Istat

LABORATORI tematici

# Trade networks and shock transmission capacity: a new taxonomy of Italian industries

S. Costa, F. Sallusti, C. Vicarelli

28-29 APRILE 2022

#IstatWebinar

# Outline

- The project
- Background
- Data and methods
- Italy in international trade network
- Sectoral structure of domestic trade
- Taxonomy of shock transmission capacity of Italian industries
- The network of shock transmission of the Italian economy
- Conclusion and step forward

# The project | Aims and instruments

- The project was originally focused on studying inter-firm relationships in order to identify relevant sets of connections in the perspective of analyzing supply-chains and industrial districts
- The lack of suitable micro-data (i.e., “fatturazione elettronica”) pushed to change the orientation of the project towards a meso-economic approach to inter-sectoral relationships, using Input-Output and other sectoral databases
- The aim is identifying the main transmission mechanisms that underlies the Italian business system and propose a new classification of Italian industries that is able to capture their capability in transmitting shocks to the rest of the system
- The main instruments used in the project are related to Social Network Analysis (SNA)

# The project | Outcome

- Main outcomes has been published in:
  - Costa, Sallusti, Vicarelli (2022) Trade networks and shock transmission capacity: a new taxonomy of Italian industries. *Journal of Industrial and Business Economics* https://doi.org/10.1007/s40812-022-00208-2
  - Costa, Sallusti, Vicarelli (2021) Trade networks and shock transmission within the Italian business system. *LEM Working Paper Series* 2021/15

- Partial results from the project have been used in several Istat's publications:
  - Rapporto sulla competitività dei settori produttivi (2019, 2020)
  - Rapporto annuale sulla situazione del paese (2019, 2020)
  - Nota Mensile (April 2020)
  - Committee on Industry, Innovation and Entrepreneurship Meeting (OECD, April 2020)

# Background

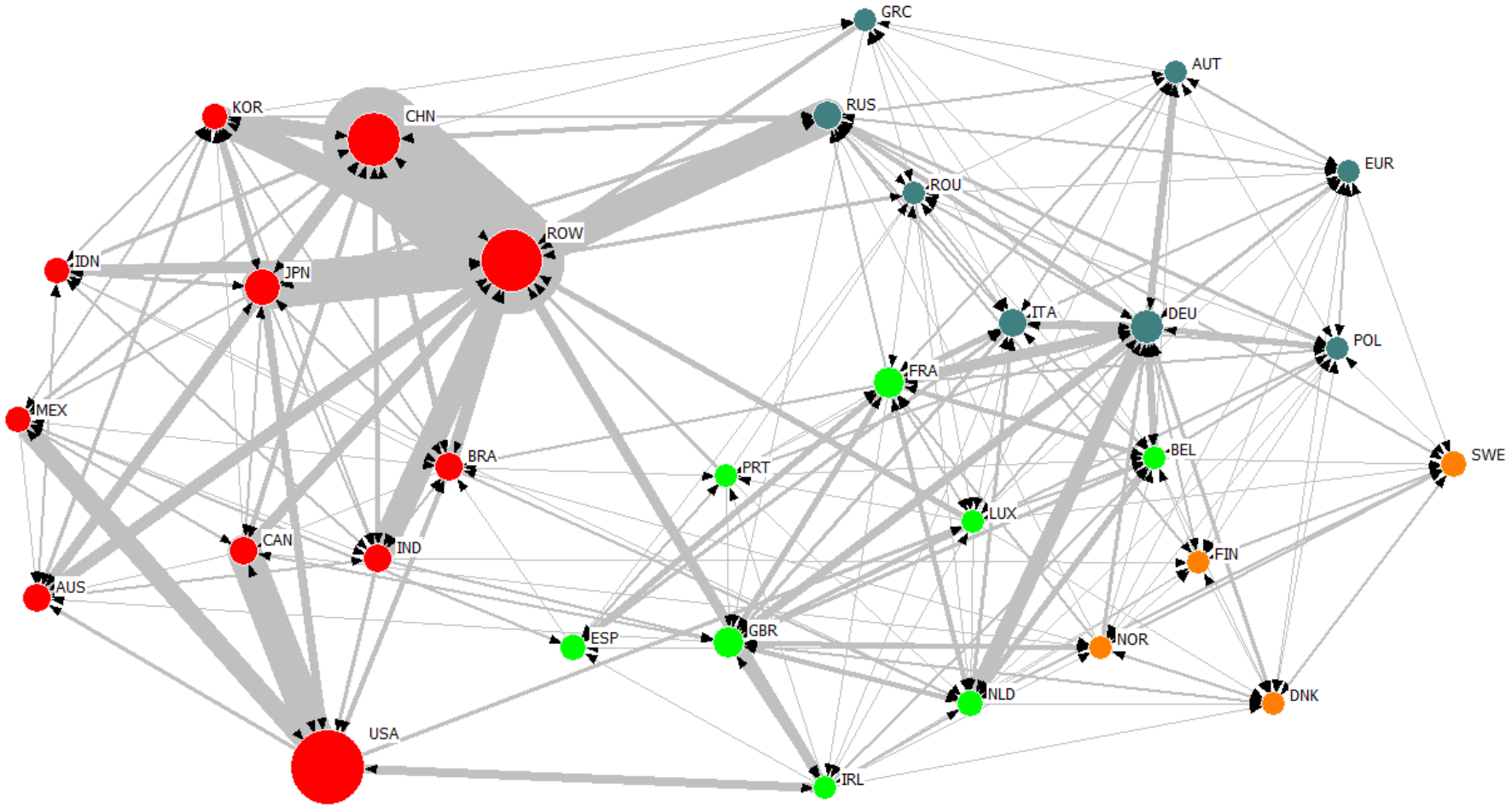
- Trade networks represent a relevant vehicle for the transmission of economic shocks. The structure of inter-sectoral relationships contributes to determine how several factors or phenomena can affect the business system through trade relationships along supply-chains
- The extent and speed of transmission can be heterogeneous between and within countries: a mismatch may emerge between sectors that are central for the international transmission of shocks and those that are central for their domestic propagation
- In order to verify such mismatch, we propose a new taxonomy of Italian business sectors which is based on the speed and the extent of their capacity of transmitting impulses across the domestic business system

# Data and methods

- The information used throughout the work mainly refers to Italian (ISTAT) and multi-regional (WIOD) Input-Output tables
- The main instruments are represented by SNA tools such as:
  - Degree (strength) centrality
  - Eigenvector centrality
  - Betweenness
  - Density
  - Ego-networks
  - Graphs
  - Clustering algorithm

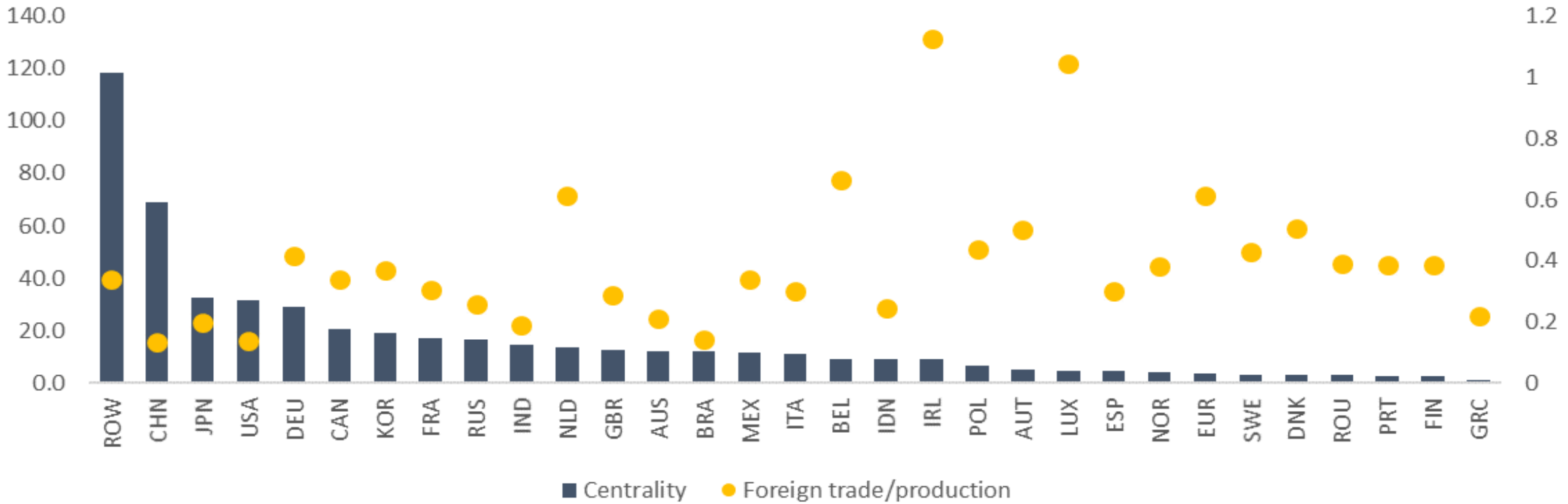
# Italy in international trade network

- Using multi-regional WIOD tables a graph can represent the network of international trade
- Clustering techniques (factions) allow to identify different clusters of country based on their trade relationships



# Italy in international trade network

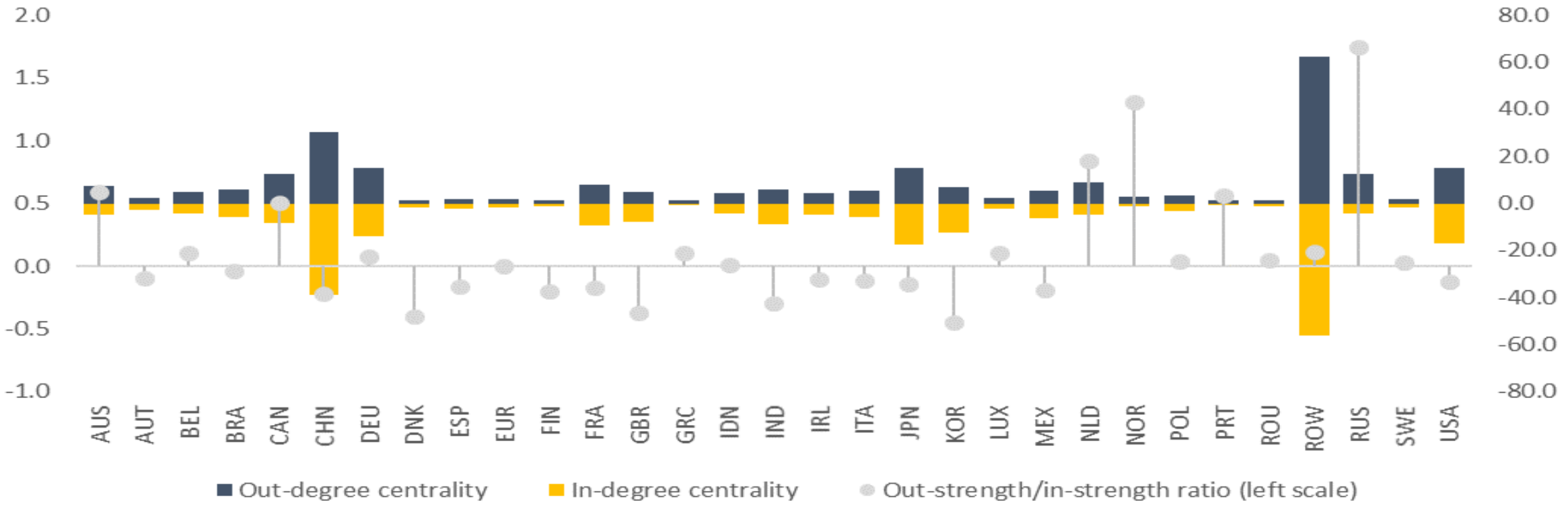
- Based on the existence and relevance of bilateral trade relationships Countries can be ranked according to their centrality in the international trade network (**histograms**)
- Centrality can be analysed in its interaction with the degree of openness of Countries' economies (**bullets**)



# Italy in international trade network

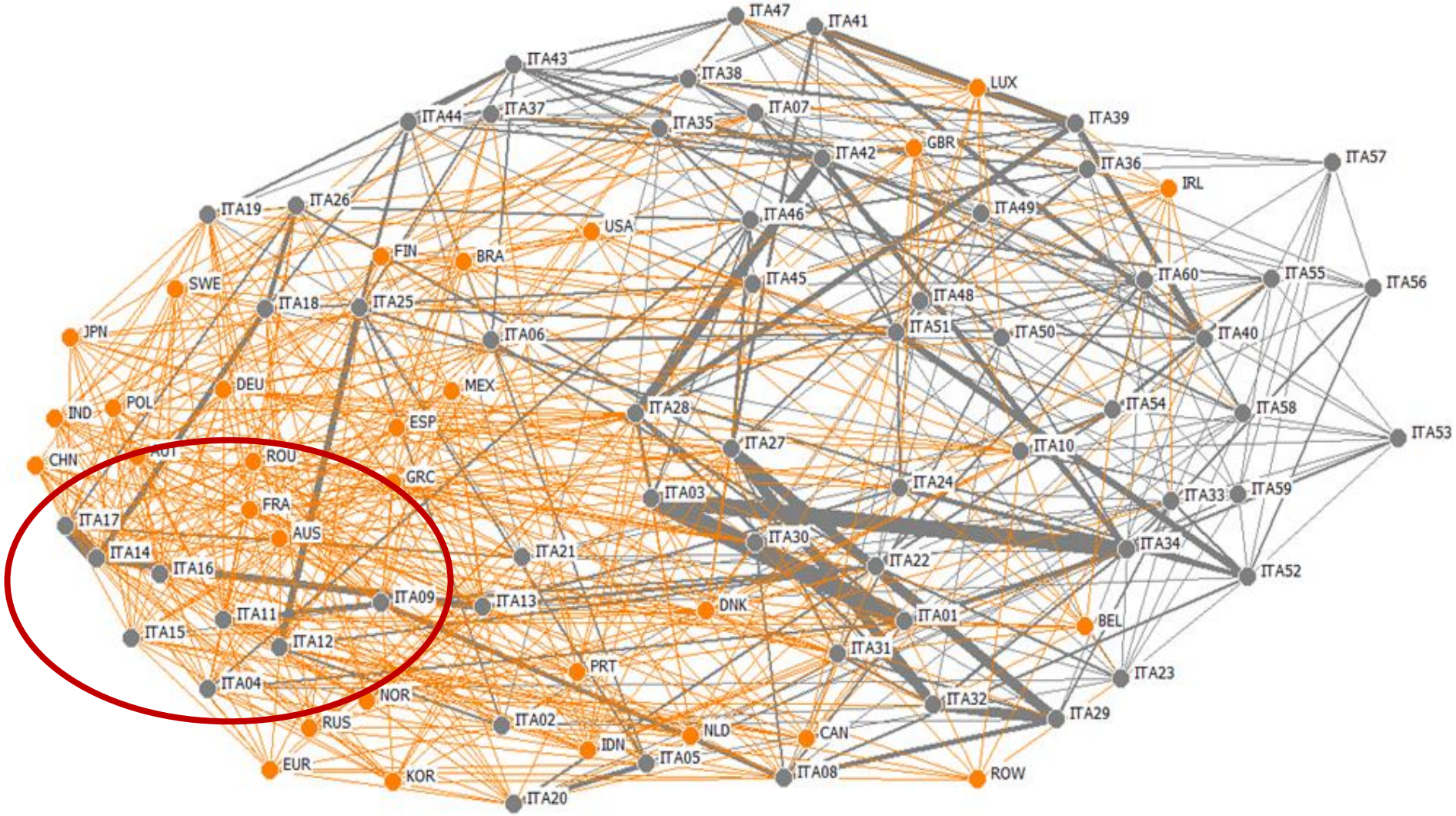
- In-degree (**yellow histograms**) represents centrality in inward trade relationships; Out-degree (**blue histograms**) represents centrality in outward trade relationships

- The ratio between Out- and In-degree (**grey bullets**) provides a measure of the upstream or downstream positioning of the Country in international trade network



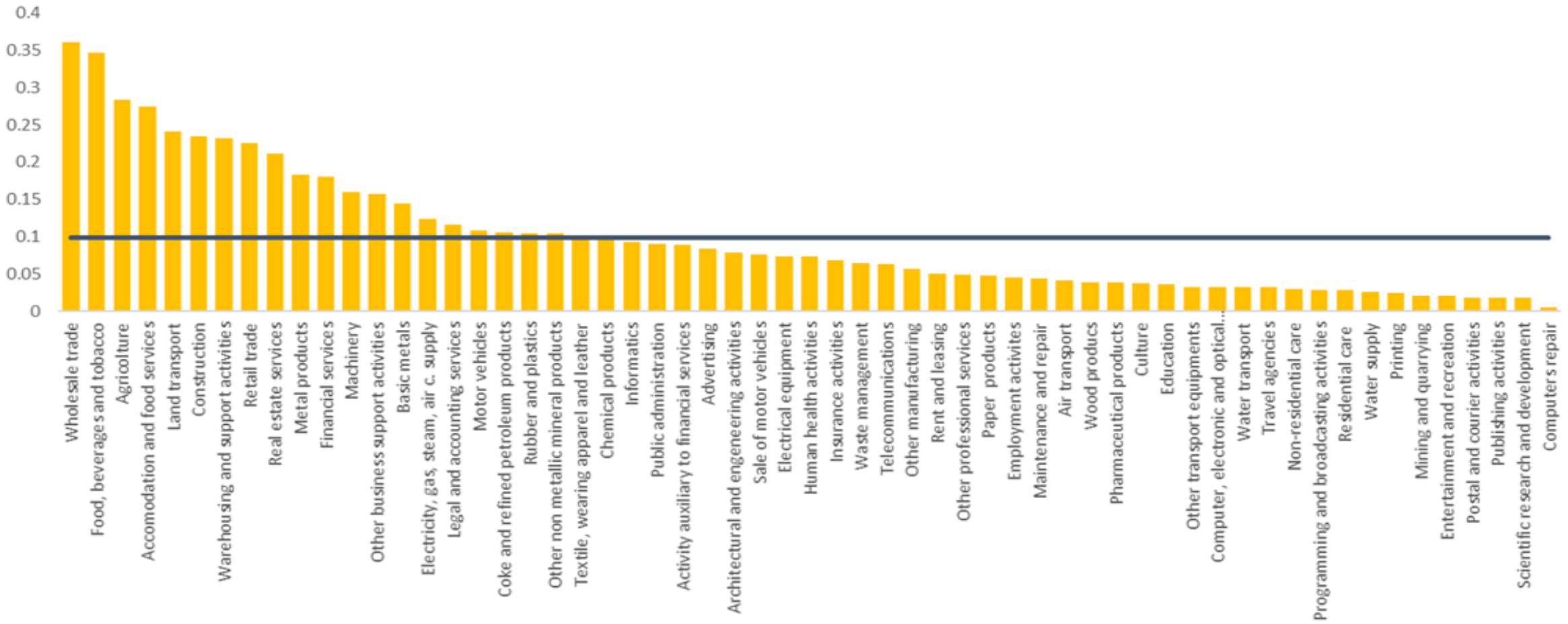
# Italy: sectoral structure of domestic trade

- Italian industries (**grey nodes**) can be plotted in a gravitational graph including their bilateral trade relationships with other countries (**orange nodes**)
- In the left-hand side of the graph **more open** industries are positioned
- In the right-hand side **domestic** industries are positioned



# Italy: sectoral structure of domestic trade

- Considering domestic trade relationships, Italian industries can be ranked based on their centrality



# A new taxonomy of Italian industries' transmission capacity

- Using ego-networks, for each Italian industry a sub-network of its main suppliers is built up. Each ego-network is characterized by its **number of nodes** (which represents the extension of transmission) and its **density** of relationships (which represents the speed of transmission)

- Combining this features the following taxonomy can be derived:

  - **Weak transmission industries**: sectors with limited (size below the average) and slow (density below the average) transmission
  - **Hierarchical transmission industries**: sectors with wide (size above the average) and slow (density below the average) transmission
  - **Selective transmission industries**: sectors with limited (size below the average) but fast (density above the average) transmission
  - **Widespread transmission industries**: sectors with wide (size above the average) and fast (density above the average) transmission

# A new taxonomy of Italian industries' transmission capacity

| Weak transmission | Hierarchical transmission | Selectve transimission | Widespread transmission |
|---|---|---|---|
| *Small sized and low density ego-network* | *Large sized and low-density ego-network* | *Small sized and high density ego-network* | *Large sized and hig-density ego-network* |
| Paper products | Textile, wearing apparel and leather | Rubber and plastics | Activity auxiliary to fin. services |
| Chemical products | Basic metals | Metal products | Machinery |
| Other manifacturing | Retail trade | Computer, electronic and optical pr | Informatics |
| Sales of motor vehicles | Publishing activities | Waste management | Legal and accounting services |
| Air transport | Agricolture | Postal and courier activities | |
| Accomodation and food services | Wood producs | Real estate services | |
| Programming and broadc.activities | Pharmaceutical products | Travel agencies | |
| Scient. research and development | Other transport equipments | Food, beverages and tobacco | |
| Advertising | Wholesale trade | Electrical equipment | |
| Rent and leasing | Water transport | Land transport | |
| Computer repairs | Telecommunications | Warehousing and support activities | |
| Mining and quarring | Arch. and eng. activities | Insurance activities | |
| Printing | Other professional services | Other business support activities | |
| Other non metallic mineral products | Public administration | Employment activites | |
| Human health activities | Non-residential care | Education | |
| Culture | Financial services | | |
| Residential care | Coke and refined petroleum products | | |
| | Maintenance and repair | | |
| | Water supply | | |
| | Construction | | |
| | Entertainment and recreation | | |
| | Motor vehicles | | |
| | Electricity, gas, steam, air c. supply | | |

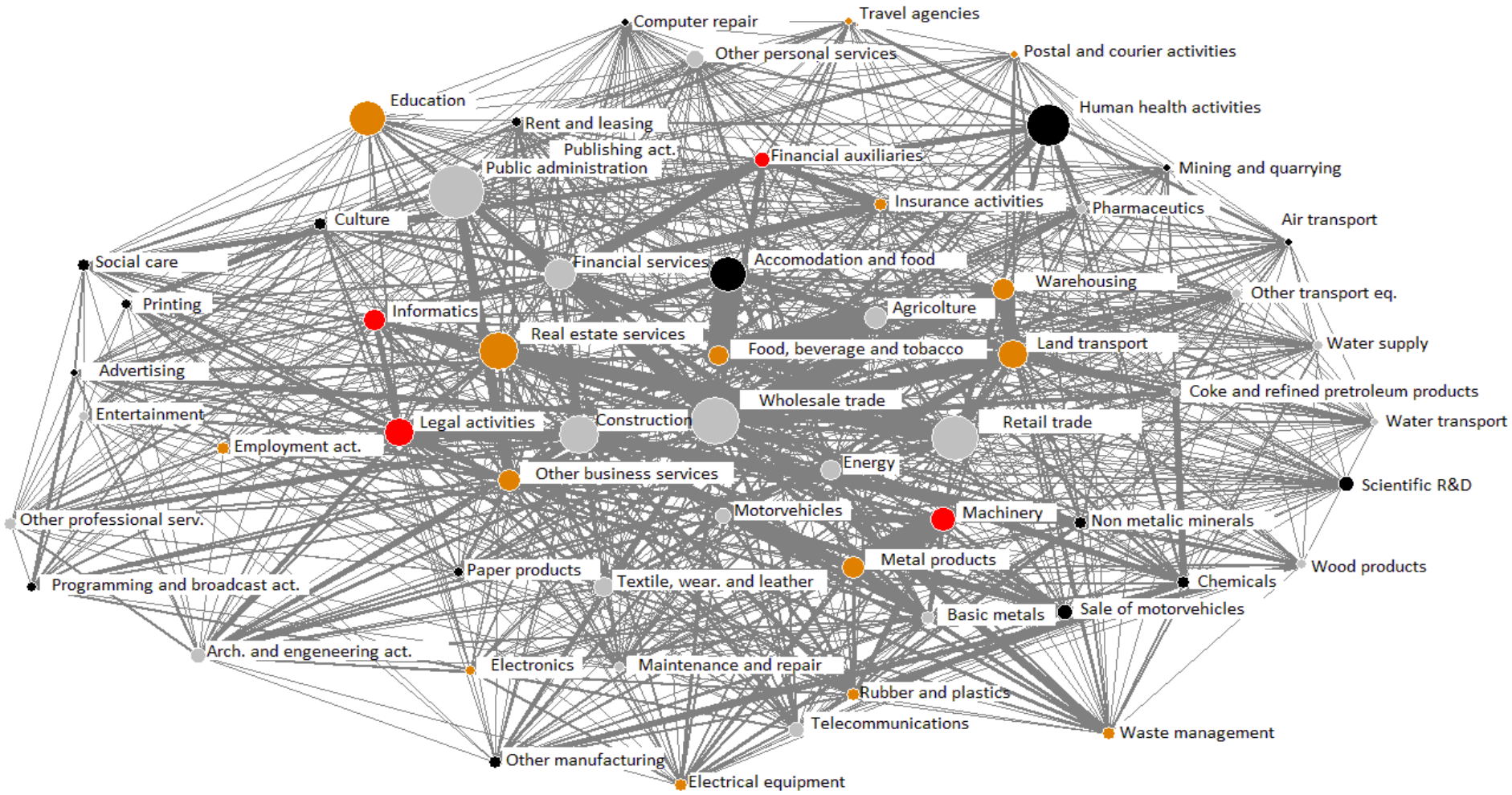
# A new taxonomy of Italian industries' transmission capacity

- **Hierarchical transmission** sectors represent 55.3% of firms and 44.6% of value added but with the lowest productivity
- **Widespread transmission** industries are low in number and value added, but they show the highest degree of openness and the highest productivity
- **Weak transmission** industries are about 20% of Italian economy with low openness but high productivity
- **Selective transmission** sectors have lower-than-average productivity and openness

| Type of transmission | Enterprises | Workers | Value added | Export | Import | Openness | Labour productivity |
|---|---|---|---|---|---|---|---|
| Weak | 19.5 | 18.1 | 19.4 | 16.2 | 18.7 | 51.4 | 74.0 |
| Widespread | 11.4 | 6.0 | 9.6 | 17.1 | 8.4 | 82.3 | 110.8 |
| Hierarchical | 55.3 | 49.4 | 44.6 | 41.7 | 46.6 | 56.8 | 62.3 |
| Selective | 13.8 | 26.5 | 26.4 | 24.9 | 26.3 | 56.0 | 68.8 |
| **Total** | **100.0** | **100.0** | **100.0** | **100.0** | **100.0** | **58.0** | **69.0** |

# The network of shock transmission of Italian economy

- The structure of Italian inter-sectoral trade relationships
- Hierarchical sectors (**grey nodes**) tend to be more central
- Widespread sectors (**orange nodes**) are in the intermediate crown, as well as selective sectors



# Conclusions

- The project aimed at describing the system of inter-sectoral trade relationships (domestic and international) to investigate the structure of shock transmission for the Italian economy
- A new taxonomy of sectors has been derived in order to represent the characteristics of their transmission capacity
- This allowed for mapping the Italian inter-sectoral network and for analyzing its features also in the light of the difference between the positioning of industries in the domestic and international trade network
- A mismatch emerged between industries having a central position in terms of transmission of foreign shocks and those having a central role for their domestic propagation
- This mismatch in trade networks and the distribution of sectors among the four classes of the taxonomy involves a limitation in the transmission of foreign shocks within the Italian economy

# thank you.

FEDERICO SALLUSTI | fsallusti@istat.it

Istat | Istituto Nazionale di Statistica