Comparative Advantage and Centrality in the World Network of Trade and Value Added: An Analysis of the Italian Position

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We examine Italy's market share on total gross exports over time and its relation with countries' position in the World Trade Network (WTN). By means of network analysis, we assess Italy's position in overall world trade and in two different sectors of comparative advantage, and we place emphasis on the network of trade partners of Italy. We focus on centrality indices considering Italy's position, using both gross export flows and flows measuring domestic value added. We use the computed centrality measures to explain sectoral export performance, to assess Italian position in the WTN giving evidence on how Italy is increasing its distance from the world markets.

JEL Classification: C02, F10, F14.

Keywords: Italy, Comparative advantages, Global value chains, Trade in value added, Network analysis.

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The authors wish to thank Laura dell'Agostino and Silvia Nenci for sharing their data with us. Luca De Benedictis wishes to thank the Isaac Newton Institute in Cambridge, UK, for the hospitality. The usual disclaimer applies.

1. Introduction

Italians are merchants (Kindleberger, 1996; Najemy, 2004). They produced, bought and sold goods around the world for centuries. They did it, and they still do it in many countries and in many sectors. But between the 1980s and the 1990s many Italian trade economists started to be convinced that Italians were, at that time, producing, buying and selling the wrong kind of goods and that the Italian model of trade specialization was at best inappropriate to sustain the economic growth of the country (see Onida, 1978; Modiano, 1982; De Nardis and Traù, 1999, on this debate).[3] The question was not a moot point considering the dynamics of Italy's export displayed in Figure 1, showing the long-term pattern of Italy's world market share together with other relevant exporters in the world market.[4] From an initial world trade share of 2.5% in 1950, Italy did rapidly increase its export participation to international markets at the remarkable rate of more than 3% per year, reaching a share over 4% in the early 1970s. However, after the First Oil crisis, the Italian market share flattened out, and between 1973 and 1995 the Italian share of world exports oscillated around a horizontal drift, at a level of 4.5%. From 1995 onwards, Italian trade shares declined, reaching the 2.8% of the 2010s, and this new trend renovated the worrisome concerns emerged in the debate of the 1980s.

[Figure 1 – Long-term trends in export market shares – about here]

The inverted-U shape of Italian trade shares can be taken as a reference to delimit the three phases that characterize also the evolution of other countries' participation to international trade in the last sixty years.

In the first phase, that goes from the end of World War II to the first half of the 1970s, European countries regained international market shares to the United States, while China's trade dynamics was essentially null, and its export participation was mediated by Macao, Hong Kong and Taiwan. Germany's exports grew at a much faster pace than the ones of Italy, reaching a world trade share of 13%.

The second phase, running along the twenty years between the mid-seventies and the mid-nineties, is a phase of relative trade stability for Italy, Germany and the US. Their trade shares were around 4.7%, 10.3% and 11.8%, respectively. On the other hand, China started its remarkable export grow during these years.

The third phase marks the contraction of export shares for Italy, Germany and the US and the large expansion of Chinese shares, which now reach 14.1% of world exports.

[3] See also De Nardis and Traù (2005) and De Benedictis (2005) for a review of the debate on the structure of sectoral specialization in Italy.

[4] The export market share by itself gives only limited information of the performance of a country in international markets, as it does not take into account many factors, such as the use of different forms of firms' internationalization, changes in other countries' market shares, relative and marginal effects of trade resistances (Anderson and van Wincoop, 2003). Therefore, the trends in the picture must be interpreted with all the necessary *caveat* applying.

The literature of the 1980s ascribed the changes in Italian market shares, to the peculiar Italian model of trade specialization (De Benedictis, 2005), put under stress by the integration of the European market, the sudden change in the exchange rate regime, and the emergence of new international competitors, especially in Asia. The literature of the 2010s emphasizes instead the crucial role of firms' productivity in its relation with the export status of firms (Castellani, Serti and Tomasi, 2010), together with their capacity to adapt to the changing world markets, and to benefit from the opportunities arising from the international fragmentation of production (IFP) and the creation of global value chains (GVCs).

In this paper we offer a view on the evolution of the Italian model of trade specialization based on the analysis of the structure of Italian comparative advantages through the lenses of network analysis. To give account of role played by global value chains in influencing the production structure of countries, we compare the information on Italian comparative advantages obtained using gross trade values, from the UN Comtrade database, and value added trade, from the WIOD database (Timmer *et al.,* 2015). Our goal is not to identify one unique causal explanation to the dynamics of Italian export shares, but to complement previous discussions with an analysis of the structural dimension of Italian trade.

The rest of the paper is organized as follows: in Sect. 2 we examine Italy's comparative advantages over time using the traditional Balassa indicator, comparing what emerges with an analogous index computed using only the domestic value added content of exports. In Sect. 3 we illustrate which additional insights can be obtained considering the changes occurred in Italy's position in the world trade network (WTN), and especially in its centrality. In Sect. 4 we examine the structure of trade in value added in two of Italy's main sectors of comparative advantage to understand if this can shed light on the changes occurred in Italy's model of specialization. Finally, Sect. 5 concludes.

2. Evolution of Italy's comparative advantages

2.1 A stable model of specialization ?

We evaluate the evolution of Italian comparative advantages focusing on one particular year for each of the three phases previously described: 1965, 1995, 2011. These specific years were selected as representative of the dynamics of Italian market shares in each phase and for comparability reasons with data in value added, which is available only for 2011 as the last year included in the WIOD database.

For each of these years we obtained from the UN Comtrade database the gross values of Italian and World exports, X_i and X_w, for the 67 sectors , $s = 1, 2, \dots, 97$, of the SITC rev.2 nomenclature. Then, we calculated, for Italy, the share of each sector on total Italian exports (domestic share), X_i^s / X_i , the share of each sector on world sectoral

exports (world share), X_i^s/X_w^s, and the Balassa (1965) index of Revealed Comparative Advantages (RCA), $\left.{X_i^s/X_i}\right/_{X_w^s/X_w}$. All variables are included in Table 1.

Table 1 – Italian trade and comparative advantages

SITC rev.2	Sector	Domestic share $\frac{X_i^s}{X_i}$	World share $\frac{X_i^s}{X_w^s}$	RCA $\frac{X_i^s}{X_i}/\frac{X_w^s}{X_w}$	Domestic share $\frac{X_i^s}{X_i}$	World share $\frac{X_i^s}{X_w^s}$	RCA $\frac{X_i^s}{X_i}/\frac{X_w^s}{X_w}$	Domestic share $\frac{X_i^s}{X_i}$	World share $\frac{X_i^s}{X_w^s}$	RCA $\frac{X_i^s}{X_i}/\frac{X_w^s}{X_w}$
		1965			1995			2011		
0	Live animals	0.01	0.06	0.01	0.02	0.43	0.09	0.01	0.21	0.07
1	Meat and meat preparations	0.30	0.69	0.15	0.40	1.94	0.40	0.63	2.35	0.81
2	Dairy products and eggs	0.55	1.90	0.43	0.38	2.85	0.59	0.59	3.71	1.27
3	Fish and fish preparations	0.04	0.22	0.05	0.15	0.75	0.16	0.15	0.65	0.22
4	Cereals and cereal preparations	1.56	1.68	0.38	1.00	3.98	0.83	1.09	3.09	1.06
5	Fruit and vegetables	7.64	13.52	3.03	2.13	7.10	1.48	1.85	4.59	1.58
6	Sugar, sugar preparations and honey	0.05	0.39	0.09	0.09	1.21	0.25	0.08	0.80	0.27
7	Coffee, tea, cocoa, spices & manufacs. thereof	0.19	0.41	0.09	0.35	2.58	0.54	0.57	2.92	1.00
8	Feed. stuff for animals excl. unmilled cereals	0.15	0.87	0.20	0.10	1.09	0.23	0.14	1.05	0.36
9	Miscellaneous food preparations	0.13	2.52	0.56	0.32	3.92	0.82	0.59	4.69	1.61
11	Beverages	1.03	6.15	1.38	1.20	8.61	1.80	1.60	8.66	2.98
12	Tobacco and tobacco manufactures	0.13	0.79	0.18	0.09	0.83	0.17	0.06	0.78	0.27
21	Hides, skins and furskins, undressed	0.18	1.38	0.31	0.04	1.42	0.30	0.06	2.43	0.83
22	Oil seeds, oil nuts and oil kernels	0.01	0.05	0.01	0.00	0.06	0.01	0.03	0.21	0.07
23	Crude rubber including synthetic and reclaimed	0.32	1.58	0.35	0.05	0.86	0.18	0.11	0.78	0.27
24	Wood, lumber and cork	0.04	0.13	0.03	0.13	0.86	0.18	0.08	0.72	0.25
25	Pulp and waste paper	0.03	0.14	0.03	0.01	0.09	0.02	0.08	0.86	0.29
26	Textile fibres, not manufactured, and waste	1.14	1.63	0.36	0.14	1.32	0.28	0.08	0.86	0.30
27	Crude fertilizers and crude minerals, nes	0.64	3.39	0.76	0.21	3.43	0.71	0.22	2.89	0.99
28	Metalliferous ores and metal scrap	0.18	0.34	0.08	0.12	0.65	0.13	0.33	0.44	0.15
29	Crude animal and vegetable materials, nes	0.74	4.78	1.07	0.29	3.60	0.75	0.29	3.37	1.16
32	Coal, coke and briquettes	0.05	0.22	0.05	0.01	0.12	0.03	0.04	0.13	0.05
33	Petroleum and petroleum products	5.35	4.15	0.93	1.26	1.30	0.27	4.77	0.99	0.34
34	Gas, natural and manufactured	0.05	1.63	0.36	0.02	0.21	0.04	0.10	0.13	0.05
35	Electric energy	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.95	0.33
41	Animal oils and fats	0.04	0.68	0.15	0.02	1.95	0.41	0.03	2.66	0.92
42	Fixed vegetable oils and fats	0.13	0.98	0.22	0.37	4.39	0.91	0.42	2.41	0.83
43	Animal and vegetable oils and fats, processed	0.03	1.01	0.23	0.04	1.81	0.38	0.04	1.41	0.49
51	Organic chemicals	3.15	5.12	1.14	1.47	3.04	0.63	1.14	1.42	0.49
52	Inorganic chemicals	0.00	0.25	0.06	0.23	1.67	0.35	0.46	2.07	0.71
53	Dyeing, tanning and coloring materials	0.23	1.69	0.38	0.50	3.75	0.78	0.62	4.18	1.44
54	Medicinal and pharmaceutical products	0.84	3.63	0.81	1.60	5.07	1.06	4.05	4.18	1.44
55	Perfume materials, toilet & cleansing preptions	0.42	4.00	0.89						
56	Fertilizers, manufactured	1.14	6.88	1.54	0.02	0.37	0.08	0.07	0.49	0.17
57	Explosives and pyrotechnic products	0.05	2.93	0.66	0.01	1.45	0.30	0.01	0.94	0.32
58	Plastic materials, etc.	2.10	7.85	1.76	2.60	5.15	1.07	2.73	3.48	1.20
59	Chemical materials and products, nes	0.52	2.13	0.48	0.86	3.65	0.76	1.24	3.15	1.08
61	Leather, lthr. manufs., nes & dressed fur skins	0.62	6.63	1.48	1.76	17.38	3.62	1.29	17.07	5.87
62	Rubber manufactures, nes	1.06	7.36	1.65	1.08	6.17	1.29	1.04	3.49	1.20
63	Wood and cork manufactures excluding furniture	0.75	5.81	1.30	0.43	3.28	0.68	0.36	2.95	1.02
64	Paper, paperboard and manufactures thereof	0.67	1.49	0.33	1.72	3.94	0.82	1.59	4.18	1.44
65	Textile yarn, fabrics, made up articles, etc.	8.86	7.87	1.76	5.65	7.95	1.66	2.95	4.91	1.69
66	Non metallic mineral manufactures, nes	2.16	4.54	1.02	3.80	8.48	1.77	2.28	3.55	1.22
67	Iron and steel	5.09	4.48	1.00	3.70	5.80	1.21	5.17	5.07	1.74
68	Non-ferrous metals	1.50	1.87	0.42	1.12	2.69	0.56	1.81	2.30	0.79
69	Manufactures of metal, nes	3.16	6.48	1.45	4.00	8.42	1.76	3.99	5.65	1.94
71	Power generating machinery and equipment	14.42	5.68	1.27	2.03	3.93	0.82	3.08	3.99	1.37
72	Machinery specialized for particular industries	5.98	5.06	1.13	7.28	10.03	2.09	6.18	6.72	2.31
73	Metalworking machinery				1.42	8.34	1.74	1.49	8.79	3.02
74	Gen. industrial machinery & eq. & parts, nes				7.92	9.27	1.93	9.83	7.99	2.75
75	Office machines and autom. data processing eq.				2.33	2.14	0.45	0.67	0.57	0.20
76	Telecommunications, sound rec and reproducing eq.				1.17	1.40	0.29	0.96	0.71	0.24
77	Electric machinery, apparatus and appliances & parts, nes				6.33	3.31	0.69	5.06	1.89	0.65
78	Road vehicles	9.84	4.96	1.11	8.40	4.39	0.92	7.00	2.82	0.97
79	Other transport equipment				1.34	2.72	0.57	2.20	3.00	1.03
81	Sanitary, plumbing, heating and lighting fixt.	0.38	6.79	1.52	0.96	14.54	3.03	0.74	7.61	2.62
82	Furniture	0.51	7.09	1.59	3.66	18.14	3.78	2.31	7.81	2.69
83	Travel goods, handbags and similar articles	0.35	15.71	3.52	0.69	10.55	2.20	1.07	10.15	3.49
84	Clothing	5.90	16.00	3.58	6.25	8.93	1.86	4.63	5.38	1.85
85	Footwear	2.93	31.67	7.09	3.22	17.88	3.73	2.06	9.89	3.40
86	Scientif & control instrum, photogr gds, clocks	1.33	3.29	0.74	1.09	3.09	0.64	1.33	1.77	0.61
89	Miscellaneous manufactured articles, nes	4.10	7.01	1.57	5.52	6.39	1.33	4.23	3.55	1.22
93	Special transact. Not class. According to kind	0.00	0.00	0.00	0.87	1.57	0.33	2.17	1.63	0.56
94	Animals, nes, incl. Zoo animals, dogs and cats	0.00	0.80	0.18	0.00	1.06	0.22	0.00	1.72	0.59
95	Firearms of war and ammunition therefor	1.21	9.79	2.19	0.04	1.52	0.32	0.05	2.64	0.91
96	Coin, other than gold coin, not legal tender	0.00	0.01	0.00	0.00	4.37	0.91	0.00	1.58	0.54
97	Gold, non-monetary, excluding gold ores & concentrates				0.03	0.37	0.08	1.67	3.50	1.20
	TOTAL	100	4.47	1	100	4.80	1	100	2.91	1

Source: our elaboration on UN Comtrade database.

In 1965, Italy was still largely an agricultural country. 7.64% of its exports were in Fruits and Vegetables (13.52% of world sectoral exports), produced especially in the South of the country. In the North, the prominent Road vehicles sector (9.84% of Italian exports) and a Power generating machinery sector (14.42%) typify the industrial development of the country. The heritage of mediaeval and Renaissance handicraft emerged as a distinct industrial structure in medium-size cities of the North-east and the Center of the country, through the spread of Marshallian districts (Becattini, 1999) characterized by small firms exporting Textiles, Leather products, Clothing and Footwear, that together with other sectors producing design-goods defines the set of consumers' goods labeled and characterized as "Made in Italy".

The Italian sectoral specialization, the one that prevailed in the first twenty years of the postwar period, can be sketched through the RCA index in 1965: sectors with a RCA>1 (a.k.a. $X_i^s/X_i > X_w^s/X_w$) are the ones which reveal a comparative advantage. As an example, in the case of Footwear 31.67% of world exports were made of Italian shoes, and the Italian domestic share (the numerator of the RCA index) was a little bit more than 7 times the world sectoral share (the denominator of the RCA index).

In 1995, the export landscape changed. Some sectors become so marginal at world level to disappear from the SITC classification (e.g. Perfume materials) and others acquired a new specific status in the classification (e.g Other transport equipment). In Italy, the agricultural sector reduces its relevance and, as an example, the Fruit and vegetables sector reduces its share both at the domestic and at the world level. The "Made in Italy" compartment constitutes the backbone of the Italian model of trade specialization, together with the newly expanded mechanical sectors (e.g. SITC codes 71-77), reaching almost a quarter of the entire Italian export. The overall picture is multifaceted: some of the traditional sectors grew, like Leather (from 6,63% to 17.38% of world shares) and Furniture (from 7.09% to 18.14%); others shrunk, like Footwear (from 31.67% to 17.88%), or Clothing (from 16% to 8.93%), depending on local elements such as the evolving characteristics of industrial districts, or global ones, such as the booming of vertical integration, IFP and offshoring.

In 2011, the agricultural and agri-food sectors present a new diversified conformation: SITC sectors 2, 4, 5, 9,11 confirm or acquire a RCA>1. The presence of multinational firms favors the positive development, started in the 1990s, of a Medicinal and pharmaceutical products sector. At the same time, the Italian model of trade specialization confirms a very high degree of persistence (De Benedictis and Tamberi, 2004), having its peculiarity on the existence of an elliptical structure with two focal points: the "Made in Italy" compartment and the Mechanical compartment, a structure which is more similar to the one of emerging economies that to the one of OECD countries with a similar level of income per capita.

This traditional analysis of Italian comparative advantages requires to be complemented on two different domains: the metric used and the account of the changes in the structure of the trade network.

2.2 Revealed comparative advantages in value added

A key feature of international trade patterns in the last decades is the development of international production chains stretching across different countries, where the various production phases and the creation of value added for a given final good is taking place in different locations. As a consequence of the growing relevance of trade in intermediate goods, directly related to the expansion of IFP and embodied in final goods, the observation of gross export values is less indicative of the actual comparative advantages of a country than in a context where only final goods are traded. This occurs because of double counting (some parts of goods can cross the border of a given country more than once) and because the domestic contribution to export can be overstated. This phenomenon has been studied extensively in the recent trade literature in order to understand how the shift from trade in final goods to this `vertical trade' affected the trade patterns and specialization of countries (Deardorff, 2001; Hummels et al., 2001; Yi, 2003; Johnson and Noguera, 2012), and it led scholars to partially revise the traditional measures of trade flows across countries and the related indexes of comparative advantage (Deardorff, 2005; Baldone et al., 2007; Stehrer, 2012; Koopman et al., 2014).

The matter is not only a measurement issue. This international reorganization of production can allow countries to modify and improve their competitiveness. Higher competitiveness through IFP can be reached through cost and, therefore, price reduction (Deardorff, 2001); it can arise through technological improvements or factors' productivity enhancement (Grossman and Rossi-Hansberg, 2008; Halpern et al., 2011) and through the quality of intermediate inputs and components from abroad incorporated in a country's final product. Therefore, the reorganization of production by means of IFP could have helped Italy to preserve its traditional comparative advantages (see Baldone et al., 2002).

But there can be also negative effects related to the adoption of IFP. In fact, a large gross export flow can generate a small effect on national income if the amount of domestic value added embodied in exports is trivial. In a context where IFP is widespread, in order to assess the specialization model for a country, it is not enough to consider the structure of its gross exports, but it is important also to understand in which sectors value added, and therefore income, is generated. A country may present a revealed comparative advantage in a sector using a measure based on gross trade, but that advantage might be originated by foreign imported inputs and produce a small effect on the domestic economy.

It is therefore useful to assess whether the structure of comparative advantages emerging from the traditional trade measures is confirmed by an analysis undertaken using only the domestic value added embodied in exports to measure comparative advantages. This can be done using recent datasets based on inter-country input-output tables and accounting decomposition methodologies developed originally by Koopman et al. (2014).

In a recent paper, Dell'Agostino and Nenci (2016) analyze the Italian specialization pattern in trade comparing the Revealed Comparative Advantage index computed both in terms of gross exports and in terms of domestic value added in export. As usual, the RCA index is

calculated as reported in Table 1. In the calculation using value added, only the domestic value added produced in sector *s* and embodied in exports (directly and indirectly, by the same sector or in export from other sectors) is used at the numerator, while the world value added at the denominator excludes double-counting.[5] Therefore, the index computed using value added in exports should capture the relative strength of sector *s* in producing and exporting, directly or indirectly, the value added generated in that sector.

Table 2 RCA indicators in value added and gross value for the Italian manufacturing sectors

ISIC rev. 3 code	Sectors	RCA in value added			RCA in gross value		
		1995	2007	2011	1995	2007	2011
19	Leather, leather products and footwear	2.436	2.273	2.565	4.181	4.525	4.831
29	Machinery, not elsewhere classified	1.813	2.040	2.030	2.130	2.419	2.454
36, 37	Manufacturing, not elsewhere classified (a); recycling	2.175	1.621	1.571	2.384	1.618	1.384
27, 28	Basic metals and fabricated metal	1.304	1.378	1.457	1.123	1.389	1.608
17, 18	Textiles and textile products	1.703	1.632	1.454	1.920	1.813	1.513
21, 22	Pulp, paper, printing and publishing	1.064	1.227	1.345	0.637	0.784	0.862
24	Chemicals and chemical products	0.847	1.043	1.245	0.812	0.961	1.075
26	Other non-metallic mineral	1.296	1.123	1.086	2.623	2.279	2.086
25	Rubber and plastics	1.237	1.068	1.066	1.920	1.519	1.481
15, 16	Food, beverages and tobacco	0.768	0.953	1.041	0.778	1.026	1.137
34,35	Transport equipment	0.813	0.898	0.932	0.791	0.919	0.896
20	Wood and products of wood and cork	0.750	0.764	0.812	0.553	0.705	0.764
30-33	Electrical and optical equipment (b)	0.567	0.629	0.591	0.549	0.537	0.553
23	Coke, refined petroleum and nuclear fuel	0.460	0.400	0.349	0.633	0.835	0.852

Source: Dell'Agostino and Nenci (2016) calculations on WIOD data, 1st release.
Note: Sectors listed by the decreasing value of the RCA value added in 2011; (a) It includes furniture; (b) It includes computers and office equipment, radios, televisions and telecommunication equipment.

From Table 2, we see that the overall picture of the Italian specialization does not change dramatically when considering only value added. On average, RCA in value added tends to be closer to the threshold value of 1 than RCA in gross exports. This concentration of the distribution around the threshold indicates that in terms of production of value added, the Italian economy is less polarized than in terms of gross exports, as it is expected for a mature economy.

The correlation between the indices in gross terms and in value added across sectors is quite high, but it is worth noting that it declines over time: from 0.89 in 1995, the correlation between the two sets of indices drops in 2007 and it sets to 0.77 in 2011. This confirms that

[5] The number of sectors included in the WIOD database is far more limited than the one of UN Comtrade. See Dell'Agostino and Nenci (2016) for details.

as the Italian participation to GVCs increased in recent years, it becomes more important to take into account the role of such participation in determining the country's comparative advantages.

In 2011, in most sectors of comparative advantage, the index declines somewhat if considering value added only, as the international organization of production becomes more widespread also in these sectors. The sectors with the largest difference (in absolute terms) between the two indices are Paper and Printing, Non-metallic minerals, Leather products and Fuels. In Paper and Printing, the RCA in value added displays a comparative advantage that does not appear in gross terms. In the other sectors, the presence of comparative advantages or disadvantages is confirmed by both indices, but both in Leather Products and in Non-metallic minerals (two traditional sectors of specialization for Italy) the comparative advantage in terms of value added is much smaller, showing that the foreign inputs' content of these goods is large. This means that the role of foreign suppliers for producers in these sectors is very important. Instead, the Italian comparative advantage is slightly reinforced in terms of value added in Other Manufactures (including furniture) and in Chemicals, where the domestic value added content appears crucial for the revealed comparative advantage.

Given the growing relevance of the participation to GVCs, in Section 4 we take a closer look to the system of international linkages that Italy has in two of its main sectors of comparative advantage to understand how they evolved over time.

3. Network analysis of the Italian position

3.1 The role of network analysis

A useful way to assess the changing position of Italy in international markets is through the visual and topological representation of its position in the network of international trade flows. Italy, as every other country, is represented as a node of the network, connected through trade link to its trade partners. The position in the network does not depend exclusively on the characteristics of the country itself but also on the influence that the position of others exerces

The implication of this structural view is that the relation between country *i* and country *j* cannot be considered independently from the relation between *i* and *z*, and between *j* and *z*. This is very important when we want to understand Italy's position in the world markets, as even if the country's characteristics and specialization remained stable, the rest of the world changed dramatically the three phases depicted in Figure 1, inevitably affecting Italy's position. The application of Network Analysis (NA) can, therefore, nicely complement previous empirical evidence.

The network of trade links, in which Italy is involved directly or indirectly, can be examined in its binary version (just considering the partnership status of any pair of countries) or its weighted version (also considering export values). In both cases, network analysis provides several indicators to assess the importance of a node centrality, capturing different aspects of its position with respect to the structure of connections (Newman, 2012; Borgatti, 2005). In general, even if all indices share the same axiomatic configuration (Bloch, Jackson and

Tebaldi, 2016), each of them, being constructed using different information on node's position, can provide different insights on the country's participation to international.

Centrality measures can be classified into four main groups (Jackson, 2010): a) degree centrality, that measures how much a node is connected to others (with strength centrality as a weighted version of degree centrality); b) closeness centrality, showing how easily a node can be reached by other nodes; c) betweenness centrality, describing how important a node is in terms of connecting other nodes; d) the fourth group of indexes, such as the eigenvector centrality measure, which associates node's centrality to the node neighbors' characteristics, directly referring to how important, central, influential or tightly clustered a node's neighbors are.[6] We compute these measures for Italy, in 1965, 1995 and 2011, to better understand the evolution of the position of the country and how this is connected to the changes occurred in its export market share.

3.2 The evolution of the Italian position in the World Trade Network

The network of world trade is represented in Figures 2a, 2b and 2c, displaying the structure of exchanges among countries over time. Countries are the nodes of the graph and trade flows are the links connecting nodes. Countries from the same continent share the same node's color. Following De Benedictis et al. (2014) and Zhou, Wu and Xu (2016), in order to sparsify the trade matrix and focus on the backbone of trade connectivity, only the two largest export flows are displayed (the out-degree of the nodes is fixed to two) to keep the figures readable, and the size of the dot representing each country is proportional to the number of incoming trade links of the country (the in-degree of the node).

[Figure 2a,2b and 2c (WTN 1965, 1995, 2011) about here]

As mentioned, a primary use of network analysis is to identify key-players by looking at the position they have in the system. The concept of centrality seeks to quantify graph theoretic ideas about an individual node's prominence within a network by summarizing structural relations among the nodes. A node with high degree centrality maintains numerous contacts with other network actors. Nodes have higher centrality to the extent they can gain access to or influence over others. A central node occupies a structural position (network location) that serves as a source or conduit for larger volumes of exchange with other nodes. In the visual representation of networks, central nodes are located at or near the center in network diagrams of topological space. In contrast, a peripheral country maintains few or no relations and thus is located spatially at the margins of a network diagram. The algorithm (e.g. Force-directed algorithm) used to draw Figures 2a, 2b and 2c follows this approach, and it places at the center of the figure the most connected countries, so that centrality in the figure is related to a central position in the world trade network in terms of overall linkages.

In Figure 2a we can see that the world trading system in 1965 was built around the USA and the UK. This last country was playing a key role in connecting Europe (blue nodes) and the USA to many developing countries. In the graph, Italy is still a relatively peripheral country, but it is strongly connected to the trading center of Europe through its strong links to Germany

[6] For details on these measures of centrality, see De Benedictis et al., 2014. A general treatment of the issue can be found in Newman (2013).

and France. The picture in 1995 (Figure 2b) is substantially different. The UK still plays the role of bridging different parts of the network, but it is much less central. Japan appears as a much more relevant player, and other Asian countries are more visible, but to a large extent, developing countries are still quite peripheral. One of the areas that changed the most is Europe: the effects of the process of European integration are clearly visible. Italy, together with Germany and France, forms a strong trading group at the core of Europe. Italy also plays the role of connecting this core to some more peripheral parts of Europe and North Africa.

The process of European integration continues to be visible in Figure 2c, where the trade ties between Italy and Germany are so strong to make the two countries overlap in the graph, and where very strong ties appear among all the main EU members. But in 2011 the network structure suggests a partition of the world trading system in two: on the one hand, a very connected European bloc, strongly tied to its geographic neighbors and to some parts of Africa. Italy is at this point more connected and more central than the UK, still working as bridge, but much more peripheral than it used to be in the past. The second bloc in the picture is built around the strong trade ties between USA and China. China was hardly visible in the network graph in 1995, while it has become much more central in 2011. Over this time period, Italy moves closer to the center of the network, but its evolution is always very closely connected to the rest of Europe.

To better assess Italy's position, it is useful to analyze the topological indices related to the position of the country in the network, in order to correctly interpret the visual impression gathered from Figures 2a-2b-2c.

Table 3 – Network indicators for Italy

		1965				1995				2011			
$\mathcal{N}(\mathcal{V},\mathcal{L})$		$\mathcal{N}_{1965}(134, 5293)$				$\mathcal{N}_{1995}(178, 15331)$				$\mathcal{N}_{2011}(182, 21451)$			
Density		0.30				0.48				0.65			
Zeros		12932 [0.70]				16353 [0.52]				11673 [0.35]			
Ego-network statistics - Italy		$\mathcal{L}$-in	$\mathcal{L}$-out	$\mathcal{W}$-in	$\mathcal{W}$-out	$\mathcal{L}$-in	$\mathcal{L}$-out	$\mathcal{W}$-in	$\mathcal{W}$-out	$\mathcal{L}$-in	$\mathcal{L}$-out	$\mathcal{W}$-in	$\mathcal{W}$-out
		1965				1995				2011			
1	Centrality												
1.1	degree	0.90	0.91	4.02	4.53	0.97	1.00	3.89	4.83	0.99	1.00	3.23	3.01
1.2	closeness	0.87	0.92	0.93	0.98	0.97	1	0.81	0.13	0.99	1.00	0.99	0.01
1.3	betweenness	0.47		0.06		0.88		0.17		0.99		0.10	
1.4	eigenvector	0.95		0.96		0.98		0.23		0.99		0.19	
2	Distance	1.14	1.09	245.50	239.75	1.03	1.00	921.83	232.55	1	0.99	1241.31	246.22
2.1	Italy → Germany	1	1	1.37	1.01	1	1	1.25	1.08	1	1	1.98	2.49
2.2	Italy → UK	1	2	2.78	2.94	1	1	2.89	2.25	1	1	5.36	4.37
2.3	Italy → United States	1	2	1.72	3.99	1	1	3.38	2.33	1	1	5.45	4.17
2.4	Italy → Japan	1	2	2.33	4.60	1	1	3.59	3.07	1	1	5.27	5.55
2.5	Italy → China	∞	4	∞	60.12	1	1	5.26	5.24	1	1	4.22	4.39
3.1	Hubness	0.98		0.23		0.99		0.30		0.99		0.17	
3.2	Authority	0.97		0.34		0.99		0.14		0.99		0.15	

Source: our elaboration on UN Comtrade database.

In Table 3, we see the effects of growing globalization in the WTN: over time the number of trade links among countries increased (from 5293 in 1965 to 21451 in 2011), increasing the value of density in the network (the ratio between the number of existing links and the number of possible links) and reducing the number of countries' pairs with zero trade among them (from 12932, that corresponds to 70% of the possible links - in square brackets -, in 1965, to 11673 [35%] in 2011). The position of Italy is assessed looking at different position indicators, which consider separately whenever possible in-coming and out-going links (import flows and export flows, respectively), and consider the simple presence of links (binary network perspective, or the extensive geographic margin), or their strength (the value of trade carried on each link, or the intensive margin). Looking at the binary centrality indicators, we see that Italy's position in the system becomes more central over time, as the number of links that the country has with the rest of the world grows, and they connect the country with the main world markets, as seen also in Figures 2. But considering the centrality indicators that take into account the strength of the links, the resulting trend is quite different. As the complexity of the network increases and the role of emerging countries grows since the late 1990s, the relative centrality of Italy tends to diminish. This is in line with the decline in market shares observed in Figure 1, but additional information can be obtained considering the global Italian position in the system. The main reason of concern for the position of Italy comes from the reduction of the eigenvector centrality, which computes the position of a country in the WTN with respect to the main players of the system. The reduction of this indicator suggests that the Italian geographic orientation of its trade flows did not adapt to the evolution of the world trading system, as a large part of its trade flows is connecting the country to relatively peripheral nodes.

This is confirmed by looking at the second set of indicators, measuring the topological distance between countries in terms of trade flows. Over time, Italy has become more "distant" from the most relevant world markets and from the most relevant suppliers. We see that between 1965 and 1995, the relative distance from Germany, UK, USA and Japan decreased somewhat in terms of out-going links, in the period of expanding Italian exports, but it was increasing in terms of imports, as Italy's participation to the production chains of these countries was probably not very strong. Between 1995 and 2011, all distance indices with the main industrialized countries increase. The only country seeing a decline in distance for the overall period is China, but even in 2011 the Asian country was still far apart from Italy. The fact that Italy is no longer pointing mainly to the most relevant nodes of the system is also visible looking at the hubness index, that should be high for a country exporting to the most important markets on the network: for Italy this indicator goes from 0.30 to 0.17 between 1995 to 2011. The authority index, showing how relevant a market is for the most important exporters, is more stable in this period, but still quite low for an advanced country.

4. Comparative advantages and the international organization of production

As mentioned above, in a world where the role of GVCs has been increasing rapidly, the involvement of a country in these international production processes can deeply affect its comparative advantages and its location in the WTN. Not only the extent of participation to

GVCs can be relevant, but also the structure of the existing international production links and the position of a country along the GVC can determine its performance in international markets. In fact, for the same level of gross exports, countries can generate very different amounts of domestic value added (and therefore domestic income) according to the position they have in the production chain, and have different power in setting prices with respect to the final destination markets (Antràs et al., 2012; Baldwin and Lopez-Gonzales, 2015).

For these reasons, we want to examine more in details Italy's comparative advantages in two sectors of strong specialization considering the overall position of the country in the trading system, both in terms of gross exports and in terms of domestic value added content of export. The position of Italy in the global production network in these sectors can determine if a central position in gross trade is accompanied by a large amount of value added generated.

The sectors considered here are leather and footwear, and machinery. We chose these sectors as they are the two in which traditionally Italy holds the strongest comparative advantage (see Tab. 1 and 2). But these sectors are very different in terms of technological content, and the competition in world markets in these sectors evolved differently.

4.1 Trade structures in footwear and in machinery

Figures 3 and 4 show the network of world trade in the two sectors analyzed, similarly to what was done for aggregate trade in Figure 2. In a traditional, labor intensive sector like footwear (Fig. 3) we can observe the relevant role of many emerging and developing countries already in 1995. Italy appears as the second most connected market in this industry, by far the largest industrialized country in this network, confirming the "anomaly" of its specialization. Italy is closely linked to many European countries also in this sector, but it has a number of relevant ties to many small less developed countries as a relatively central player in both industries.

In 2011, the spectacular growth of China in footwear trade is evident, with the country reaching even more the central position of the network, connected in terms of gross exports to nearly every other country of the system, and outweighing most other countries. In this industry, Italy appears as the only country still competing with China for the most central position.

[Figure 3 (network in footwear, gross trade) about here]

The trade network in machinery (Fig. 4) shows even deeper changes in the trade structure. In 1995 the network is dominated by the large developed countries, with very close positions of the European group, and very close ties between the USA and Japan. Italy is part of this core group. Fifteen years later, China seems to have taken over the center of the network, while Japan and UK remain relatively central, but much less relevant, and European countries are no longer forming such a connected group. Italy's position in the European core of the network is preserved, as well as its ties with Germany.

[Figure 4 (network in machinery, gross trade) about here]

4.2 Global value chains and structure of exchanges of value added in footwear and machinery

In order to understand the role of GVCs in the deep changes observed in the examined network structures and in Italy's relative position, it is useful to start by considering the origin of the value added embodied in Italy's export in the two sectors. This can be done by computing the domestic and the foreign value added content of gross exports. The methodology used to assess value added at the sector level, taken from Wang et al. (2013), decomposes the final value of Italy's exports of a given sector *s* in the domestic part, originated in any domestic sector, and in the foreign parts, including both direct and indirect foreign value added from different countries. For Leather products and footwear, this decomposition is presented in Table 4.

Table 4. Origin of value added in Italian export of Leather Products and Footwear – DVA and FVA share of gross exports (%)

1995		2011	
Domestic VA share	**84.729**	**Domestic VA share**	**81.744**
Total FVA share	**15.271**	**Total FVA share**	**18.256**
Germany	2.128	Germany	1.666
France	1.636	China	1.520
United States	1.483	United States	1.465
United Kingdom	0.904	Russia	1.194
Australia	0.604	Brazil	1.173
Netherlands	0.579	France	0.979
Belgium	0.575	United Kingdom	0.720
Russia	0.550	Spain	0.710
Spain	0.490	Netherlands	0.512
Brazil	0.424	South Korea	0.386
Japan	0.406	Australia	0.357
India	0.393	Belgium	0.330
China	0.278	Turkey	0.314
Austria	0.237	India	0.306
South Korea	0.180	Japan	0.272
Sweden	0.175	Austria	0.262
Canada	0.165	Indonesia	0.224
Indonesia	0.145	Poland	0.197
Turkey	0.144	Ireland	0.169
Ireland	0.137	Canada	0.167
Taiwan	0.128	Mexico	0.165
Poland	0.121	Sweden	0.130
Mexico	0.104	Czech Republic	0.127

Denmark	0.090	Romania	0.126
Slovenia	0.080	Taiwan	0.116
Finland	0.072	Hungary	0.107
Luxembourg	0.066	Denmark	0.069
Portugal	0.064	Portugal	0.067
Czech Republic	0.060	Slovak Republic	0.066
Hungary	0.055	Finland	0.063
Romania	0.053	Slovenia	0.053
Greece	0.042	Luxembourg	0.043
Slovak Republic	0.027	Greece	0.042
Lithuania	0.023	Bulgaria	0.035
Bulgaria	0.022	Lithuania	0.015
Malta	0.011	Malta	0.007
Latvia	0.006	Estonia	0.006
Estonia	0.004	Latvia	0.005
Cyprus	0.003	Cyprus	0.002
Rest of the world	***2.603***	***Rest of the world***	***4.088***

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The increase of the share of foreign value added in Italian gross exports of leather products and footwear confirms that also in this sector there has been a reorganization of the production processes and the extent of international fragmentation of production has increased somewhat. Both in 1995 and 2011 Germany was the main supplier of FVA for this industry, and a number of advanced, high income countries appear as relevant suppliers still in 2011, even if with a generally smaller share, indicating that also in a very traditional and labor-intensive sector, the delocalization of production phases is not relying only on low cost locations. At the same time, the change of position of China, whose share of value added in Italian export in this sector increased by more than 5 times confirms the relevance of this country in the manufacture of traditional goods even for countries that maintain a strong RCA in this sector (see Table 2). Also the FVA share of central and eastern countries members of the EU increased on average by more 50% in this period.

This shift toward foreign suppliers of inputs, especially in in emerging markets, means that because of the lower domestic value added share, in 2011 every euro of export in this sector was generating 3 cents less of income than in 1995. But in the same period, the higher FVA is associated with an increase of the RCA indices, and even if causality cannot be inferred from these simple observations, it is possible that this reorganization of production has allowed Italian firms in this sector to maintain a higher comparative advantage.

Table 5. Origin of foreign value added in Italian export of Machinery – DVA and FVA share of gross exports (%)

1995		**2011**	
Domestic VA share	**81.977**	**Domestic VA share**	**79.484**
Total FVA share	**18.023**	**Total FVA share**	**20.516**

Germany	3.783	Germany	3.198
France	2.236	China	1.535
United States	1.558	France	1.415
United Kingdom	1.198	Russia	1.316
Belgium	0.746	United States	1.220
Russia	0.687	Spain	0.950
Netherlands	0.682	United Kingdom	0.767
Spain	0.611	Netherlands	0.694
Japan	0.581	Belgium	0.494
Austria	0.436	Turkey	0.446
Sweden	0.370	Austria	0.425
Canada	0.338	Brazil	0.397
China	0.227	South Korea	0.397
Brazil	0.211	Japan	0.381
South Korea	0.163	Poland	0.344
Australia	0.162	India	0.282
Turkey	0.161	Sweden	0.270
Finland	0.141	Canada	0.252
Romania	0.122	Australia	0.217
Luxembourg	0.119	Czech Republic	0.216
Poland	0.118	Indonesia	0.169
India	0.118	Taiwan	0.154
Taiwan	0.117	Romania	0.148
Denmark	0.110	Ireland	0.131
Ireland	0.107	Hungary	0.131
Mexico	0.105	Mexico	0.129
Indonesia	0.096	Slovak Republic	0.118
Czech Republic	0.088	Finland	0.110
Slovenia	0.082	Denmark	0.097
Hungary	0.072	Slovenia	0.081
Portugal	0.063	Bulgaria	0.080
Greece	0.057	Portugal	0.069
Slovak Republic	0.051	Luxembourg	0.058
Bulgaria	0.032	Greece	0.048
Malta	0.019	Lithuania	0.009
Lithuania	0.005	Estonia	0.007
Latvia	0.003	Malta	0.006
Cyprus	0.002	Cyprus	0.006
Estonia	0.002	Latvia	0.005
Rest of the world	***2.246***	***Rest of the world***	***3.745***

Also in Machinery, the share of FVA has increased moderately, and also in this case the first partner for Italy is Germany. In this sector, the share of German value added embodied in

Italian exports is larger and more stable in time, but here too we observe a sharp increase in the Chinese share. Similarly to what was observed for the footwear industry, in machinery the larger participation to global value chains, measured through the FVA content of export, is not associated with lower comparative advantages, but quite the contrary: also in this industry the RCA for Italy increases in the past decade.

To better understand the Italian position in the world market in these sectors, we can analyze not only the change in the share of domestic value added and the shift in the shares of foreign suppliers, but also the underlying structure of production in these industries at the world level, by considering in trade flows only the domestic contribution to the value of the goods exported. In fact, more than the overall change of the Italian value added content in exports (complementing the increase in FVA observed in Tables 4 and 5), what can be relevant in terms of market power and efficiency is the Italian position in the international production system, its connectivity and its centrality (Baldwin and Lopez-Gonzales, 2015). An analysis of the network of trade in value added at the aggregate level as been undertaken recently by Amador and Cabral (2016), but this technique has not been applied yet to individual sectors.

To understand how the Italian position in two industries of comparative advantage changed in the past decade, we consider the network formed by the exchange of domestic value added in footwear and in machinery, respectively, built applying again the decomposition of Wang et al. (2013) to the WIOD database. In this case, links between countries are given by the domestic value added content of exports from country *i* to country *k* of a given sector *s*, regardless of the domestic sector in country *i* where this value added was produced. Using this backward perspective and including all upstream domestic inputs, DVA in bilateral export of good *j* embodies the underlying domestic production structure and it includes the overall contribution of domestic factors of production to the export of industry *j*. Therefore, it measures the domestic factors content of exports from a given sector. Unfortunately, in this networks our nodes are only 40, as this is the countries' coverage available in the WIOD database, but they cover more than 85% of world GDP and even larger share of world trade.

Looking at the picture of the trade network built using these links, we observe remarkable differences from the network of gross exports. In the footwear industry, again there is an important growth of China as a supplier of value added, but the difference between Figure 3 and 5 is striking. In terms of value added, the relevance of China in the network is much smaller than in the case of gross exports. Italy's position in the network of value added trade did not almost change. The decline in market shares and in centrality in gross export appears due to the reorganization of production at the international level, while the position in terms of value added centrality is much more stable. Still, the overall structure of the value added network in footwear changed remarkably over time. While in 1995, Italy was the clear center of the network, the 2011 structure displays two main hubs, closely connected to each other. In fact, Italy itself contributed to the rise of centrality of China. As shown in Table 4, the share of Chinese value added in Italy's footwear exports increased by more than five times in this period.

[Figures 5 and 6 (network in footwear and machinery, value added) about here]

The difference between Figures 4 and 6 is even more remarkable. In the machinery sector, in terms of value added, China still in 2011 is a quite peripheral node, even if more connected than in 1995. It is also possible to observe that while Germany maintained the think links with the most relevant nodes of the network, in 2011 there is a large increase in the link between Germany and China.

In this sector, the center of the network of value added exchanges remains the Germany-Italy pair, showing an increased relevance of both countries and even closer ties between the two. In spite of the small reduction in the share of exported value added in this sector (see Tables 2 and 5), Italy is still one of the main nodes of the system. But its position, far away from the non-European main nodes of this network, in 2011 just like in 1995, might create some difficulties as the center of system shifts in coming years.

5. Concluding remarks

The analysis of the Italian specialization and position in the world trade markets suggests a general persistence of the model of specialization both in terms of sectors and in terms of overall connections to countries. This does not mean that no change is observable: in the past decades, like many other countries, Italy has become more involved in international production networks, with a partial reorganization in its production structure, and changing the role of some country-partners. This is visible not only through the indicators of GVC participation measuring the share of foreign value added in the country's export, but even more clearly looking at the changes in the network of flows of value added between countries, and the shift in Italy's position. Looking at Italy's overall structure of international trade linkages highlights an important element related to the diffusion of GVCs: a country's position in terms of exports flows is strictly connected to its import linkages, which should be considered when assessing the international situation of a country.

Increased participation to GVCs has affected to some extent Italy's specialization. On the one hand, the stronger involvement in international production networks might have allowed Italy to preserve some of its traditional comparative advantages even in presence of dramatic changes in international markets. On the other hand, some new sectors of specialization might arise thanks to the production links with other countries. The role of GVC in shaping a country's specialization is not univocal, as observed in the literature (Taglioni and Winkler, 2016).

A consideration based on the evolution of Italy's centrality in the world trade network is that Italy, even if preserving many characteristics of its specialization, is increasingly far from the main nodes of the network, both in terms of final destination markets as well as for production links. The relative loss of centrality of the European bloc in the past decade, both at the aggregate level and in the examined sectors of Italian comparative advantage, impacted negatively also on the position of Italy. The shift of the center of the world trade network left behind a part of Italian firms, especially the smaller ones that find difficult to reach markets that are far away and different in terms of institutional environment. In this respect, some concerns on the possibility of reversing the trend in the country's market share might arise,

reopening the debate on the Italian model of specialization. On the other hand, complementing traditional analysis of comparative advantages with analyses in terms of value added and considering the entire structure of the trade network reinforce the argument against neo-mercantilist trade policies. When input and output flows are strongly interlinked proposing the promotion of export and the substitution of imports make little sense.

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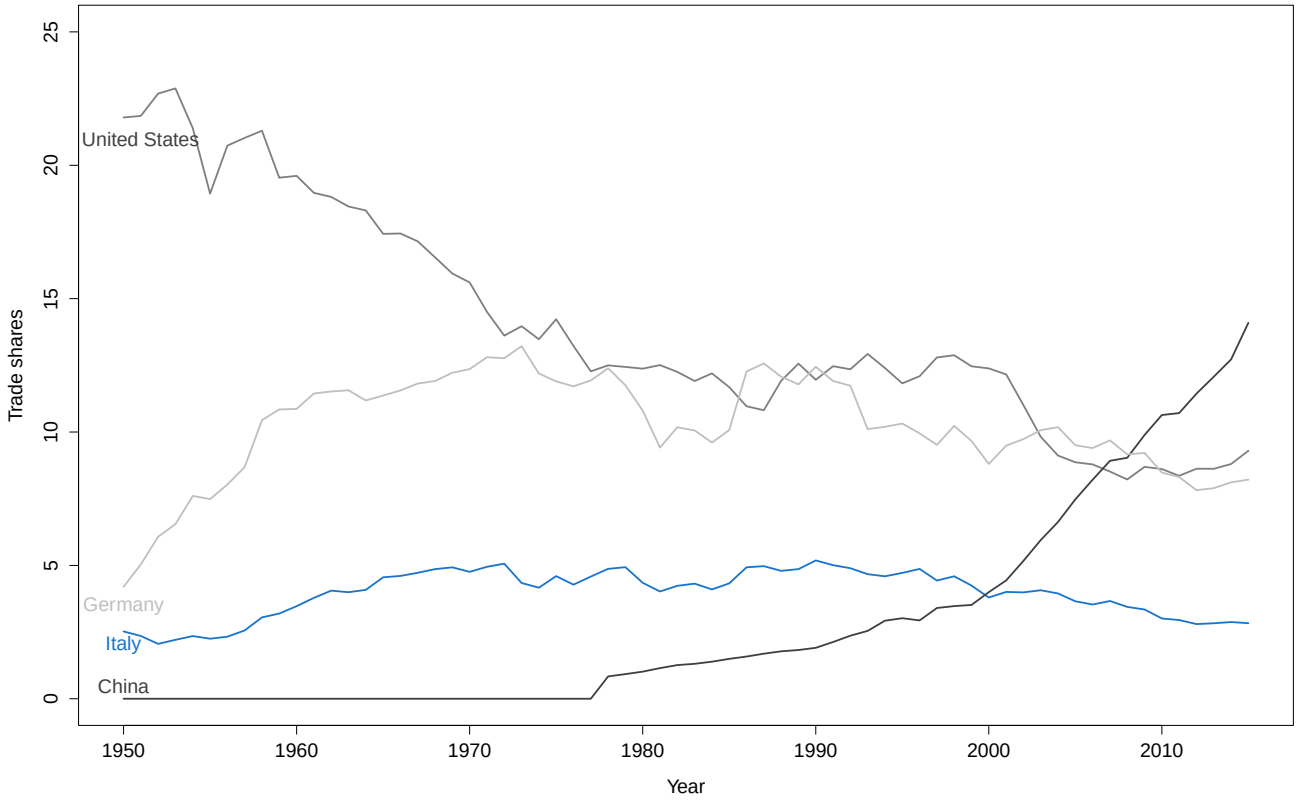
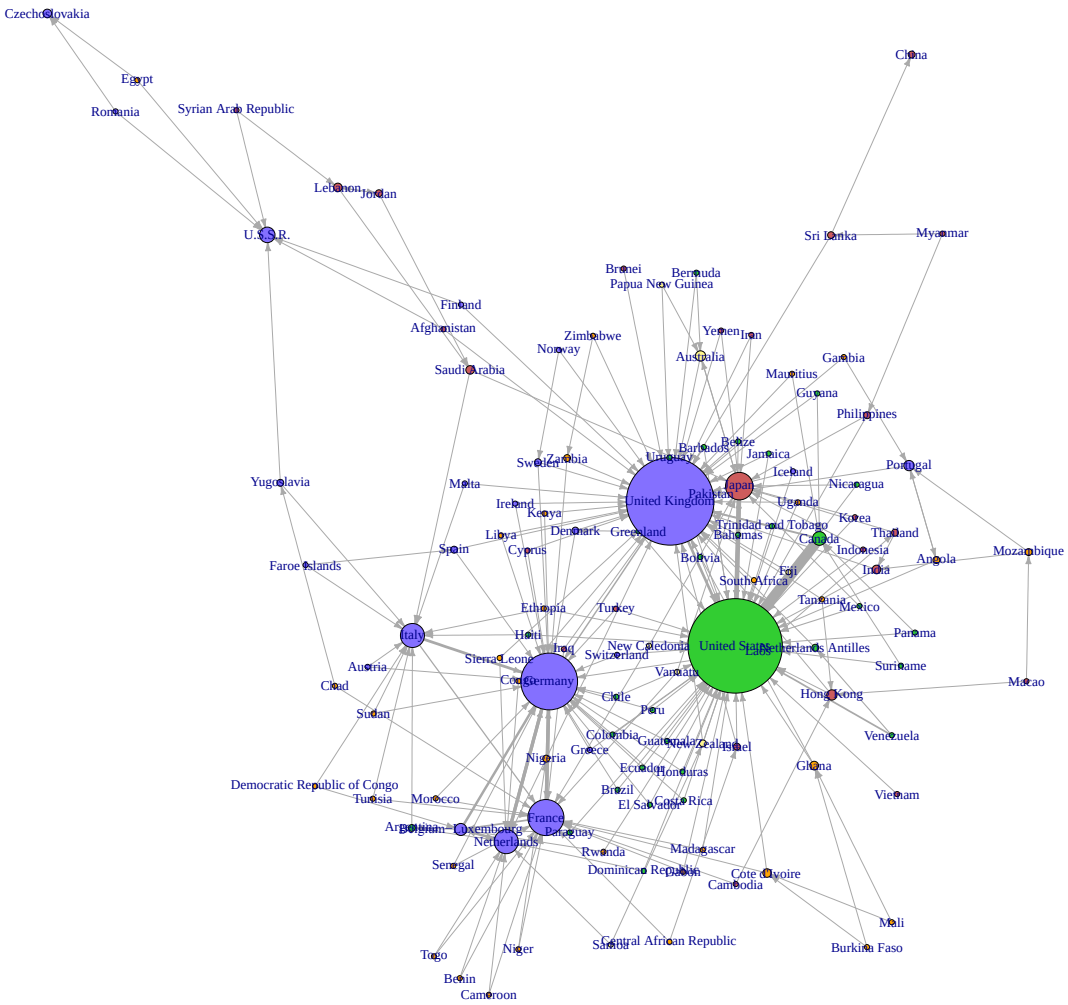
Figure 1 – Long-term trends in export market shares



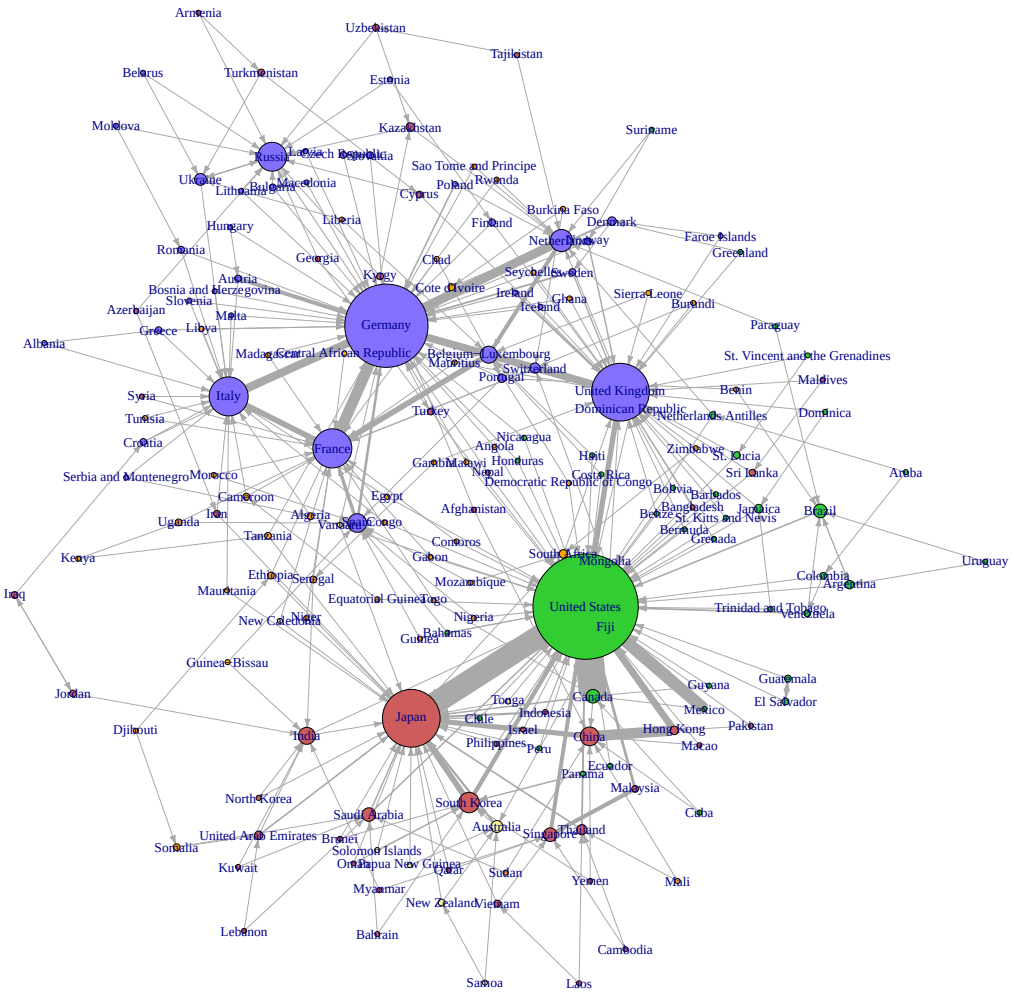
Source: our elaboration on IMF Directions of Trade Statistics

Figure 2a – The world trade network in 1965



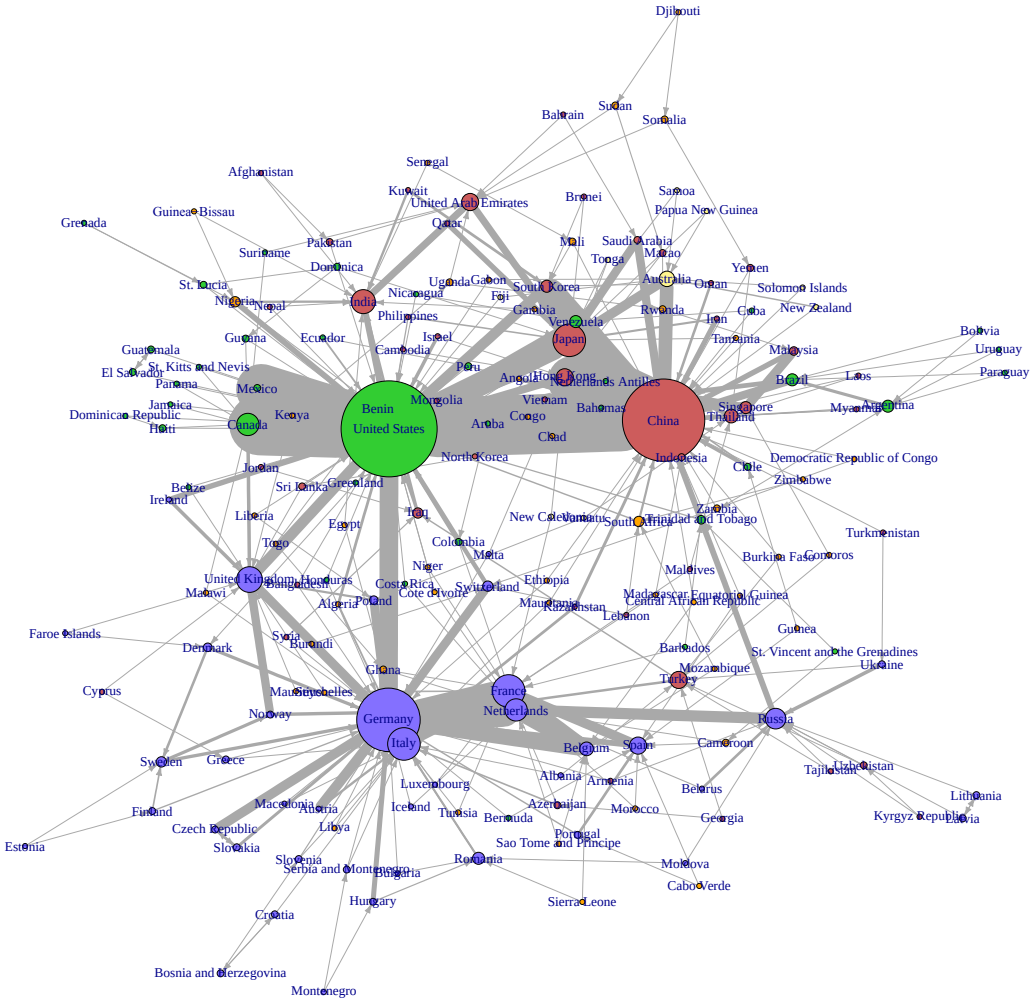
Source: our elaboration on BACI-Comtrade database

Figure 2b - The world trade network in 1995



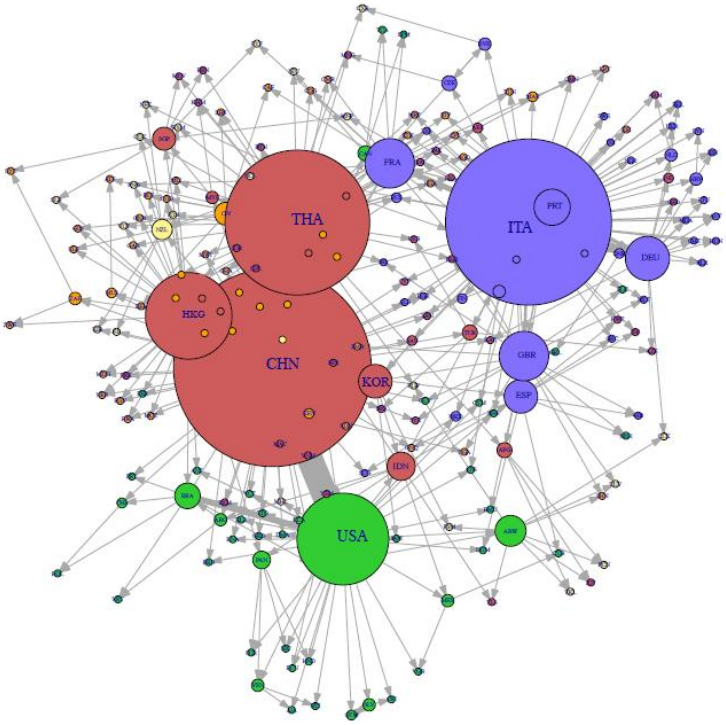
Source: our elaboration on BACI-Comtrade database

Figure 2c - The world trade network in 2011

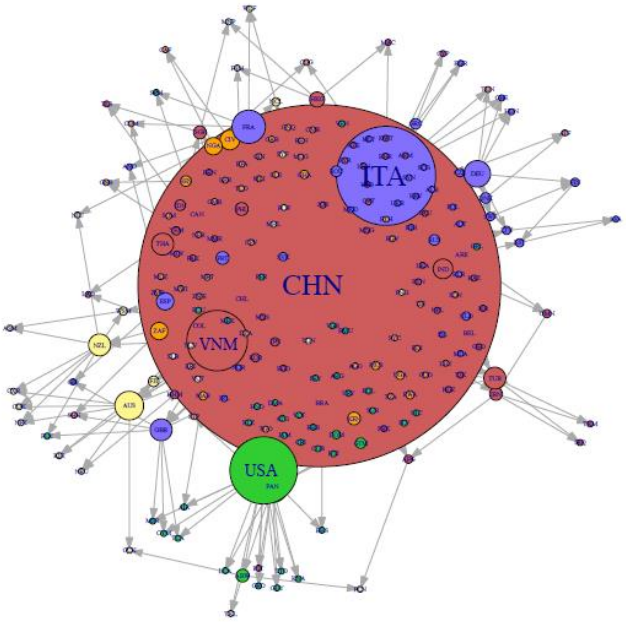


Source: our elaboration on BACI-Comtrade database

Figure 3 – Network of trade in footwear (HS 64) in 1995 and 2011 (gross trade)

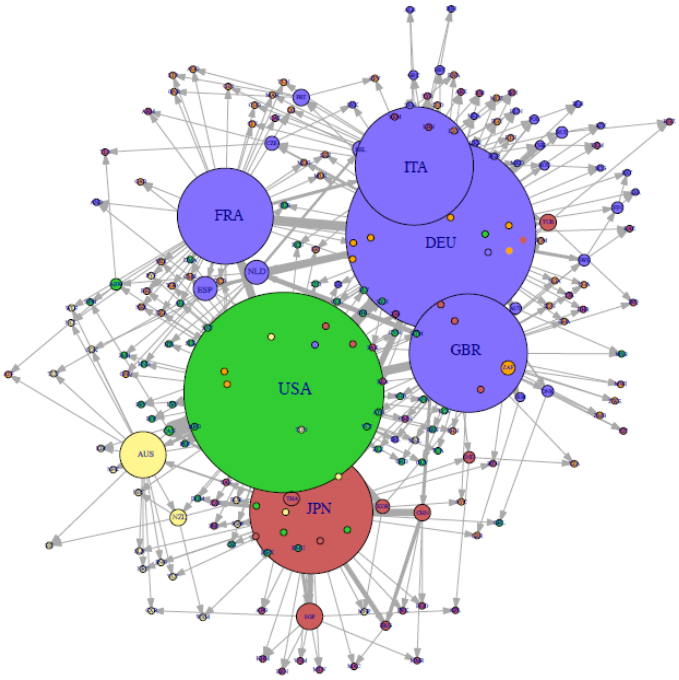


Trade network in 1995

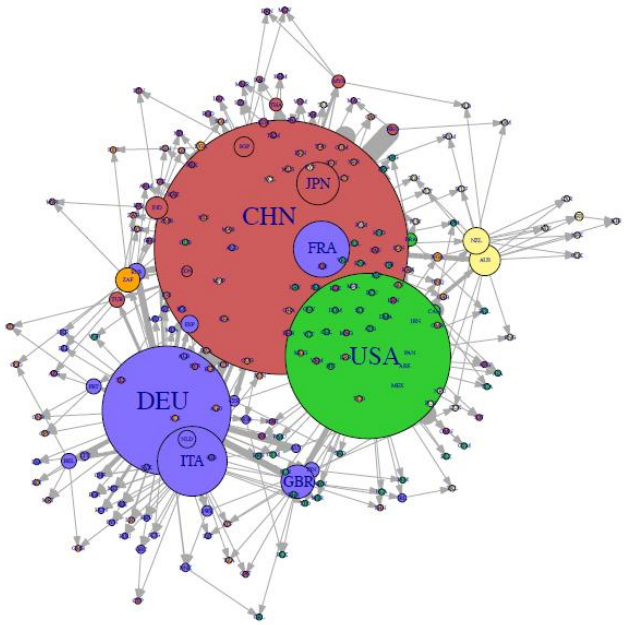


Trade network in 2011 - Source: our elaboration on BACI Comtrade database

Figure 4- Network of trade in machinery (HS84) in 1995 and 2011 (gross trade)



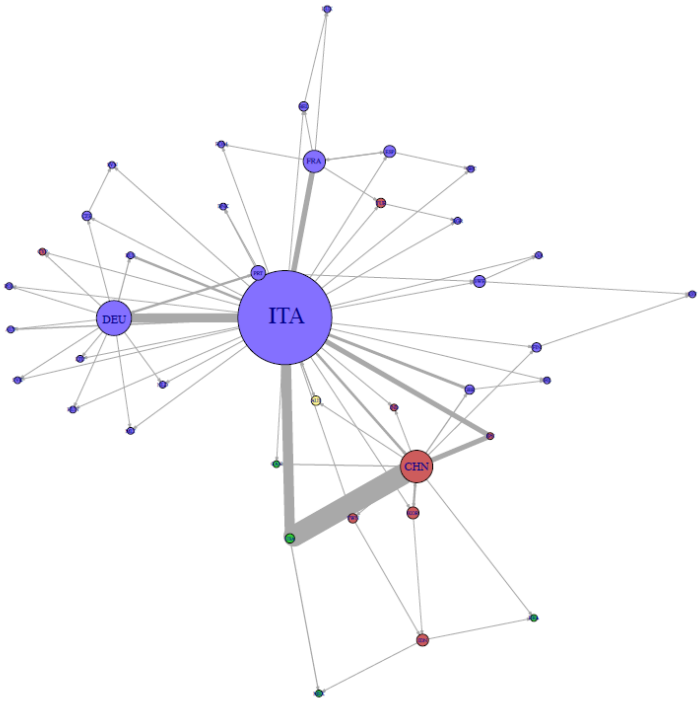
Trade network in 1995



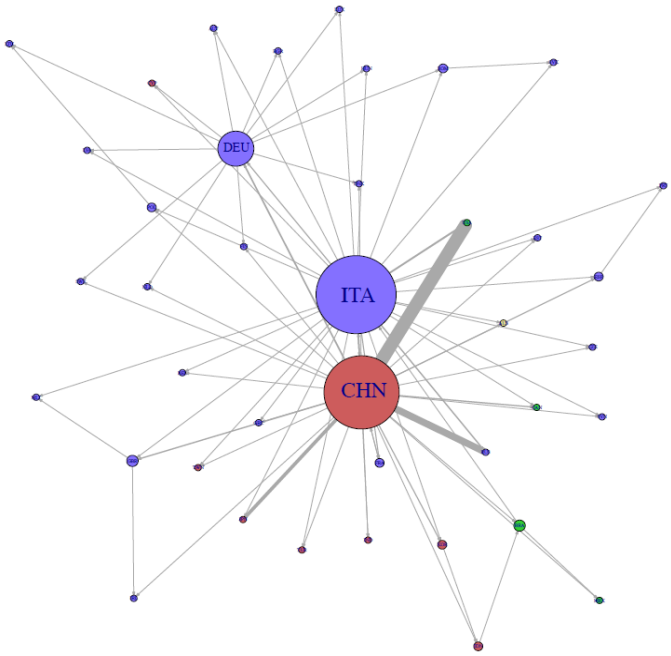
Trade network in 2011

Source: our elaboration on BACI Comtrade database

Figure 5 – Network of exported value added in footwear

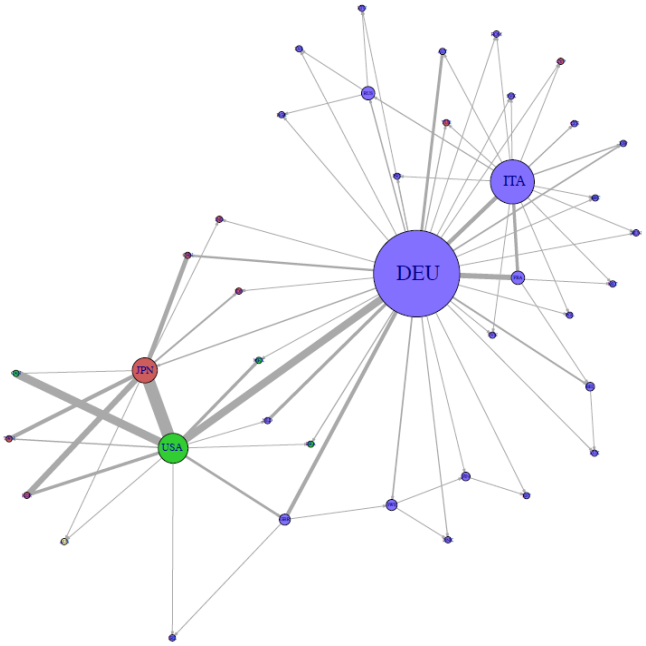


Network in 1995

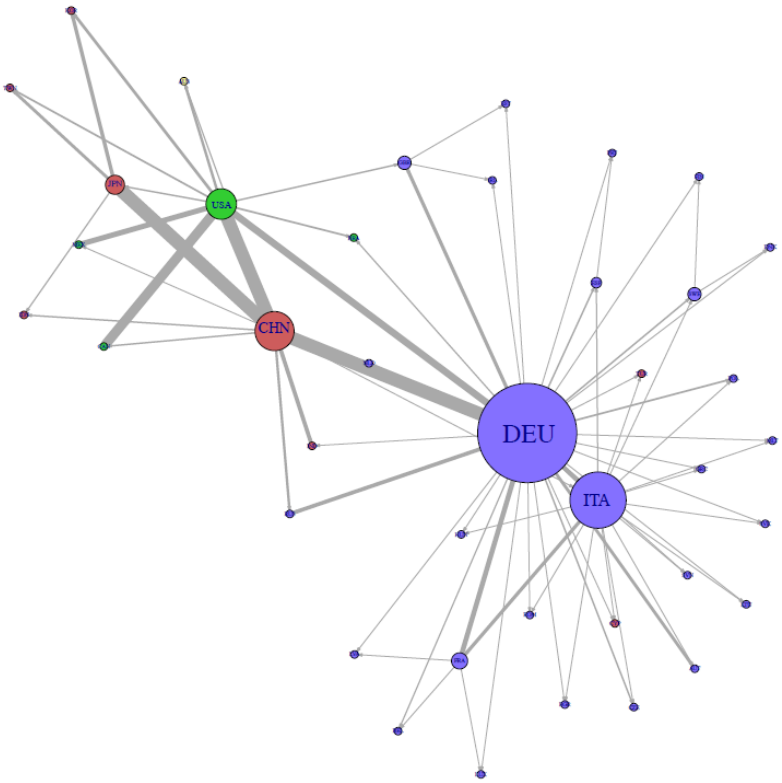


Network in 2011

Source: our elaboration on WIOD database
Figure 6 – Network of exported value added in machinery



Network in 1995



Network in 2011
Source: our elaboration on WIOD database