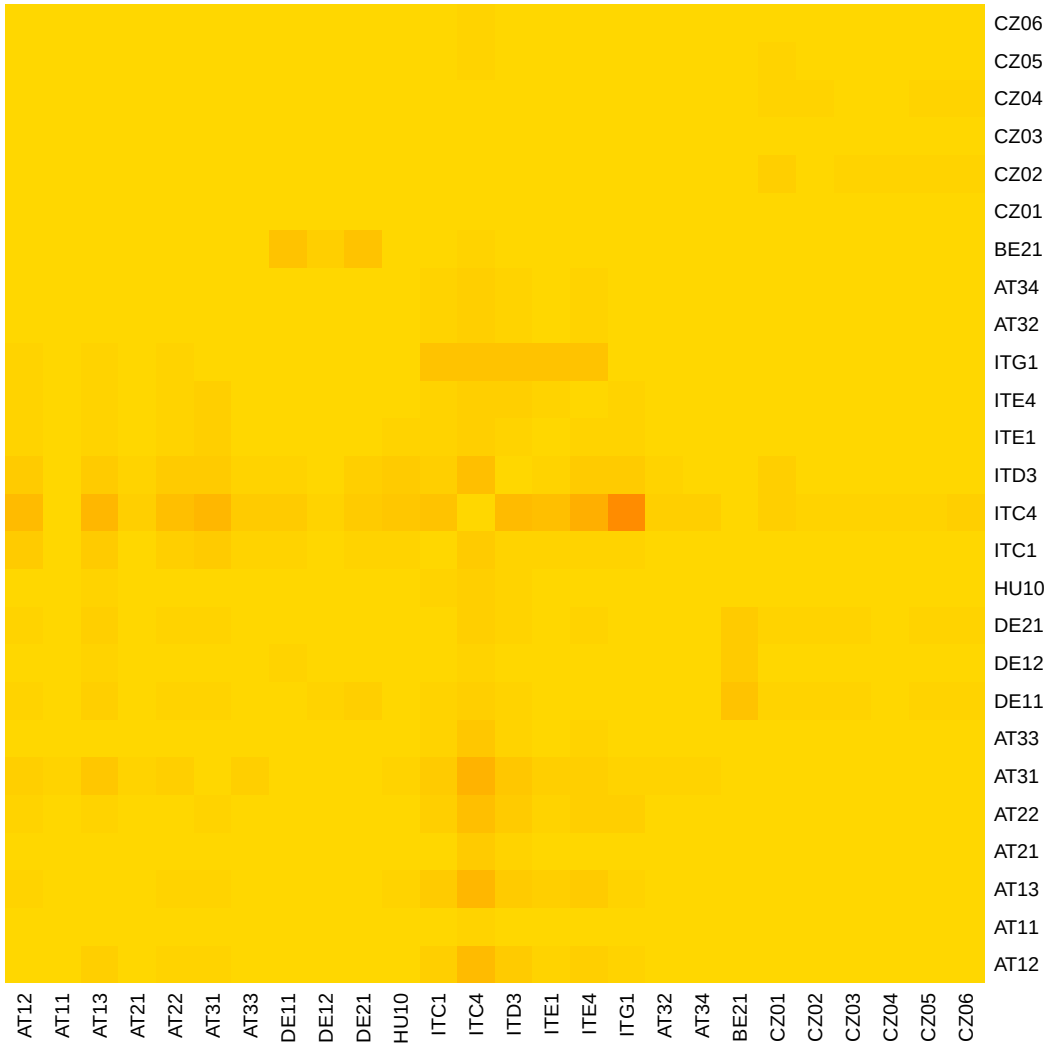
- Regional trade data is scant.
- Usually the time dimension is absent: no sequence can be traced.
- In our analysis we take advantage of two different data sets.
  - The McCallum (1995) classical dataset on US-Canada regional trade, also used by Anderson and vanWicoop (2003) and many others (the McCallum paper, that started the literature on the border effect, has 2636 citations in Google scholar).
  - The Intra EU regional trade dataset (Thissen *et al.*, 2015), is the only database on interregional trade in goods and services at the NUTS-2 territorial aggregation level, fully consistent with international trade data between the EU Member States and with the rest of the world. It is produced by the PBL Netherlands Environmental Assessment Agency.
- From the original data we retain only:
  - The information on origin and destination regions: 40 (10 Canadian regions and 30 US States) for the US-Canada data, 267 (all NUTS 2 regions) for the EU data;
  - the information on trade flows: in 1988 for US-Canada and 2010 for EU;
  - the associated binary matrix, where $\forall\{x \in \mathbb{R} | x > 0\}=1$.

Regional trade flows (USCAN subsample: 26×26)



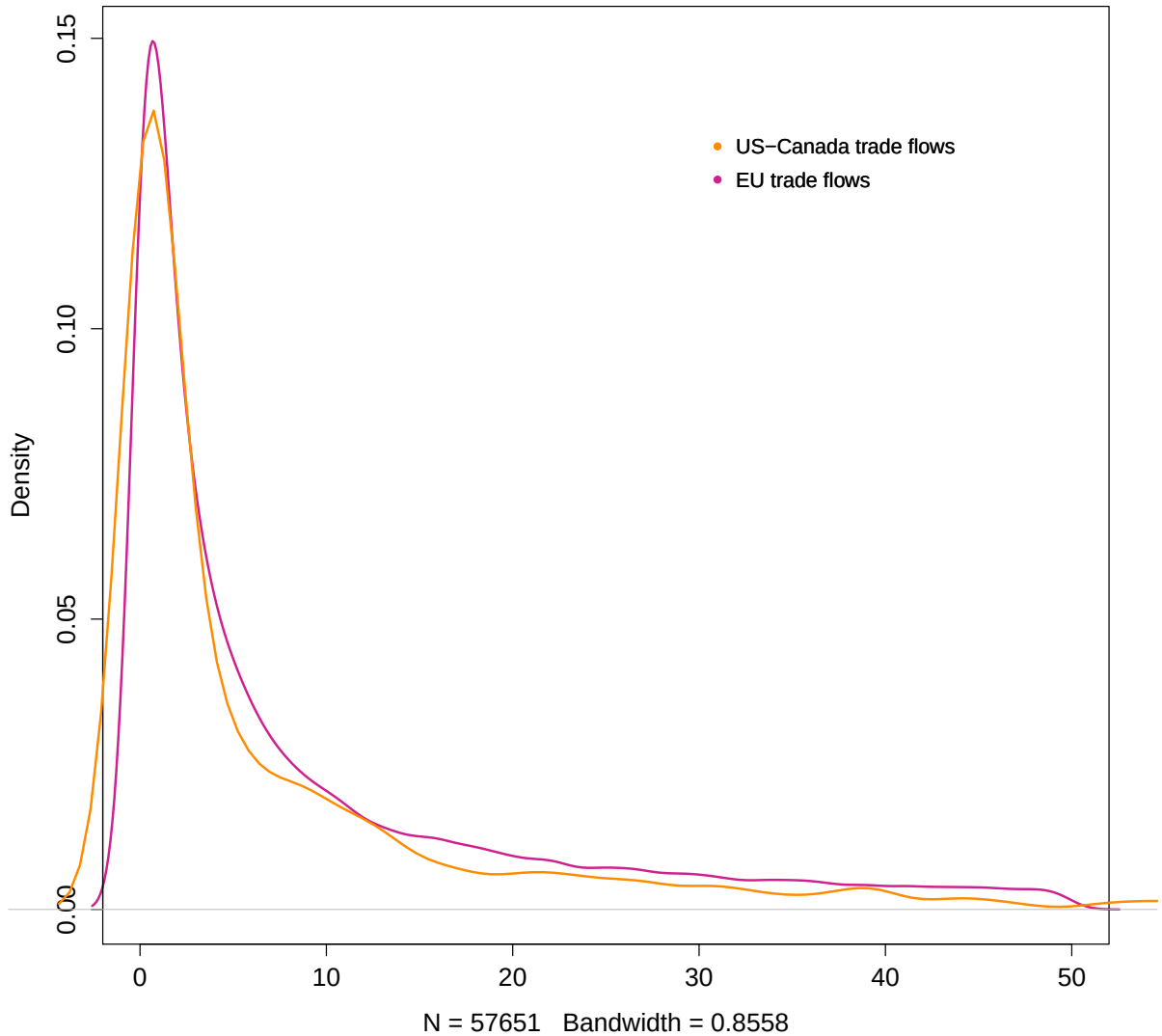
Note: The original trade matrix is 40×40. Elements on the main diagonal have been excluded from the analysis.

Regional trade flows (EU subsample: 26×26)



Note: The original trade matrix is 267 $\times$ 267. Elements on the main diagonal have been excluded from the analysis.

Regional trade flows



Part III

Network Analysis

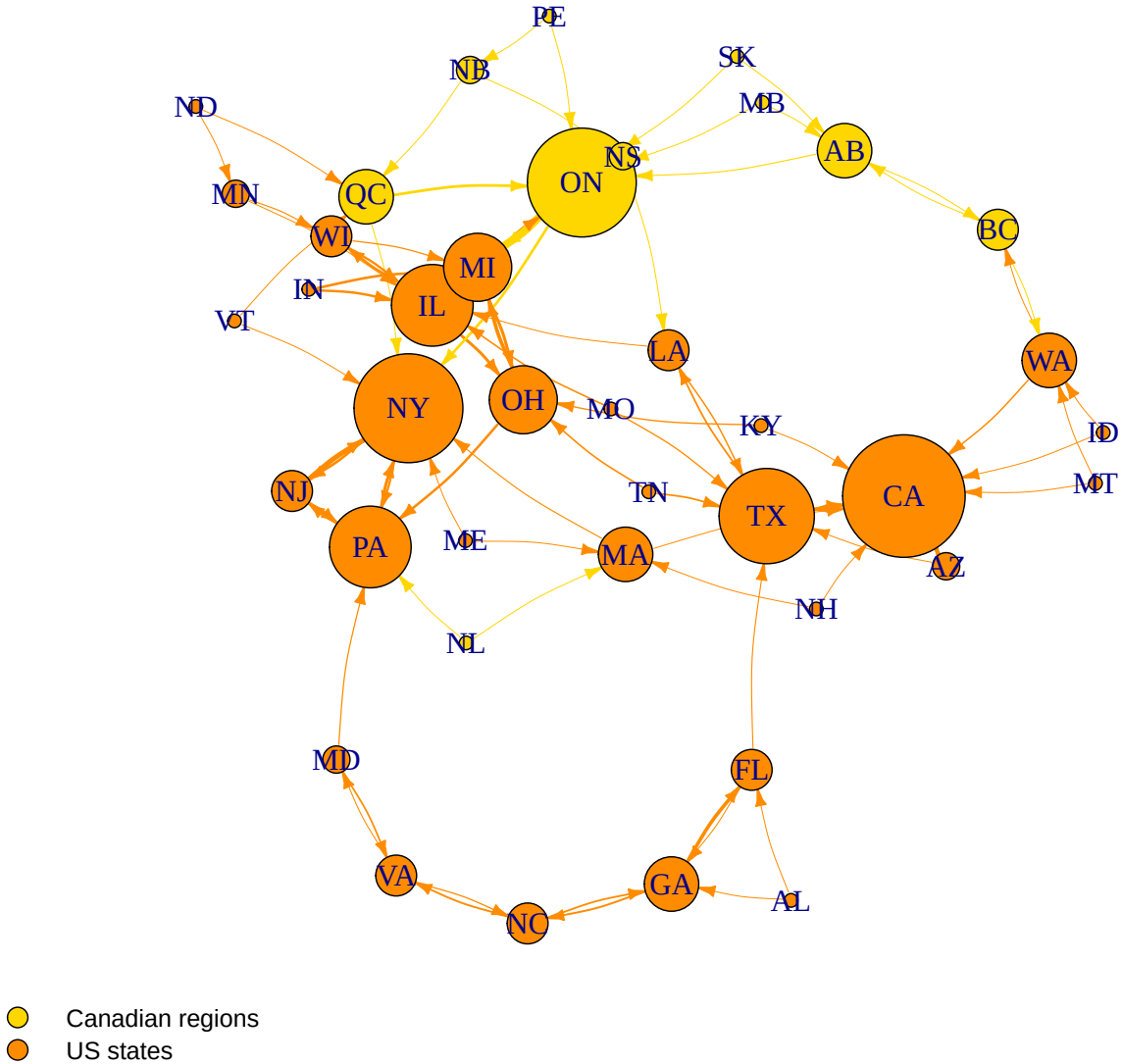
Regional trade networks

- Moving from regional trade data to regional trade networks is not a piece of cake.
- The regional trade matrix is dense: almost all elements are nonzero.
- This introduce two issues:
  - (1) network visualization is too messy;
  - (2) regions are too homogeneous in terms of inter-regional linkages.
- Two ways out:
  - (1) As far as visualization, substantially reduce the level of (redundant) information trimming the regional trade data;
    - (1a) keep the number of regions (nodes) fixed and reduce the number of trade links to a fixed number: e.g. two outgoing links for every region;
    - (1b) reduce the number of trade links up to a threshold: e.g. 90% total regional trade
  - (2) use trade values to trim the data and analyze the network statistics of the associated binary matrix.

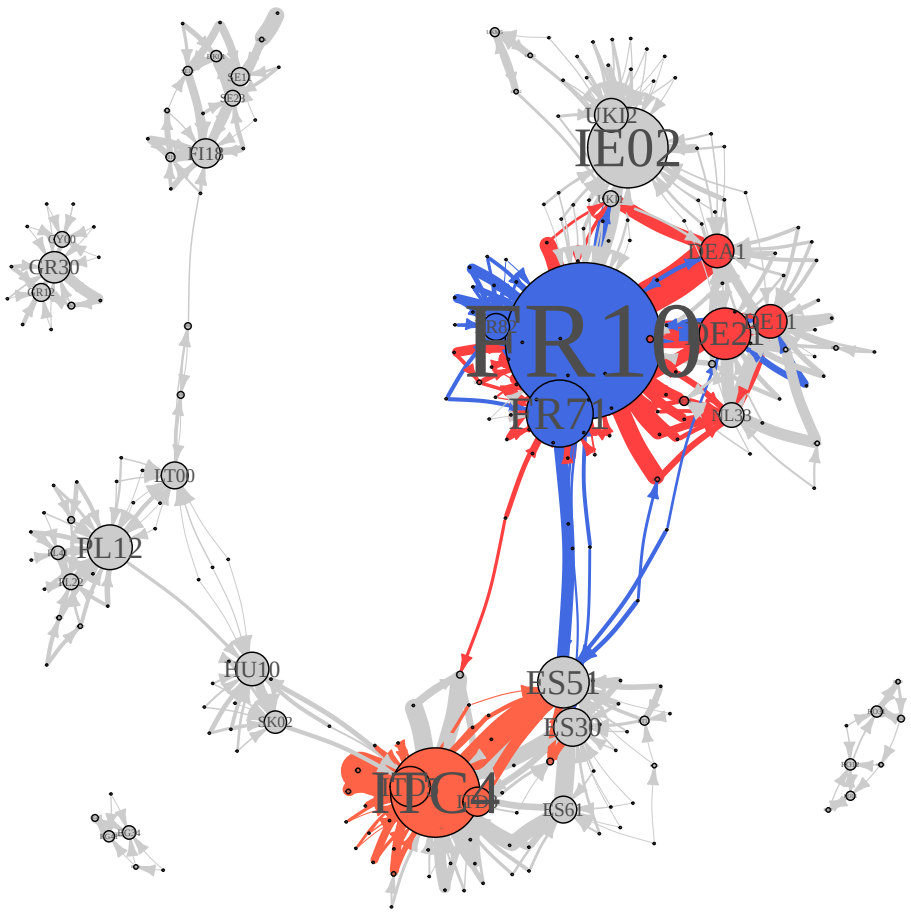
Part IV

Network Visualization

Regional trade flows: US-Canada



Regional trade flows: EU



French regions
German regions
Italian regions
Others

Part V

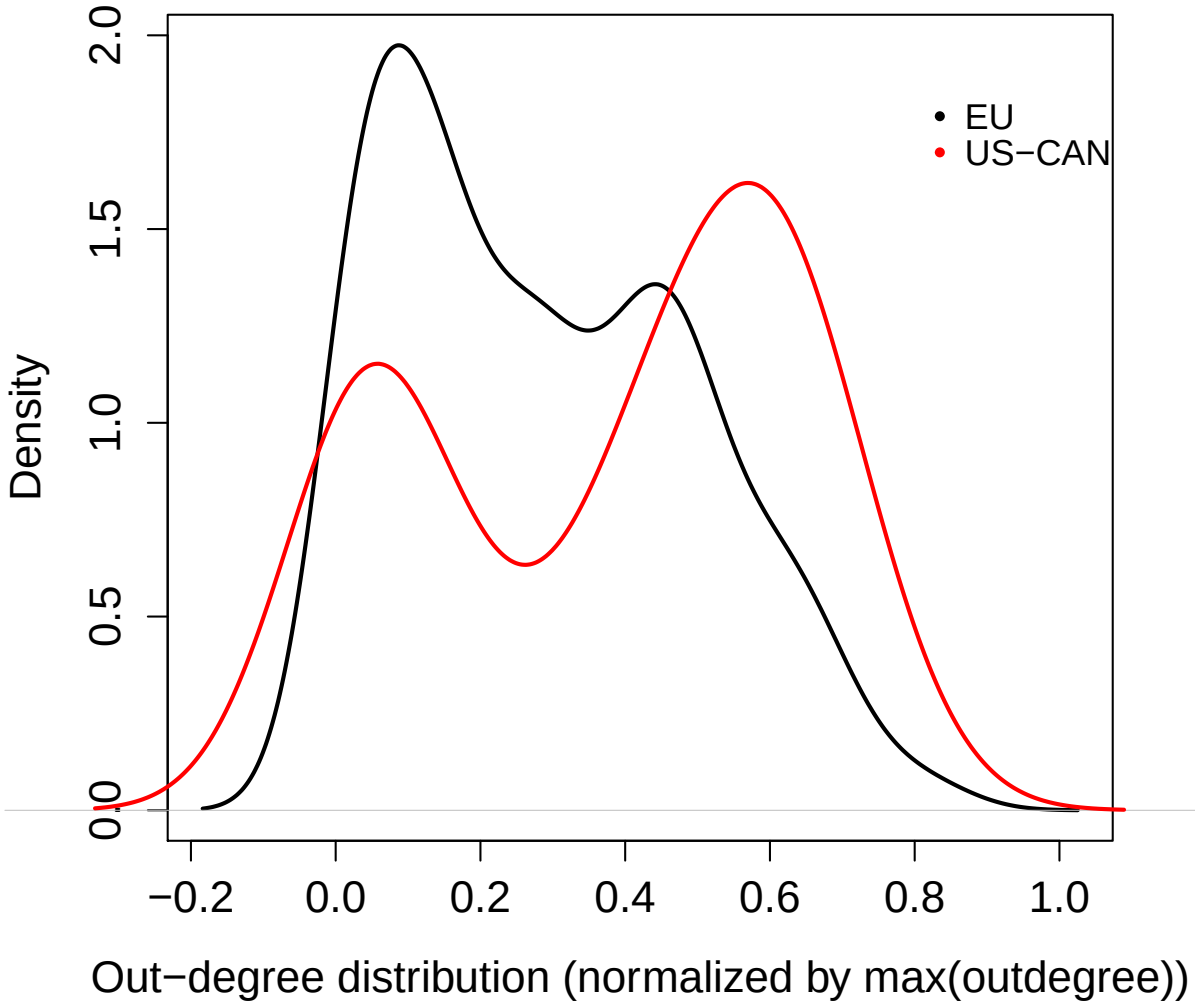
Centrality and triadic census

From regional trade flows to regional trade networks: EU

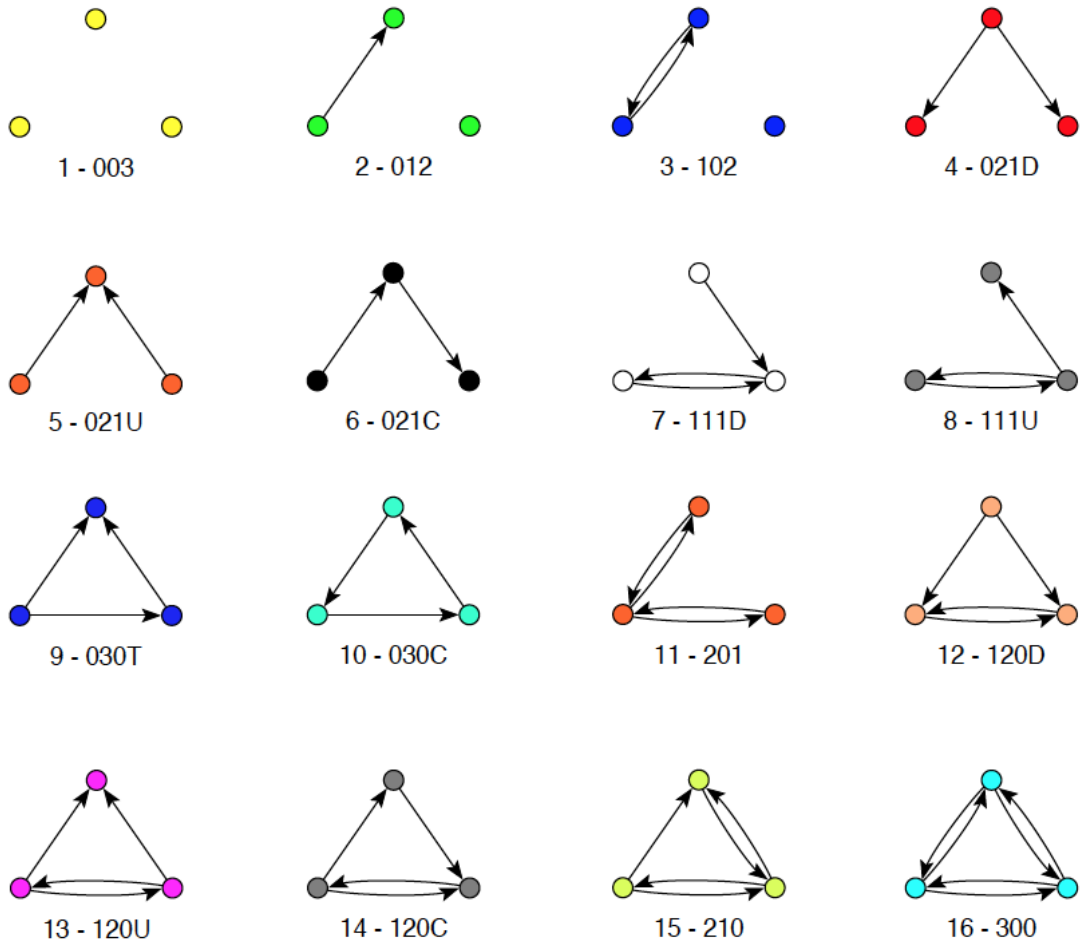
Using all the data, some trimming procedure is required:

	Full	w>25 mln.	w>500 mln.	w>1000 mln.	w>2500 mln.
% of intra-European trade	100.0	91.0	24.4	10.0	1.3
Number of nodes (regions)	267	266	217	100	13
Number of links	70,898	20,086	834	200	12
% of zeros	0.27	71.72	98.82	99.71	99.98
Density	0.998	0.283	0.018	0.003	0.001
Degree centralization	0.002	0.717	0.988	0.997	0.999
Degree SD	0.006	0.181	0.026	0.030	0.115
Eigenvector centralization	0.001	0.572	0.894	0.894	0.583
Eigenvector SD	0.006	0.297	0.162	0.204	0.322
Clustering	0.999	0.690	0.227	0.138	0.000

Regional trade flows



Triadic census



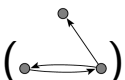
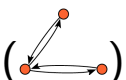
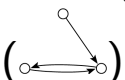
Triadic census: EU and US-Canada

	MAN code	Figure	Class	EU Full	EU w>25 mln.	EU w>500 mln.	EU w>1000 mln.	US-Canada w>57 mln.
1	003		Empty graph	14	1,040,546	1,549,950	147,072	2174
2	012		Single edge	0	487,976	88,052	10,440	810
3	102		Mutual edge	182	737,954	30,906	2,907	2574
4	021D		Out-star	1	32,297	2,665	327	32
5	021U		In-star	0	20,621	806	175	16
6	021C		Line	0	29,254	1,407	179	52
7	111D		Mutual edge + In	0	87,483	1,314	164	266
8	111U		Mutual edge + Out	0	152,936	2,562	276	375
9	030T		Transitive	1	13,299	151	11	10
10	030C		Cycle	0	664	7	0	0
11	201		Mutual-star	7,808	157,167	965	95	549
12	120D		Mutual edge + double In	121	17,185	63	2	33
13	120U		Mutual edge + double Out	248	36,178	158	19	49
14	120C		Mutual edge + Cycle	21	16,694	131	4	45
15	210		Almost complete graph	15,645	125,402	338	23	405
16	300		Complete graph	3,112,764	145,904	105	6	1046
		EU-USCAN	Pearson linear correlation		0.92			
		EU-USCAN	Spearman rank correlation		0.93			

Part VI

Conclusions

Conclusions

- Predictions from three-region model are confirmed by data.
- Once the density of the regional trade matrix is reconciled with evidence at the aggregate level and the number of zero-trade flows is inflated, no matter what threshold is selected the predictions are confirmed.
- This is true for EU regional trade and US-Canada regional trade.
  - (1) Mutual edge + Out () and Mutual-star () prevail over Mutual edge + In ();
  - (2) the structure revealed by the triadic census is common to the two datasets.