



International wheat trade network

Database source

CEPI – BACI Dataset, available at:

http://www.cepii.fr/cepii/en/bdd_monde/presentation.asp?id=37

Selected **year**: 2019

The dataset contains information about trade flows for a wide variety of products, but here we will focus on:

100111 – Wheat and meslin, durum wheat, seed

100119 – Wheat and meslin, durum wheat, other than seed

100191 – Wheat and meslin, other than durum wheat, seed

100199 – Wheat and meslin, other than durum wheat, other than seed

A ***directed*** and ***weighted*** graph composed of:

195

Nodes, that are countries involved
in wheat trades

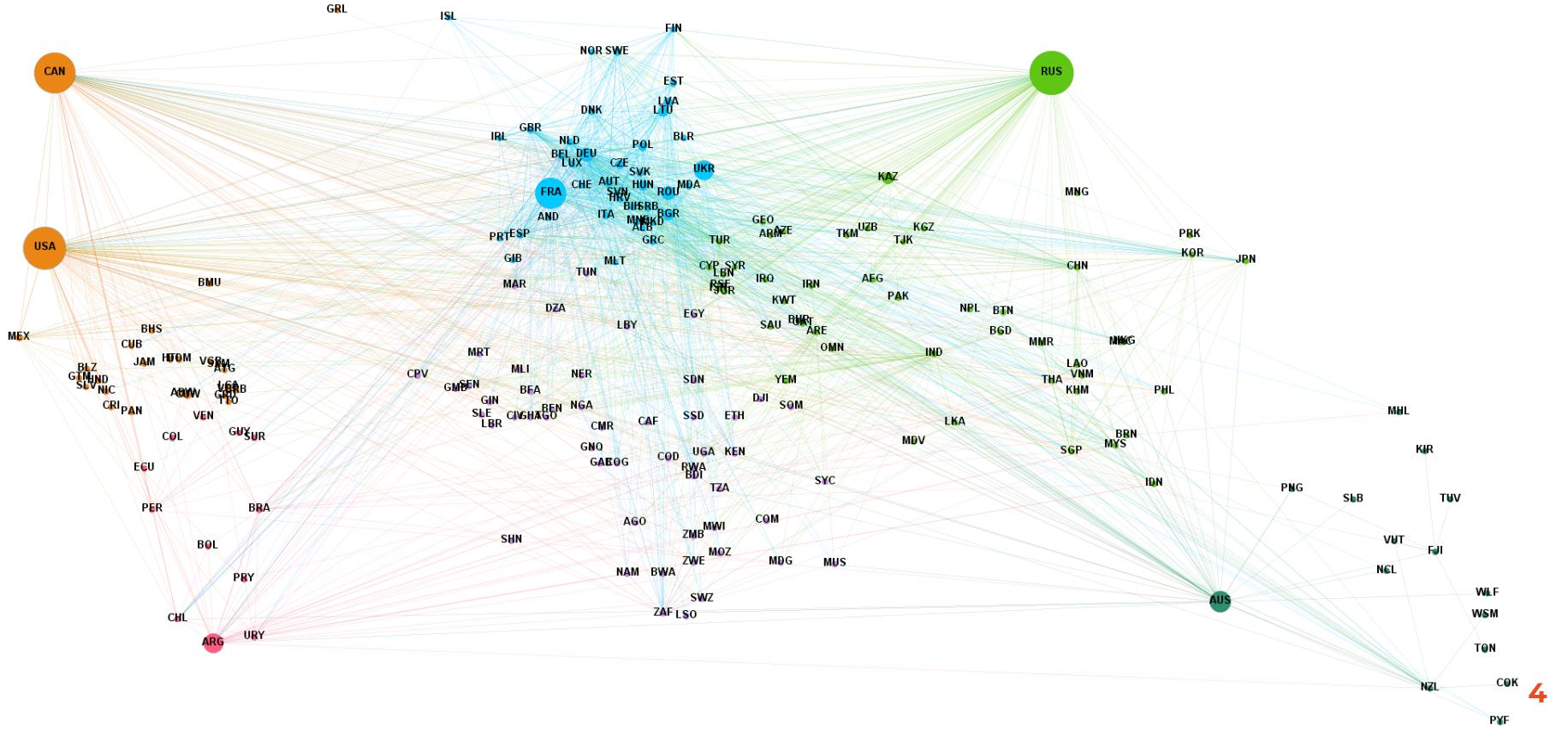
0.05

Density

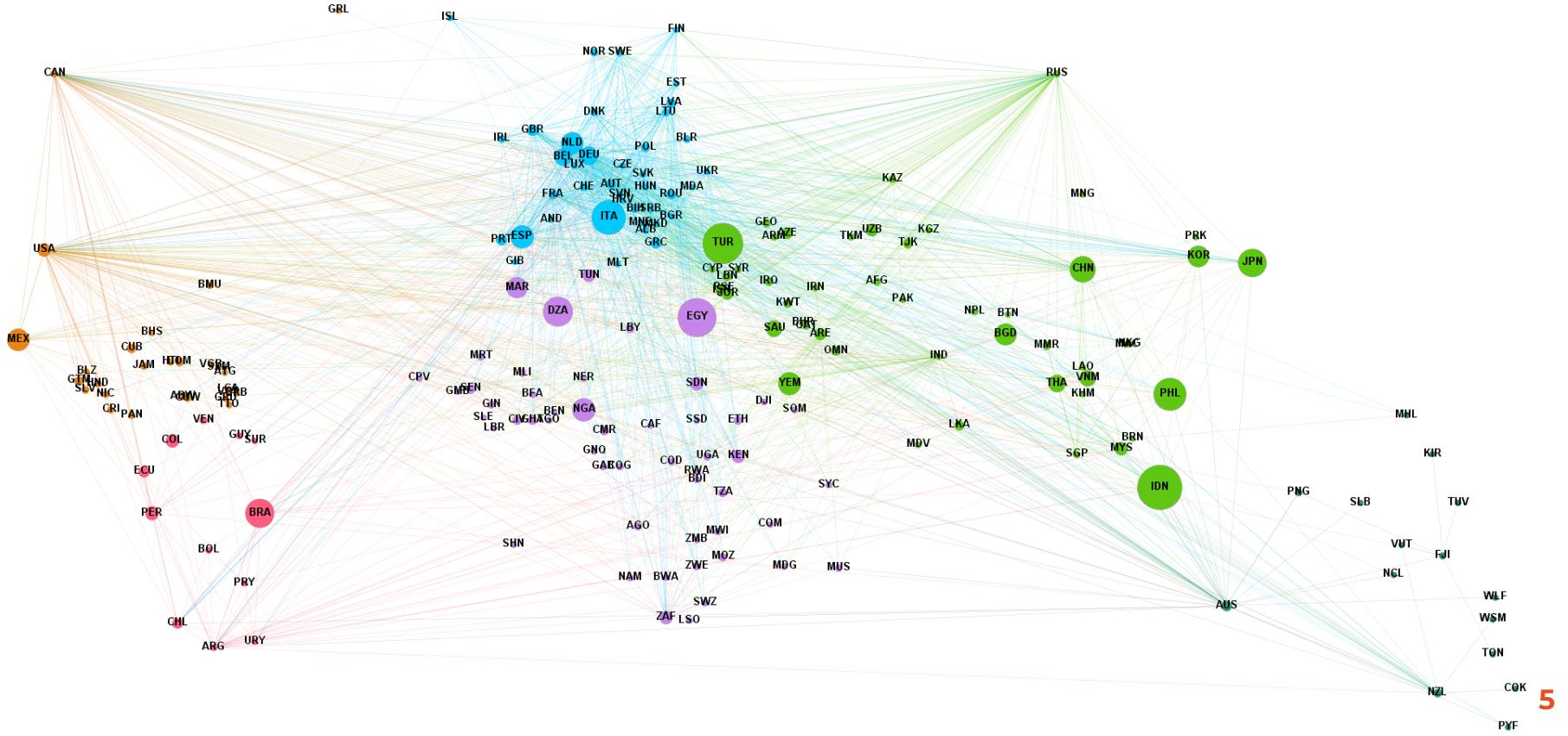
1975

Edges, that are official wheat
trades in 2019

Network visualization – Major exporters



Network visualization – Major importers



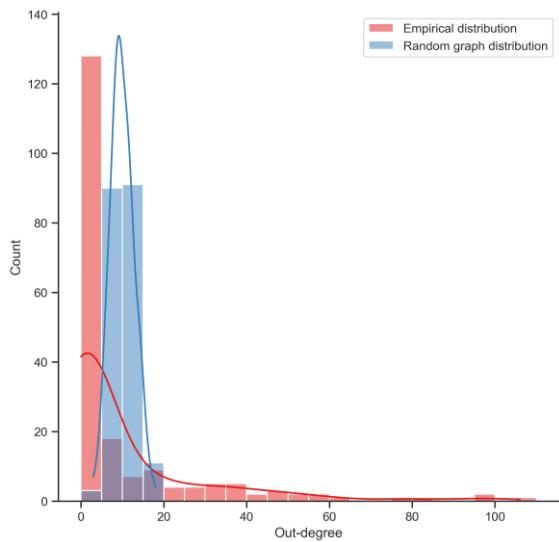
Graph decomposition

- ❑ Neither **isolated nodes** nor **self loops**.
- ❑ One **giant strongly connected component** of 113 countries; each of the remaining 82 countries is a SCC itself.
- ❑ One **giant weakly connected component** encompassing the whole network (195 nodes).

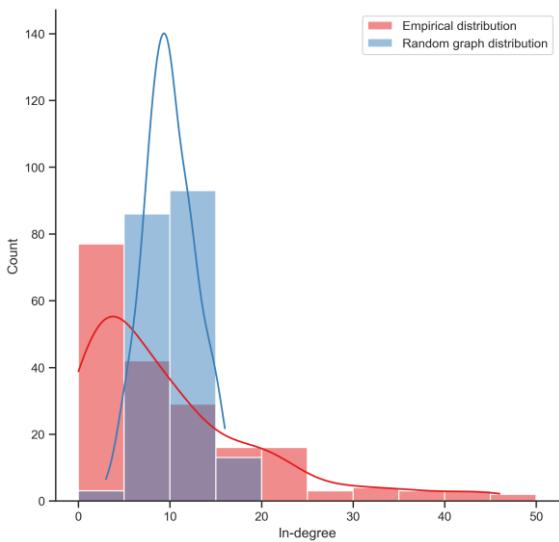
1. Degree distribution

Is the network
scale-free?

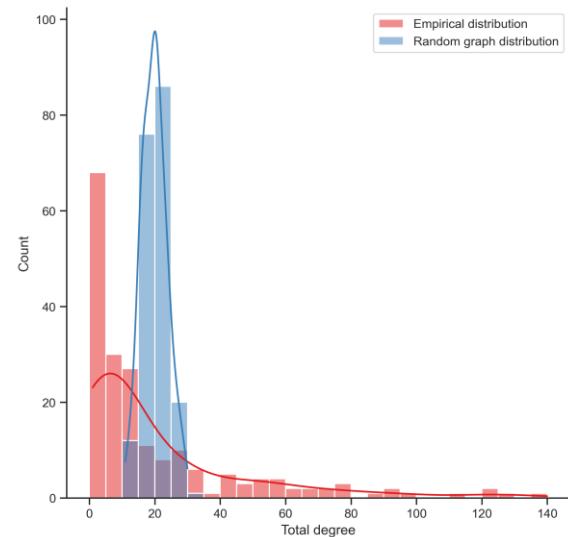
Degree distribution



Average out-degree: 10.13
Median out-degree: 2
Std dev: 19.04

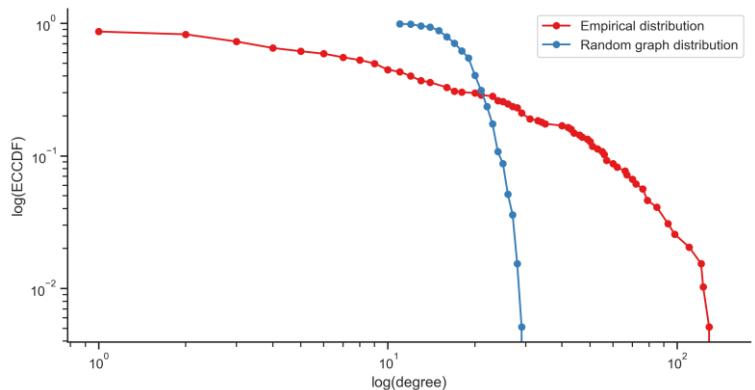
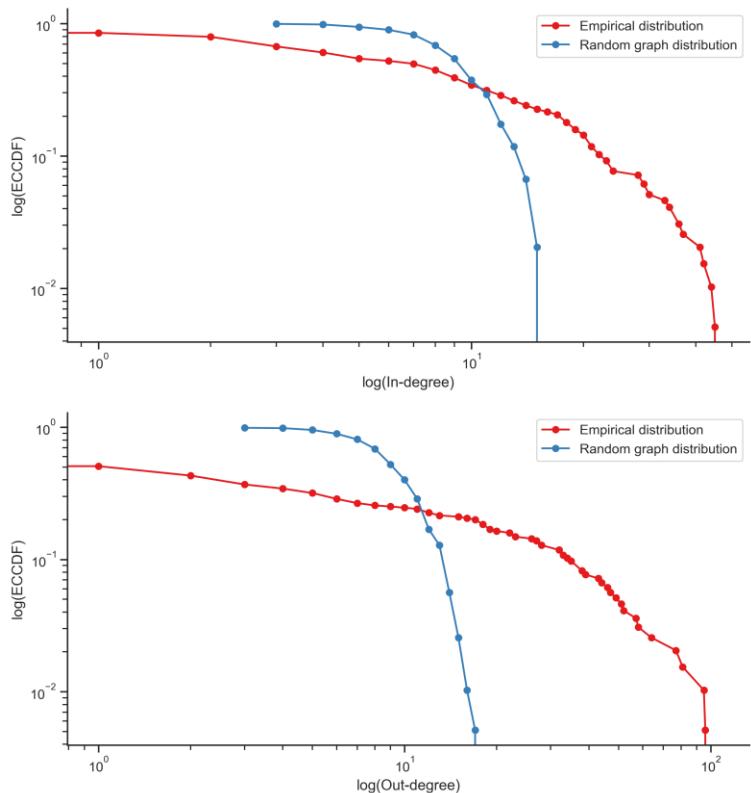


Average in-degree: 10.13
Median in-degree: 7
Std dev: 9.91



Average degree: 20.26
Median degree: 9
Std dev: 27.12

Complementary Cumulative DF



The network is
scale-free!

2. Centrality measures

Which are the
most relevant
countries for
wheat trade?

National perspective

□ **Top exporters
(out-degree)**



6.66 bln \$

□ **Top importers
(in-degree)**



2.38 bln \$

□ **Closeness
centrality**



0.57



6.33 bln \$



2.12 bln \$



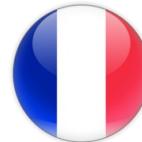
0.57



6.08 bln \$

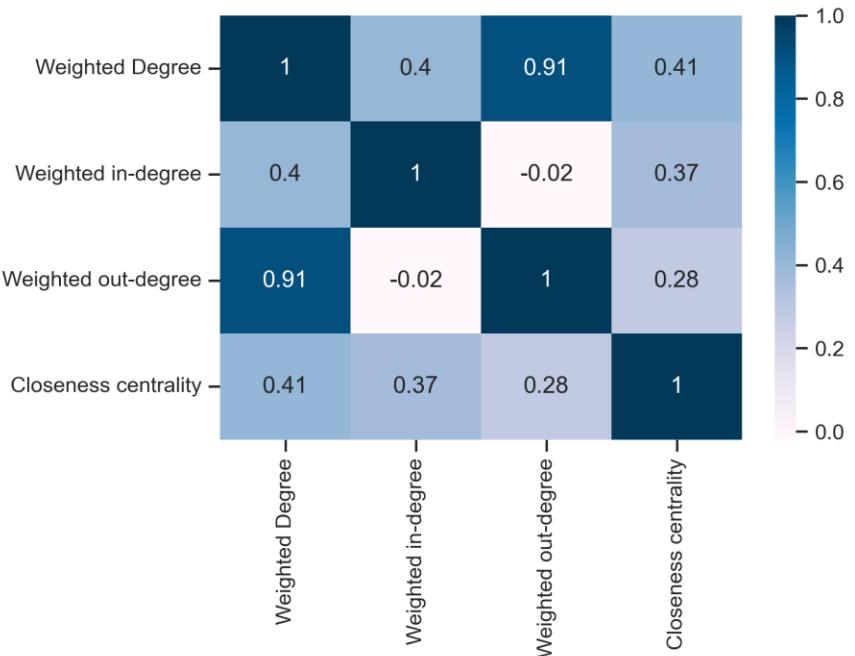


2.01 bln \$



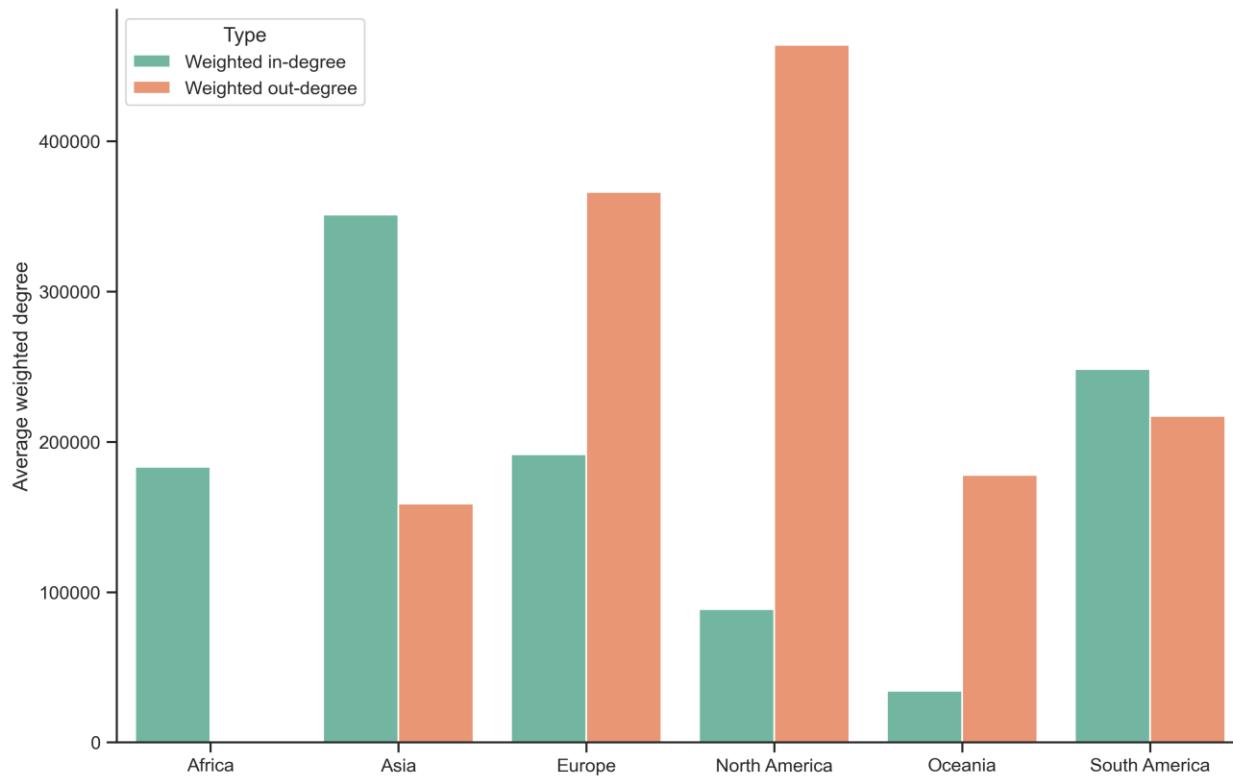
0.56

Centrality measures correlation matrix

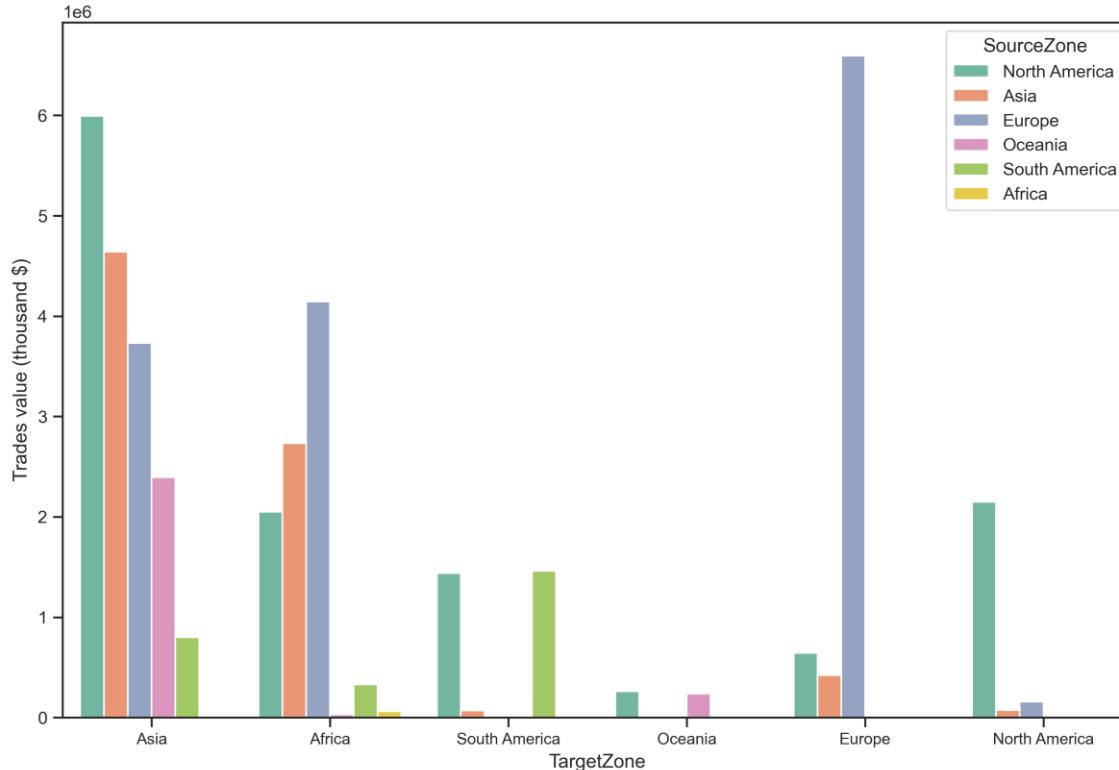


Closeness centrality is slightly correlated to all the other measures of centrality, while, interestingly, **weighted out- and in-degree** are found to be independent.

Average degree of countries per zone



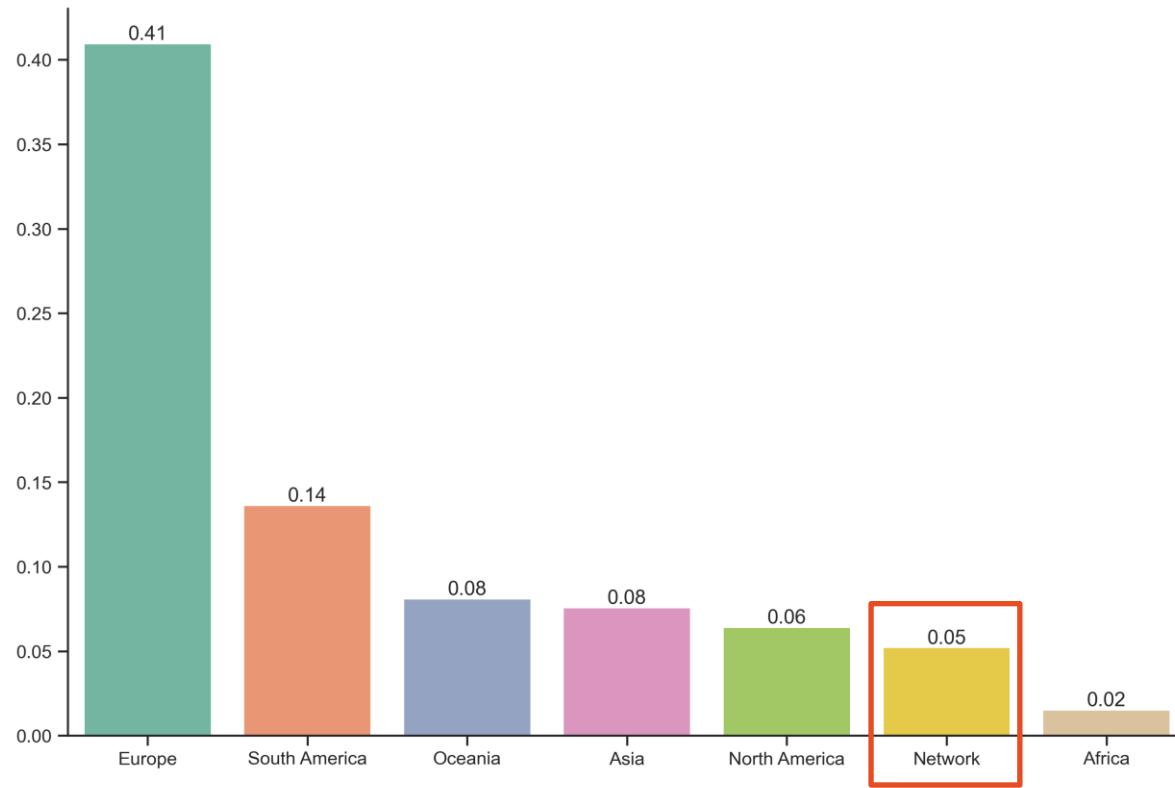
Where does wheat come from?



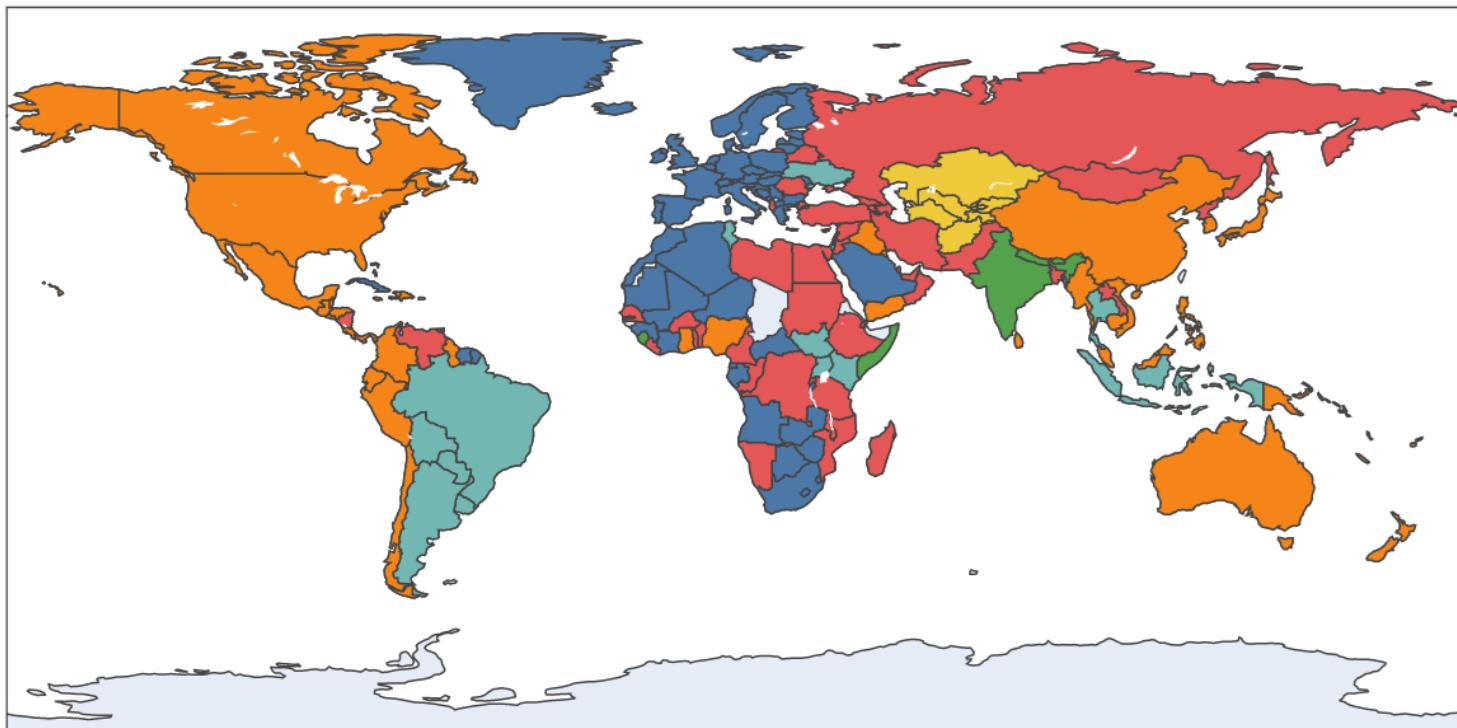
3. Community detection

The structure
underneath the
wheat trade
network

Density across regions



Greedy approach



Nr of
communities

6

Modularity

0.46

Coverage

0.49

Performance

0.74

Centrality in the communities

Group	Size	Density	Major importers	Major exporters	Closeness centrality
1	64	0.16	Italy, Algeria	France, Germany	UK, Netherlands
2	61	0.05	Philippines, Japan	USA, Canada	USA, Canada
3	43	0.05	Turkey, Egypt	Russia, Romania	Turkey, United Arab Emirates
4	15	0.13	Indonesia, Brazil	Argentina, Ukraine	Thailand, Israel

4.

Russia & Ukraine

Focus on the
two countries
at war

Export

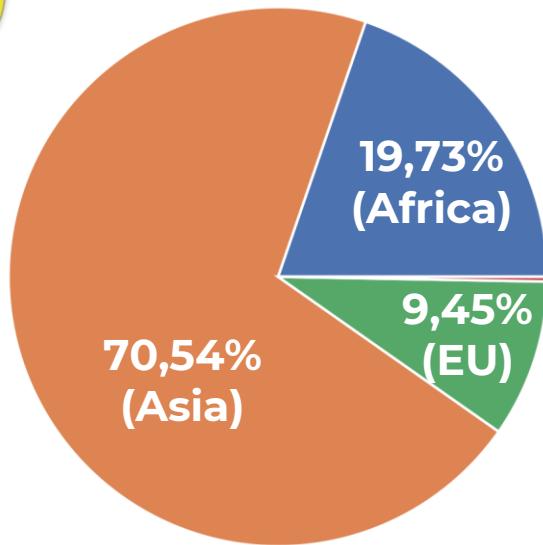
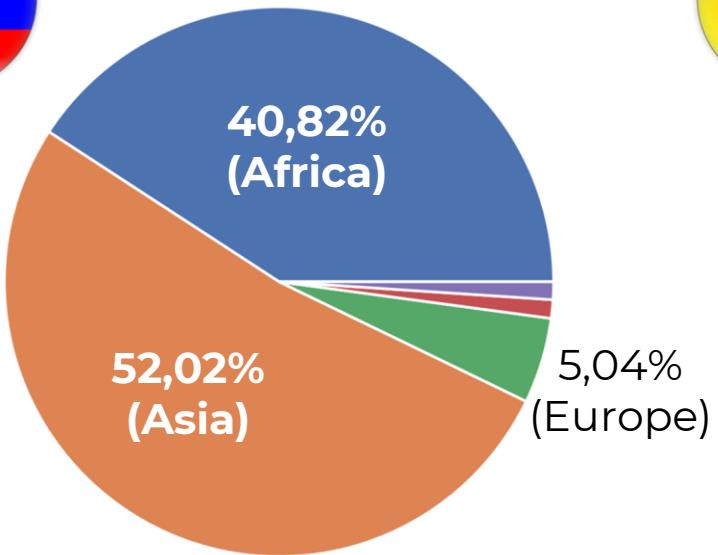


Exports in **106 countries**
for a total export worth of
6.66 billion \$.



Exports in **38 countries**
for a total export worth of
2.33 billion \$.

Export destination



«Dependency map» for Ukraine

Tunisia

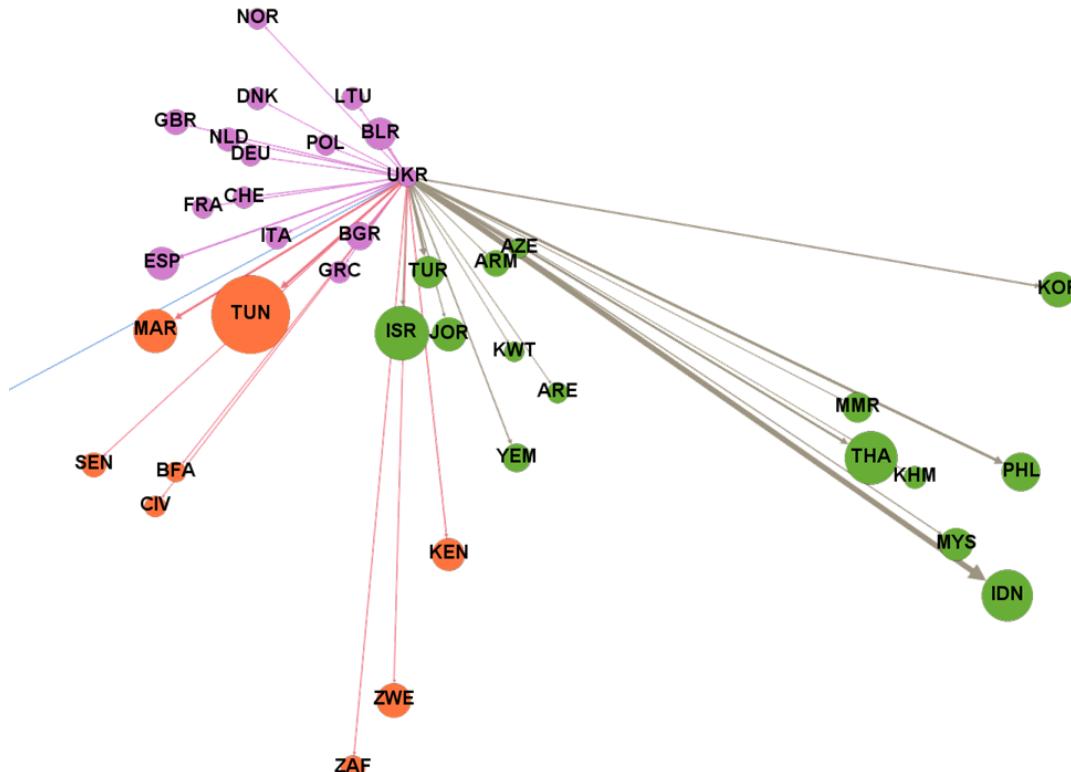
48.20%

Israel

28.20%

Thailand

27.20%



«Dependency map» for Russia

Mongolia

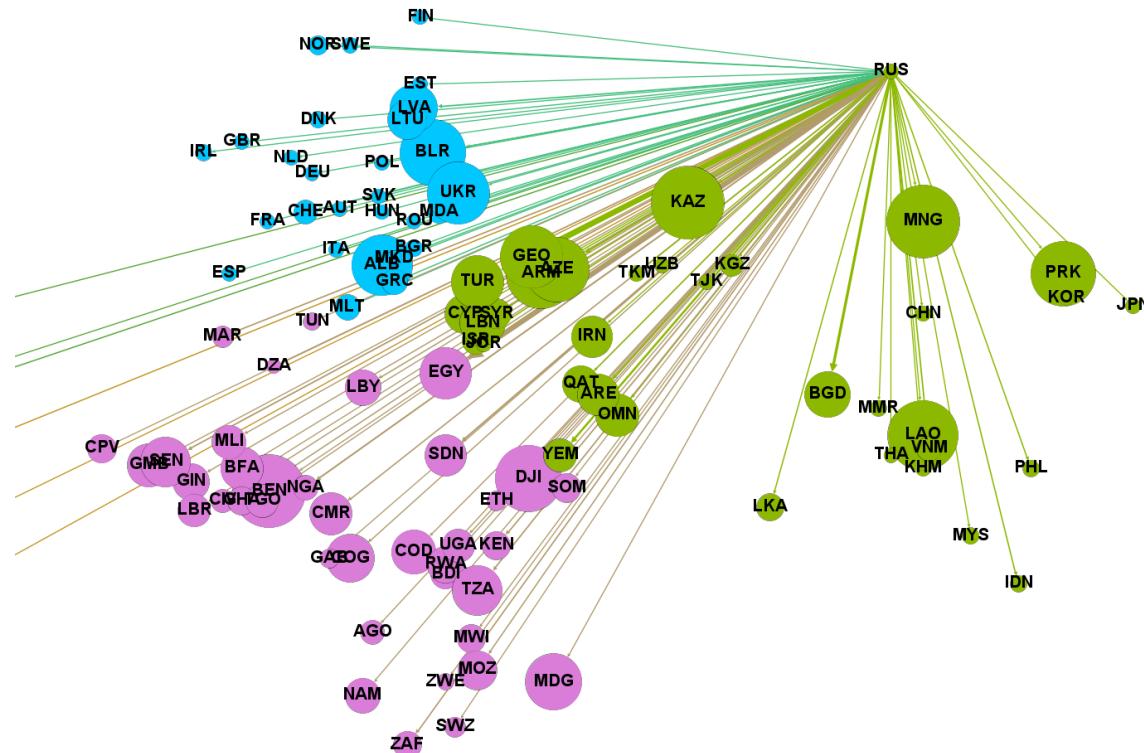
100%

Benin

99.80%

Kazakhstan

99.68%



Conclusions

- ❑ Wheat trade is **highly disequal**: some world's zones depend dramatically on imports (e.g., Africa), while some others are massive exporters (e.g., North America).
- ❑ Contrary to common believe, there's no clear relation between exports and imports, as **weighted in- and out-degree** are found to be **independent**.

Russia and Ukraine

- ❑ **Russia** is the world's greatest wheat exporter, especially relevant for **Africa** and **Asia**, as shown by the community detection.
- ❑ **Ukraine** is much less important than Russia, but still extremely relevant for some **African countries** (Tunisia and Morocco), **Middle East countries** (Israel and Jordania) and **South-East Asian** countries (Thailand and Indonesia)

Thanks

For watching!

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