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Trade networks and shock transmission within the Italian production system

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Trade networks and shock transmission within the Italian production system

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Abstract

Making use of domestic and international input-output tables and network analysis indicators, we analyze international and domestic trade relationships of Italian industries looking at their ability of transmission of shocks. To do this, we also propose a new taxonomy being able to distinguish sectors in terms of the extent to, and the speed at, which they spread domestic and foreign economic shocks into the Italian production system. Our results show a mismatch between sectors having a central position in terms of trade relationships with foreign countries and those having a central role for the propagation of shocks within the Italian economic system. Only a small group of sectors has both a high openness to international markets and a central position within the network of Italian production system. It follows that the domestic transmission capacity of stimuli from abroad is limited: this aspect strongly compromises the possibility of benefiting from positive shocks deriving from increases in foreign demand, even if it could represent, at least in part, a safeguard element in the event of negative impulses deriving from the trend of the international economic cycle.

Keywords: Input/output tables, network analysis, shocks transmission

JEL codes: D57, E30, F14.

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1. Introduction

Trade networks represent an important vehicle for the transmission of economic shocks. The shape of the relational structure of industries contributes to determine the extent and speed with which some characteristics (productivity dynamics, technological progress) or some phenomena (for example changes in demand) can directly and indirectly spread within the business system through the network of trade relationship between sectors and supply chains. In addition, the transmission effects also operate at an international level, through the links connecting the Italian exporting (importing) sectors to the foreign importing (exporting) ones.

In this paper, we analyze these transmission mechanisms in the case of Italy, looking at the network of inter-sectoral relations, both foreign and domestic. To this aim, we develop a new taxonomy of Italian industries, whose categories are able to identify different types of impulses transmission to the rest of the economy. This tool is useful for looking at the extent and speed with which international and domestic shocks spread within the Italian economic system. To do this, we make use of most common tools developed in the empirical literature, like domestic and international input-output tables and network analysis[1].

Theoretical and empirical literature has deeply analyzed how small shocks amplify and propagate through the economy causing sizable fluctuations. The view adopted has been mainly macroeconomic: among others, shocks can be originated from, and transmitted through, real (investments, capital accumulation, productivity, trade, technology) or financial channels (capital controls, liquidity, banking system, credit market friction), as well as changes in monetary policy[2].

More recently, empirical literature has showed that the origins of business cycles may be traced back to micro disturbances (Gabaix, 2011; Acemoglu *et al*., 2012; di Giovanni and Levchenko, 2012; Carvalho and Gabaix, 2013; di Giovanni, Levchenko and Mejean, 2014, 2018; Baqaee and Fahri 2017). In particular, this would occur in two cases: a) when firms are large enough to significantly affect the dynamics of a country's GDP, value added or exports (granular hypothesis, Gabaix 2011); b) when the linkages among sectors are such as to allow possible shocks occurring in a single industry − for example a significant change in the international trade relations of this sector − to spread to the rest of the business system (Acemoglu *et al*., 2012; Carvalho and Gabaix, 2013). These issues are especially relevant where concentration of exports or foreign direct investments among the largest players is larger than the concentration of output or employment (Mayer and Ottaviano, 2007; Barba Navaretti *et al.*, 2011).

Furthermore, several works, making use of input-output tables, have focused on the role of inter-sectoral relationships in the international transmission of shocks within economic systems. The importance of shock transmissions has gradually grown together with the increasing participation in global value chains;

[1] This framework has recently been used for studying the Italian production system sensitivity to the business cycle fluctuations of main Italian trading partners such as Germany, United States and China (Istat, 2019); to measure the economic impact of several exogenous shocks, such as those related to the US-China trade war (Istat, 2020a) or the recent spread of the Covid-19 pandemic (Istat, 2020b).

[2] Theoretical and empirical literature has widely analyzed these issues for decades. Here we can just limit to recall some of main seminal works. Stock and Watson (1999) verified the empirical relationship, in the postwar US, between the aggregate business cycle and various macroeconomic variables, such as production, interest rates, prices, productivity, sectoral employment, investment, income, and consumption; Kydlanm and Prescott (1982) pointed out the investment and capital accumulation responses in real business- cycle models; Frankel and Rose (1998) investigated the relationship between international trade patterns and international business cycle correlations; Bernanke et al (1999) highlighted the role of credit market frictions facing firms, households, or banks; Friedman and Schwartz (1971) analyzed the consequences of monetary policy.

moreover, trade relations between industries of different countries can lead to the transmission of national shocks across borders, contributing to the co-movements of international business cycles. Long and Plosser (1983) pioneered the study of sectoral co-movements using a network model, sowing the seeds of a rich literature that has focused on aggregate volatility generated by idiosyncratic shocks. These latter can have large effects when there are strong relationships between firms and/or sectors (Horvath, 1998 and 2000; Dupor, 1999; Conley and Dupor, 2003; Foerster et al., 2011; Acemoglu et al., 2015b; Jones, 2012). Acemoglu et al. (2015a) focused on the propagation of various types of shocks to the US economy (imports from China, changes in Federal government spending, total factor productivity shocks, knowledge / productivity stimuli resulting from changes in patents from foreign sectors) jointly using geographical networks and input-output relationships. Shea (2002) analyses the relevance of relations between sectors, rather than that of common shocks, in the co-movements between production sectors in the United States. Alatriste Contreras and Fagiolo (2014) study different models of shocks diffusion between advanced economies: the extent and heterogeneity of the impacts within national economies depend on whether or not the shocks modify the structure of sectoral interdependencies and their productive capacity.

This work is organized as follows. Paragraph 2 analyzes the position of the Italian economy within the international trade network, at both country and industry level. Paragraph 3 highlights inter-sectoral relationships among Italian industries, through which domestic and foreign shocks are transferred and spread within the national economy. To this end, we propose a new taxonomy of sectors that classifies them according to the speed with and extent to which they contribute to the propagation of shocks within the Italian economic system. Paragraph 4 draws some conclusions.

2. Sectoral structure of Italian international trade and shock transmission

In the last decades, the growth of international trade and the increasingly important role of global value chains have made the economies of the different countries progressively more integrated. Consequently, shock transmission tends to be stronger and more pervasive. In this context, the structural characteristics of international trade networks determine the extent and speed of the spread of economic shocks.

To highlight the main structural characteristics of these networks and study how international shocks can spread to the Italian business system, the tools of Social Network Analysis may be used. The analysis was carried out using the World Input-Output Database (WIOD, see Timmer et al., 2015), which includes information on the trade relationships among industries for 40 countries with a degree of disaggregation up to 50 sectors of economic activity[3]. In order to analyze the structure of Italy's international trade relationships, a "corrected" version of the WIOD tables was used in this work (the latest edition is related to 2014): for inter-sectoral trade within the Italian economy, we used the 2017 input-output tables released by Istat.

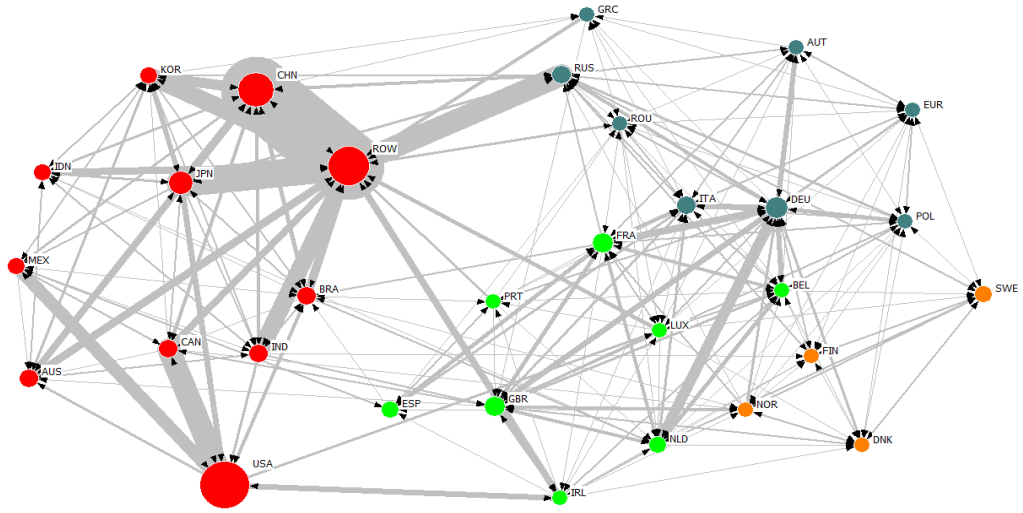
Figure 1 depicts the structure of trade relationships between Italy and its main trading partners, reporting the weight in terms of value added of each country (circumference of the node) and the magnitude of transactions (thickness of the arc). Colors, on the other hand, represent proximity clusters, identified by the faction algorithm, which allows to group countries on the basis of the intensity of their bilateral

[3] The graphical representations, as well as the indicators shown in the rest of the analysis, are drawn using the UCINET software (Borgatti et al., 2002).

relationships[4]. Four major trade areas are clearly identified: Central and Eastern Europe, Central and Western Europe, the grouping of Scandinavian countries and the rest of the World.

As for connections among European countries, an important role is played by trade relationship between Italy, Germany and France, which represent a bridge between the groups of Central-eastern and Western Europe. Linkages with non-European countries involve essentially Russia and Great Britain (with the rest of the world) and Ireland and Luxembourg (with the United States).

Figure 1. International trade relationship and cluster of countries, 2014



Source: Authors' calculations on WIOD data.

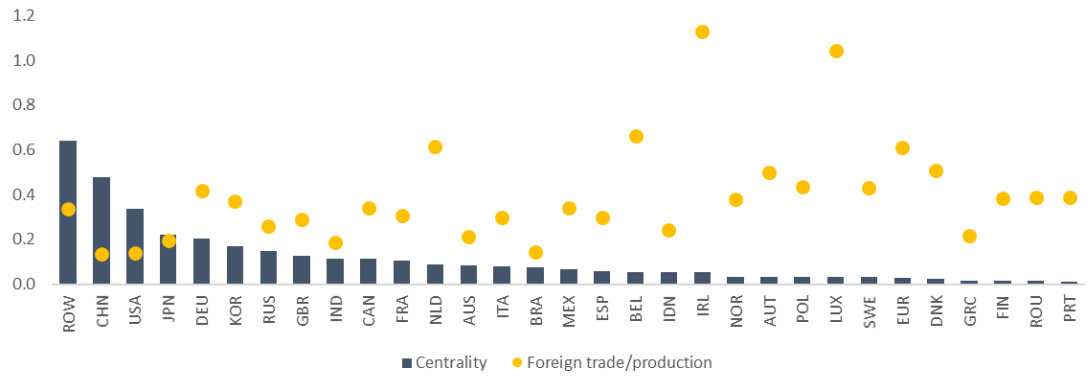
It is possible to get deeper on the role of each country into the trade network by considering the centrality index. This is a measure of "density" of a country's trade relationships, showing the degree to which the country is more or less connected to all the others. In this respect, Figure 2 shows that the most interconnected countries on international markets (also taking into account the relevance of trade, measured by the ratio between trade and production values) are China, the United States and Japan. Among European countries, Germany, UK, France and the Netherlands show a higher degree of centrality than Italy, which lies on an intermediate position in this ranking. Furthermore, country's centrality in the network of international relations is not directly linked to its export propensity; on the contrary, the more central countries have a lower average propensity with respect to more peripheral ones.

To take into account also the role of imports, the overall degree of centrality of a country is broken down according to the direction of trade: a greater (lower) out-degree than in-degree centrality value signals the

[4] In order to graphically represent the network of international trade relationships and derive centrality indicator the original matrix has been processed in order to maintain only "relevant" trade links. In particular, the matrix has been normalised so as to assign to each cell its relative weight in terms of both inward and outward flows. Finally, trade links representing a proportion less than 3% of total selling or purchasing have been zeroed. Faction algorithm allows to cluster (to split in factions) the nodes of a network by severing loose relationships among groups of strongly connected nodes in order to separate them in sub-groups. See also Borgatti, Everett and Freeman (2013).

tendency of the country's business system to establish denser trade networks in the upstream (downstream) portions of the global value chains.

Figure 2. Degree centrality and the ratio between international trade and production values, 2014

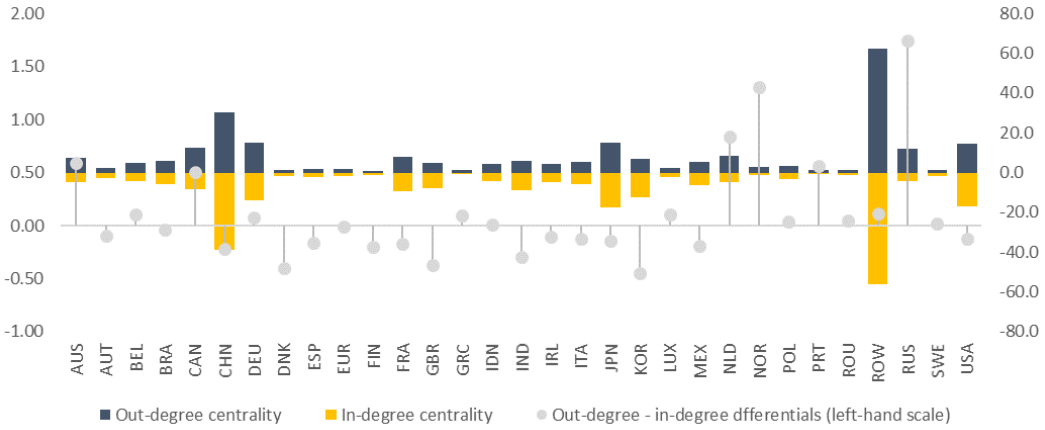


Source: Authors' calculations on WIOD data.

Figure 3 shows, for each country, the in-degree and out-degree centrality and their differential (i.e. positive values imply a higher out-degree). Some countries tend to be positioned in the upstream phase of production processes (in addition to those with a significant role in energy supply, such as Russia, Norway and Canada): it is the case of Germany, which confirms its leading role among main countries within international production chains (World Bank et alii, 2017), and the Netherlands, Luxembourg and Portugal that are able to attract foreign direct investment (mainly involving trade flows of services).

Other advanced countries – mainly Italy, France, United kingdom, Japan, the United States and China – tend to position in the downstream phases of global production processes, albeit with very different values of centrality in inward and outward trade flows: highest for China, Japan and the US, smaller for France, much lower for UK and Italy (Italian in- and out-degree centrality is about one third than the US one and about six times lower than the Chinese one).

Figure 3. In-degree and out-degree centrality, 2014



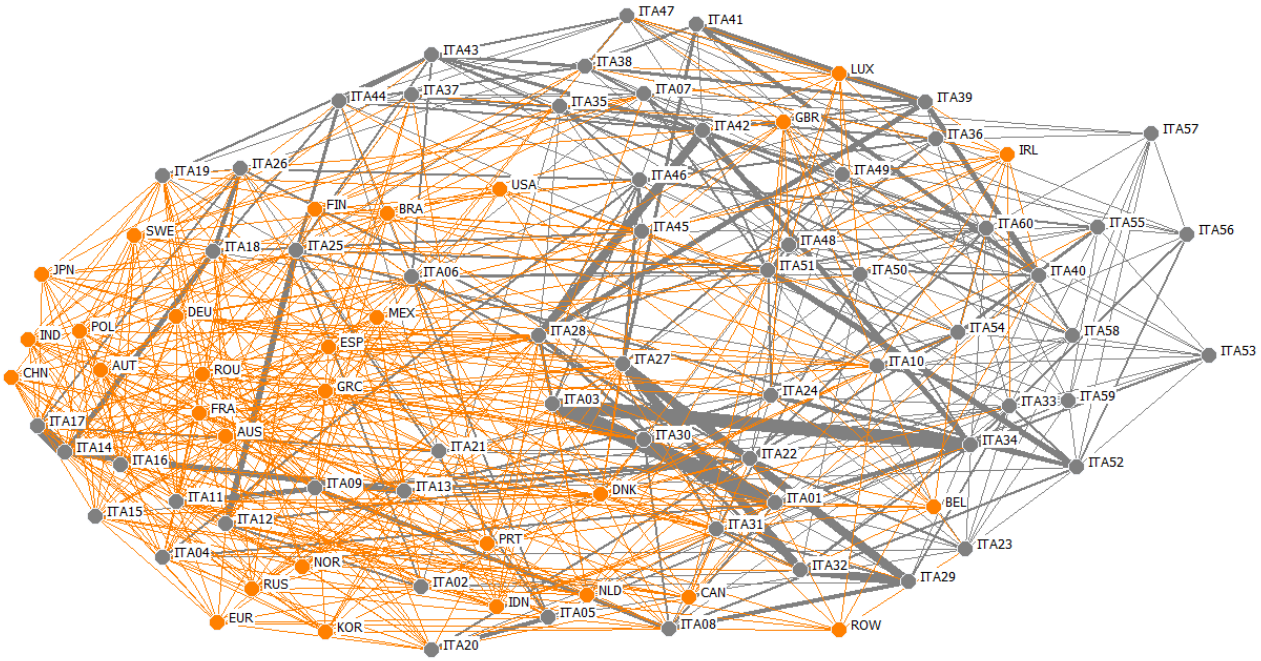
Source: Authors' calculations on WIOD data.

In other terms, the Italian business system is characterized by a relatively high degree of participation in the international trade network, but this takes place especially within the sub-networks connecting the various European countries, in particular through trade relationships with Germany and France, in turn well positioned on world markets.

Such a trade network, therefore, implies that international shocks spread to the Italian business system mainly through connections with the other large European economies, which in turn tend to intermediate impulses from the rest of the world.

Figure 4 shows the domestic and international trade network of 60 Italian economic sectors. Gray arcs highlight domestic transactions, while the orange ones depict exchanges between Italian industries and foreign countries, as well as trade among foreign countries. The positioning of the nodes (Italian sectors and foreign countries) is obtained through a gravitational algorithm that places sectors and countries on the basis of their own degree of proximity[5].

Figure 4. Graph of domestic and foreign trade relationships of Italian production sectors



ITA01 Agricolture	ITA11 Rubber and plastics	ITA21 Maintenance and repair	ITA31 Air transport	ITA41 Activity auxiliary to financ. serv.	ITA51 Other business support act.	AUS Australia	FIN Finland	MEX Mexico
ITA02 Mining and quarrying	ITA12 Other non metallic mineral prod.	ITA22 Electricity, gas, steam, air c. supply	ITA32 Warehousing and support act.	ITA42 Real estate services	ITA52 Public administration	AUT Austria	FRA France	NLD The Netherlands
ITA03 Food, beverages and tob.	ITA13 Basic metals	ITA23 Water supply	ITA33 Postal and courier activities	ITA43 Legal and accounting serv.	ITA53 Education	BEL Belgium	GBR UK	NOR Norway
ITA04 Textile, wearing app. and leather	ITA14 Metal products	ITA24 Waste management	ITA34 Accomodation and food serv.	ITA44 Archit. and engeneering act.	ITA54 Human health activities	BRA Brazil	GRC Greece	POL Poland
ITA05 Wood producs	ITA15 Computer, electronic and optical pr	ITA25 Construction	ITA35 Publishing activities	ITA45 Scient. research and developm.	ITA55 Residential care	CAN Canada	IDN Indonesia	PRT Portugal
ITA06 Paper products	ITA16 Electrical equipment	ITA26 Sale of motor vehicles	ITA36 Programming and broadc. act.	ITA46 Advertising	ITA56 Culture	CHN China	IND India	ROU Romania
ITA07 Printing	ITA17 Machinery	ITA27 Wholesale trade	ITA37 Telecommunications	ITA47 Other professional services	ITA57 Entertainment and recreation	DEU Germany	IRL Irelan	ROW Rest of the World
ITA08 Coke and refined petroleum prod	ITA18 Motor vehicles	ITA28 Retail trade	ITA38 Informatics	ITA48 Rent and leasing	ITA58 Trade Unions, political parties	DNK Denmark	JPN Japan	RUS Russia
ITA09 Chemical products	ITA19 Other transport equipments	ITA29 Land transport	ITA39 Financial services	ITA49 Employment activites	ITA59 Computers repair	ESP Spain	KOR South Korea	SWE Sweden
ITA10 Pharmaceutical products	ITA20 Other manufacturing	ITA30 Water transport	ITA40 Insurance activities	ITA50 Travel agencies	ITA60 Non-residential care	EUR Oher EU	LUX Luxemburg	USA United States

Source: Authors' calculations on Istat and WIOD data.

In the right-hand part of the graph are mostly services, which are the Italian business sectors less connected with international markets; in the left-hand part the leading sectors of the Italian specialization model (more

[5] In this case, each node is placed in the network according to the intensity of its relationships, represented by the monetary value of the transactions.

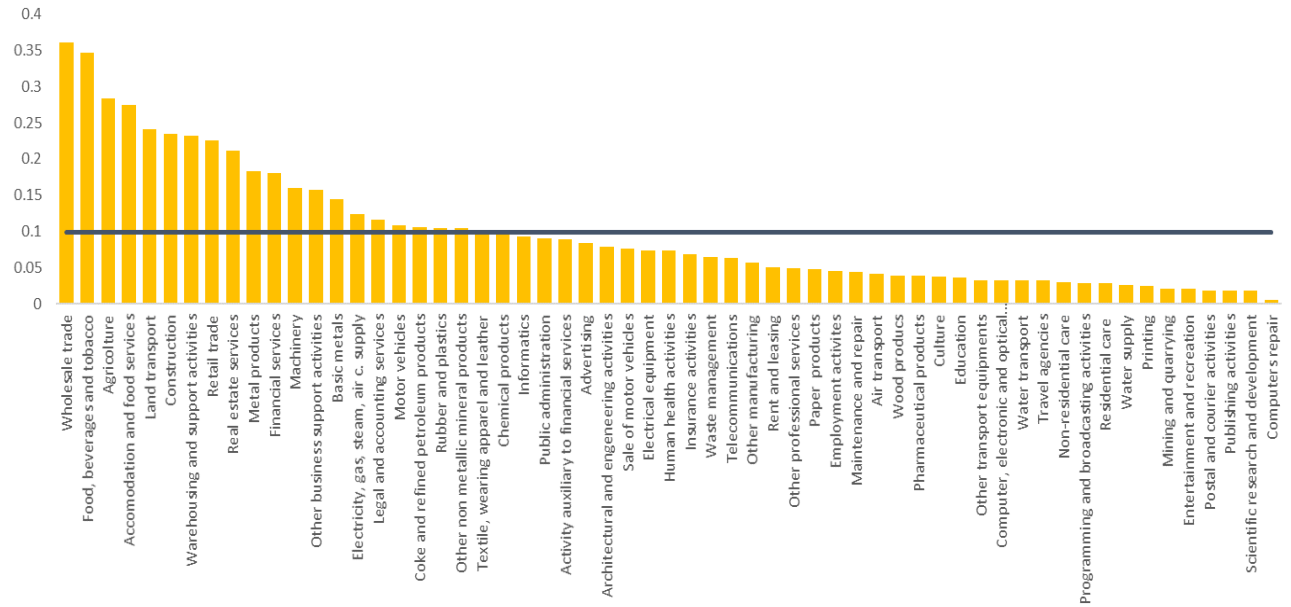
interconnected with foreign countries and, therefore, more relevant in the transmission of exogenous shocks) are concentrated. In turn, these latter form two clusters: at the bottom there are Metal products, Electrical equipment, Electronics, Machinery and Textiles/wearing apparel/leather; in the upper part Motor vehicles, Other transport equipment, Sales of motor vehicle and Construction.

3. The sectoral structure of internal trade and the transmission of shocks

International shock transmission, however, is a phenomenon partly distinct from impulse propagation within the economic system. The former depends, as we have seen, on the structure of relationships between sectors in different countries; the latter relates to the trade network linking sectors within a given country. It is therefore possible that a mismatch emerges between sectors that are central for the international transmission of a shock and those that are central for its propagation within a country. This possibility will help explain how quickly the shock moves from one country to another and how pervasive their effects on the "receiving" system are likely to be.

Consequently, in order to understand how the Italian economic system absorbs exogenous shocks we need to evaluate the structure of the trade network between Italian industries.

Figure 5. Degree of centrality by sector, 2017



Source: Authors' calculations on Istat data.

The rank of sectors according to the centrality index (Figure 5) relating to 2017 shows that only nine out of the forty-five sectors considered lay above the average. In particular, the most central ones are Wholesale trade, Food, beverages and tobacco, Agriculture. Among services sectors, Accommodation and food services, Land Transport, Warehousing and support activities show also values above the average; among the manufacturing sectors, besides Food, the only ones to show a significant degree of centrality are Metal products and Machinery. Some important sectors of the Italian specialization model, such as Textiles/wearing

apparel/leathers and Motor vehicles, are characterized by a less central position within the production system. Among the peripheral sectors stand out some knowledge- and technology-intensive sectors, such as Pharmaceuticals, Computers and Electronics and, to a greater extent, Scientific research and development activities.

Centrality index provides a first measure of the importance of production sectors in shock transmission. However, to properly outline the role of sectors within the business system at least two other elements need to be taken into account: the ability of a given sector to intermediate relations between other sectors (betweenness indicator) and the characteristics in terms of magnitude (number of sectors included) and density (share of active relationships on potential ones) of its ego-network (i.e. the sub-network centered on the sector of interest).

Considering together the betweenness indicator values and the magnitude and density of ego-networks, it is possible to build a new taxonomy of the sectors, whose categories identify the type of impulse transmission to the rest of the economic system. This provides an ultimate map of how the Italian inter-sectoral relationships react to an exogenous shock.

In particular, on the basis of the deviation of each sector's values from the average, four groups of sectors can be defined:

• **Weak transmission sectors**: sectors with ego-networks characterized by limited scale and low density, regardless of their intermediation capacity.

• **Hierarchical transmission sectors**: sectors with wide but not very dense ego-networks, with a high intermediation capacity (above average betweenness).

• **Selective transmission sectors**: sectors with limited but very dense ego-networks, characterized by a low intermediation capacity (below average betweenness).

• **Widespread transmission sectors**: sectors with wide and dense ego-networks, regardless of their intermediation capacity.

In the case of widespread transmission sectors, impulse propagation is able to reach a large number of sectors and it is strengthened by the strong sectoral connection (in turn a reflection of the density of the relationships linking them). These are therefore sectors able to transfer impulses to the rest of the economic system in an extensive and rapid way. Selective transmission sectors allows the propagation of stimuli on a limited scale, but with high speed. On the contrary, slow but extensive transmission characterizes hierarchical transmission sectors. Finally, weak transmission sectors propagate shocks to a limited and slow extent, due to both the limited number of sectors potentially involved and the low density of relationships within the ego-network.

Table 1 shows the distribution of economic activities into this four groups. In particular, looking at the industries with the highest centrality values in the domestic network (as highlighted in Figure 5), Wholesale trade and Agriculture are classified as hierarchical transmission sectors, together with Construction, Retail Trade, Financial Services and Basic metals. Selective transmission sectors, which propagate shocks to a limited but fast extent, include Food and Beverages, Metal Products, Land Transport, Other business support activities and Real Estate Services. The widespread transmission group is particularly small: among four sectors included, however, two (Machinery and Legal and accounting services) are among the most central

in domestic relations. Finally, Accommodation and food services are included in the group of weak transmission sectors.

Table 1. Taxonomy of shock transmission by sectors, 2017

Weak transmission	Hierarchical transmission	Selectve transimission	Widespread transmission
Limited breadth and low density	*Wide but low-density ego-network*	*Limited breadth but high density ego-network*	*Wide 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		

Source: Authors' calculations on Istat data.

Therefore, the Italian economic sectors are mostly characterized by hierarchical shock transmission. As a result, this category includes the majority of firms (over 55%, Table 2) which also account for the largest share in terms of value added, employment, exports, imports and production value. These sectors, however, have not, on average, the most intense connections with foreign markets: their degree of trade openness is in fact considerably lower than that of sectors included in the widespread transmission group, and substantially similar to that of selective transmission sectors.

Table 2 – Characteristics of the taxonomy - 2017

Type of transmission	Enterprises		Workers		Value added		Export		Import		Openness	Production		Labour productivity
	No.	%	No. (million)	%	€ (million)	%	€ (million)	%	€ (million)	%	((exp+imp)/ value added; %)	€ (million)	%	(Value added/workers; average; €)
Weak	961,329	19.5	3.6	18.1	270,090	19.4	79,279	16.2	59,619	18.7	51.4	598,107	19.3	74,036
Widespread	560,231	11.4	1.2	6.0	134,175	9.6	83,632	17.1	26,827	8.4	82.3	293,584	9.5	110,778
Hierarchical	2,722,770	55.3	10.0	49.4	620,383	44.6	203,583	41.7	148,509	46.6	56.8	1,390,474	44.8	62,288
Selective	682,313	13.8	5.3	26.5	367,787	26.4	121,795	24.9	83,985	26.3	56.0	819,282	26.4	68,751
Total	4,926,643	100.0	20.2	100.0	1,392,436	100.0	488,288	100.0	318,940	100.0	58.0	3,101,448	100.0	69,039

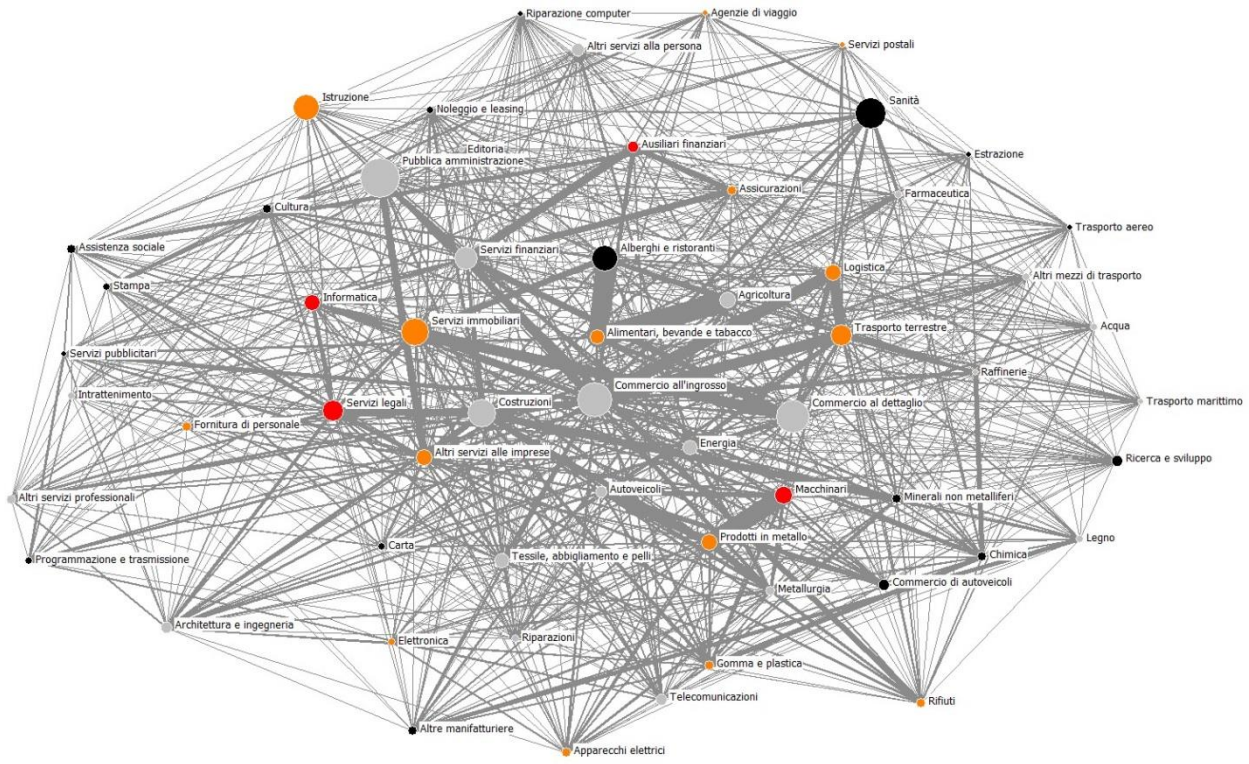
Source: Authors' calculations on National Accounts data.

It is worth to notice that the highest average productivity levels characterize the widespread transmission sectors. This may be a point of concern for the Italian economy, because their high transmission capacity, combined with the lack of centrality in domestic relations, can weaken any spillover of competitiveness.

The speed and magnitude of the transmission highlighted in our taxonomy depend also on the positioning (central or peripheral) of industries within the Italian trade network. In this respect, Figure 7 gives a representation of the cross-sectoral relationships structure through the overall centrality degree; the size of nodes represents the relevance of sectors in terms of value added, while colors indicate their belonging to the four classes of taxonomy. The thickness of the arcs reflects the value of transactions underlying the linkages.

On the one hand, all four widespread transmission sectors (in red) are placed in an intermediate "crown" of the trade network. The central part, on the other hand, is characterized by the presence of both selective transmission sectors (in orange; in particular Food beverages and tobacco, Land transport, Warehousing and support activities, Real Estate) and hierarchical sectors (in gray; in particular Wholesale trade, Agriculture, Motor Vehicles, Construction), while weak transmission sectors are in peripheral position, with the exception of Accommodation and food services. Moreover, all the activities that contribute the most to the overall value added tend to position at the center of the network, with the exception of Health and social welfare, Education and Public administration.

Figure 7 – Graph of inter-sectoral relationships - 2017



Source: Authors' calculations on Istat data.

A further noteworthy aspect concerns how the four groups interact with each other, as the extent to which this interaction takes place affects the transmission of shock within the economy. In this respect, we consider both the "relevance" and the "density" of the interactions between groups. As far as the "relevance" is concerned, we use an indicator that measures the ratio between the number of bilateral relationships linking industries of different groups and the total number of active relations in the economic system (Table 3a). The "density" is calculated as the ratio of the number of bilateral links between sectors belonging to different groups of the taxonomy and the total potential links that could be activated by the sectors belonging to those two groups (Table 3b).

As for the relevance, the relative majority of these relationships (16% of the total) occur between hierarchical transmission sectors. About 12% concern transactions from hierarchical transmission industries to weak transmission ones. The reverse flow also appears to be of some importance (10.4%). For 10% of total transactions, the propagation of a possible shock is fast (outgoing flows from hierarchical sectors towards selective ones), for 10.9% it is wide (outgoing flows from selective sectors towards hierarchical ones). Finally, the small number of widespread transmission sectors imply a low relevance of the incoming and outgoing transactions activated with sectors belonging to the other three categories of the taxonomy.

Table 3. Relevance and density of inter-sectoral relations, by groups of taxonomy, 2017 (a)

(A) Relevance

	Weak	Hierarchic	Selective	Widespread
Weak	6.9	10.4	7.5	2
Hierarchical	11.9	16	10	2.6
Selective	7	10.9	5.7	2.2
Widespread	1.8	3.2	1.5	0.4

(B) Density

	Weak	Hierarchic	Selective	Widespread
Weak	0.27	0.28	0.31	0.31
Hierarchical	0.32	0.33	0.3	0.29
Selective	0.29	0.33	0.29	0.38
Widespread	0.28	0.37	0.27	0.33

(a) Along the rows: outgoing transactions; along the columns: incoming transactions.
Source: Authors' calculations on Istat data

Nevertheless, in terms of density the widespread transmission sectors have a high propensity to interact with the industries of the other groups (in particular the hierarchical transmission industries), both in outward (with a density of 37%) and inward links (30%). A lower but still relevant density characterizes the relationships between selective and hierarchical sectors.

The centrality (and the economic relevance) of the domestic bilateral linkages of a number of hierarchical and selective transmission industries places them in a privileged position to propagate shocks of internal origin. In case of shocks from abroad, this capacity directly depends on the openness of the given industry to international markets. Comparing the evidence of paragraphs 2 and 3, however, only Motor vehicles (belonging to the hierarchical transmission group), Machinery (widespread) and Metal products (selective) show both a high openness to international markets and a central position within the Italian business system.

Furthermore, this aspect can have important consequences in terms of technological progress. In previous works, for example,[6] we pointed out that a higher centrality in the trade relationships with other countries' most productive sectors makes many Italian medium-high technology industrial sectors more reactive to any stimuli coming from abroad; however, their lower centrality within the domestic network limits their ability

[6] See Istat (2019).

to transmit these impulses to the rest of the Italian system. On the contrary, the technological upgrading of low-medium technology industries, which are more connected to domestic sectors and therefore with higher transmission capacity, may be limited by their close links with the relatively less productive foreign sectors.

Moreover, since hierarchical transmission sectors intermediate exchanges within their own ego-networks, the propagation of shocks is strongly affected by their own characteristics, for example in terms of technological content, input requirements, productivity. At the same time, widespread transmission sectors (those that would transmit the stimuli faster and to a wider extent) tend to be less central in the trade network and, with the exception of Machinery, they are also less directly open to foreign shocks. Therefore, the Italian business system generally suffers from some structural mismatches that weaken its ability to efficiently and quickly intercept potential positive shocks of foreign demand (thus benefiting from business cycle of growing countries) or to benefit from technology or productivity spillovers.

4. Conclusions

This work studies the transmission mechanisms of national and foreign shocks within the Italian economic system through the analysis of the trade network, at both international (considering the links between Italian exporting sectors and foreign importing ones) and national level (i.e. the inter-sectoral relations among the Italian industries). To this aim, we propose a new taxonomy of sectors based on the extent to and speed with which they transmit shocks within the business system.

The analysis points out a mismatch between sectors having a central position in terms of transmission of foreign shocks and those having a central role for the propagation of domestic shocks within the Italian economic system. Industries of the Italian specialization model are the most open to foreign markets and therefore, in principle, should be the most relevant in the domestic transmission of exogenous shocks. However, the most advanced (and productive) segments of the Italian business system tend to play more a central role in export relations than in internal ones (Textile, wearing apparel and leather, Pharmaceutics products, Not metallic minerals, Other transport equipments). Only a small group of sectors (Motor vehicles, Machinery, Metal products) has both a high exposure to international markets and a central position within the Italian system. This results in a higher difficulty, for Italy, to benefit from foreign spillovers and move on to more dynamic growth paths.

In addition to the openness to foreign markets and the centrality in the domestic trade network, the speed and extent of shocks transmission are also relevant. In this respect, the taxonomy here proposed shows that at the center of the network of internal relationships mainly lie sectors with a wide but slow transmission capacity (hierarchical transmission sectors: Wholesale trade, Agriculture, Motor vehicles, Construction), and those able to propagate shocks fast but to a narrower extent (selective transmission sectors: Food and beverages, Land transport, Warehousing and support activities, Real estate). Furthermore, the interactions between the sectors of these two groups account for a large share of total transactions within the Italian economic system, both effective (i.e. already activated) and potential (i.e. which may be activated). On the contrary, the small number of widespread transmission sectors, their relatively more decentralized position within the network and the reduced openness (with the exception of Machinery) to international markets negatively affect the possibility of spreading the impulses (endogenous and exogenous) to both an extensive and a rapid way.

It follows that, for the overall Italian economic system, the ability to transmit foreign shocks domestically is limited: this strongly compromises the possibility of benefiting from positive shocks in foreign demand, even if it could represent, at least, a "defensive" factor in the case of negative impulses deriving from international business cycle downturns.

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