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The Textile Trade Network – the role of Italy and Portugal

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Abstract

Production and trade processes have been undergoing tremendous reallocation due to changes in both trade costs and institutional settings. This paper studies the effect in the textile industry from the perspective of the two major textile producing countries in West Europe, i.e. Italy and Portugal. Focusing on structural change in the textile industry from the perspective of these two countries, we first show how international trade networks with regard to value added and employment changed between 1995 and 2009. We then figure out how these countries' textile industries were affected in terms of specialisation patterns, movements along the international production chain (i.e. upstreamness vs. downstreamness) and vertical specialisation. Combining both qualitative and quantitative aspects of structural change within a comprehensive empirical analysis, this paper contributes to a better understanding of the consequences of structural shifts resulting from institutional and technological change on national economic structures, but in an international context.

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Keywords: International trade network, concentration, textile industry, structural change, network analysis, multiregional input-output model

JEL: C67, F14, O12

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1. Introduction

Recent years have seen rapid advances in information technology going hand in hand with institutional changes targeted towards trade liberalisation. This has led inter alia in a decrease of transaction costs such as plummeting costs of communication and of coordination. Fostered by these changes, manufacturing production processes have been fragmenting continuously and internationally, leading to the establishment of international production chains (Timmer et al., 2014). Worldwide competition thus increasingly plays out at the level of production activities within industries, rather than in terms of

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competitive advantages with regard to endowments between industries. Firms in mature economies tend to relocate their unskilled labour-intensive production activities to lower-wage countries while keeping strategic functions concentrated in a few urban regions, where the high-skilled workers and intangible capital they require are available (Feenstra, 1998 and Baldwin, 2006a).

A prime example for these development trends is the textile industry, which has become an internationalized industry and has undergone tremendous structural changes over the course of the last two decades. A further reason to study the developments in the textile industry is the fact that it is one of the most globalized industries worldwide. Almost every country produces for the international textile market as this is one of the industries export-oriented industrialization typically starts with (Dickerson, 1995). Increased mechanization and automation processes as well as changes in the institutional setting constitute important drivers for the ongoing restructuring process (Kowalski and Molnár, 2009). The institutional changes within the textile industry are particularly noteworthy: In 1994, the agreement of the World Trade Organization on Textiles and Clothing directed the reduction of quantitative restrictions on imports. This agreement established a ten-year transition period in which trade barriers had to be eliminated step by step. Between 1995 and 1997 the import quota of traded textile goods had to rise by 16 per cent, until 2001 by 25 per cent and until 2004 by 27 per cent compared to the levels of 1995. From 2005 onwards, the industry has been operating under the general rules of the General Agreement on Tariffs and Trade, implying that all quotas were eliminated at that time. For developed economies this has likely led to increased competitive pressure from low-cost producers such as China, Bangladesh or India. At the same time, phasing-out safeguard measures were introduced in order to mitigate the pressure on industrialised countries from low-cost producers and finally import quotas were re-introduced in 2008 again as the international competition for industrialised countries had severe effects on employment in high-wage countries (Adhikari and Yamamoto, 2008).

Facing increased international competition in textile production activities, the European Union in 2003 initiated a task force, the so-called High Level Group on textiles and clothing (European Commission, 2004a and 2004b). Its aim has been to counteract the negative impact of increased international competition on employment and value added in European textile producing countries. Policy advice of the High Level Group suggests that firms in Europe can only stabilize employment and value added if they are productive, innovative and are able to modernize their production. Focusing on Italy's and Portugal's textile industry, the High Level Group stresses that "[w]hile the Euro-Mediterranean Zone provides the conditions necessary to allow the sector to remain an important contributor to European industrial production, policymakers cannot ignore the fact that a permanent process of restructuring and modernisation will continue to lead to falling employment [and value added] for some years to come." (European Commission, 2004b: 7)

Seizing this diagnosis, the aim of this paper is to study the structural changes the textile industry experienced since the assignment of the WTO treaty in 1994. We analyze the two years 1995 and 2009 and limit our investigation to Italy and Portugal's role in the international textile production and trade network. Italy and Portugal were chosen because of the textile industry's significance for their economic structures, and due to these two countries' outsize role for the European textile industry. They are expected to have faced the most intense structural shifts resulting from technological and institutional change in the textile industry. We are able to trace both quantitative and qualitative aspects of structural change in the two countries' textile industries by means of a concentration index and through studying the international textile trade network. To evaluate country-specific and industry-specific aspects of structural change, we focus on a multi-regional context, which serves as a first benchmark, and use the national manufacturing sectors of Italy and Portugal as a second benchmark. In order to obtain a true-to-detail picture of structural change in the textile industry we study the evolution of three variables – gross output, value added and hours worked.

Concentrating in a first step on quantitative aspects, we answer the following questions: Has international textile trade become more concentrated or, on the contrary, more fragmented from 1995 to 2009? Which shifts in location and net-trade position do we observe for Italy and Portugal in terms of internationally traded value added and labour? Which country-specific trade patterns prevail in the textile industry and how did these evolve from 1995 to 2009? In a second step, we study qualitative aspects of structural change. Again we use the international textile trade network to explore the following issues: (1) specialisation patterns (as well as their development from 1995 to 2009) in terms of value added-intensive versus labour-intensive production activities used to strengthen comparative advantages within the textile industry, (2) Italy's and Portugal's positions in terms of up-/downstreamness and inter-temporal movements along the international textile production chain, and (3) possible tendencies towards vertical specialisation.

Combining both qualitative and quantitative aspects of structural change within a comprehensive empirical analysis, this paper contributes to a better understanding of the consequences of structural shifts resulting from institutional and technological change on national economic structures, but in an international context. The method applied helps to uncover a great variety of aspects of structural change both of a qualitative and quantitative nature. It is a convenient tool for studying structural change as a systemic issue whenever interdependent forces prevail. We think that concentrating on a general perspective is necessary to derive effective policy advice. The paper proceeds as follows. Starting with a short literature discussion in section 2, section 3 explains the data used in this paper and related preparatory work. This is followed by a detailed introduction to the method in section 4. Section 5 discusses empirical results, and section 6 concludes.

2. Theoretical Background

Understanding the structure of economies and the changes therein over time constitutes a very old and yet ruling topic in economic research. Both technological and institutional changes are major sources of structural change. They drive the ongoing restructuring of production processes and their location. At least since the ICT-revolution on the one hand and an unprecedented, global liberalization of trade and economic integration since the middle of the 20th century on the other hand, the research interest in structural change has been increasingly oriented towards an international perspective. The reason is that changes in economic structures cannot be well captured without understanding how an economy is embedded in international production and trade. It is in particular the schools of new economic geography and multiregional input-output analysis who study multifaceted aspects of structural change. They focus on the sources and consequences of structural change in both a national and an international context. The production of goods and services, and related to this, resources and skills, are envisaged as globally fragmented processes. International linkages are thus seen as complementary to local linkages within countries. Two distinct and interconnected phenomena in this research area are (1) the establishment of international production chains, respectively global value chains (Gereffi and Korzeniewicz, 1994), and (2) vertical specialisation (Hummels et al., 2001). The development of global value chains and "supply-chain trade" between industrialised and developing countries (Baldwin, 2013) are likely to have altered not only the ways in which international trade is organized. Baldwin (2012) argues that they have also affected the specialisation and concentration patterns of countries all over the world since the 1990s, and that they have led to "globalisation's second unbundling".
The globalization of production would not have been possible without advances in communication and transport technologies and the reduction in tariffs. However, the world still is not flat as long as borders, different languages, and distance exist. As Anderson and van Wincoop (2004: 691) put it "The death of distance is exaggerated", since trade costs consist not only of the costs of transportation and tariffs but also encompass "information costs, contract, enforcement costs, costs associated with the use of different currencies, legal and regulatory costs, and local distribution costs."

Models in line with economic geography capture the effects of changing transportation and trade costs on the location patterns of industries as well as those of changes in the specialisation patterns of countries (for a comprehensive overview, see Combes et al., 2008). The relationship between trade and the concentration of an industry is not linear. A full integration of markets ought to lead to less agglomeration, whereas intermediate levels of trade costs favour concentration over dispersion. Moreover, depending on the characteristics of industries, the concentration takes place either in centers or in the periphery. In this context, Fujita and Thisse (2006) make the relevant distinction that not whole industries, but rather production stages are agglomerated, due to competitive advantages in single stages of the production process. Therefore, there is an uncoupling of work, carried out in headquarters and in production plants. Whether agglomeration occurs in economic centers or in the periphery strongly

depends on the size of the wage gap between the areas. If wage differentials are large, as in the case of the textile industry, concentration of production that needs only low-skilled workers is expected to take place in the low-wage periphery, whereas economic centers are left with fewer workers who mainly serve in strategic functions of the production process. This is associated with a lower welfare level for low-wage workers in these areas. Thus, countries do not specialize in different industries. Instead, industries allocate different steps of the production process to different countries. This was already discussed in Jones and Kierzkowski (2001a and 2001b) who describe this phenomenon as the result of increased fragmentation of production. They argue that the value chain of production is split into an increasing number of tasks, which are performed in different countries as there is no need for spatial proximity for sequential production. Yi (2003) moreover shows that lowering tariffs and quotas can make vertical specialisation more profitable compared to single-location production, as decreasing trade costs have a larger impact on the former than on the latter. Yet, in order to reallocate production, the benefits gained by low labour costs must be greater than the fragmentation costs, such as costs for packaging, tariffs, transportation and communication (Hanson et.al., 2005). The geographical fragmentation of production has been shown to increase trade in intermediate goods substantially and allow for a finer division of labour (Feenstra and Hanson, 1996).

Similar to work in the field of economic geography, but oriented more towards a formal-analytical framework, a range of papers in the field of multiregional input-output analysis have focused on the relocation of production processes, skills and resources to an international level due to trade opening. Based on studies by Hummels et al. (2001) and Daudin et al. (2011), Stehrer (2012) develops two input-output measures for trade in value added and the factor content of trade. He applies these to a world input-output table and conducts a detailed empirical investigation of trade flows across countries. Contrary to our paper, his focus of analysis is on a rather aggregate level and not on a single industry. Furthermore, the advantage of the present paper consists in using an inter-temporal framework rather than a static analysis as in Stehrer (2012). Stehrer et al. (2012) also focus on an inter-temporal framework and study international patterns of trade in value added and heterogeneous labour for selected years in the period from 1995 to 2009. Differentiating between import and export flows of value added and employment allows them to decompose the factor content of trade into domestic and foreign components. Again, the focus in this paper is not at an industry level but at a sectoral level. Stehrer et al. (2012) hence only distinguish between the manufacturing and the service sectors. In a similar vein, Los et al. (2014) explore changes in the employment structure of heterogeneous labour by applying structural decomposition analysis from 1995 until 2008, concentrating on a global supply chain. In contrast to Stehrer et al. (2012) and Los et al. (2014) our paper focuses on a single industry, without setting aside the inter-industry context. The need for measuring trade in value added and labour as well as the need to develop instruments for studying production processes as a global value chain within an input-output framework was recently also tackled by the OECD and other organisations. These efforts have resulted in a range of papers published in this field (e.g. Jones et al., 2013,

Miroudot and Ragoussis, 2009 and OECD, 2012). However, these papers yet again focus on a rather aggregate level and do not explicitly study textiles, which we consider a prime industry for exploring phenomena like trade in value added and vertical specialisation.

Studies focusing on the textile industry so far have separately analyzed either the development of Western European countries or that of developing countries, without accounting for the impact of free trade and globalization on a wider range of countries. Empirical studies provide ample evidence that the textile industry has declined since the 1970s and, by the mid-1990, has become more concentrated in the low-wage periphery countries of Italy and Portugal (Amiti, 1998, Brülhart, 2001, and Aiginger and Pfaffermayr, 2004). Palan and Schmiedeberg (2010) moreover report evidence that de-concentration processes have occurred within the Western European Union since the mid-1990s. Portugal could no longer hold all production sites, and employment levels converged towards the European mean. One of the reasons they identified is that global processes, such as the increasing importance of global value chains, altered production processes worldwide. They made it ever easier to transfer production from Western countries to newly industrializing Asian countries characterized by low wages (UNCTAD, 2013). Since the 1990s, China has become a world-class export leader in mainly buyer-driven, labour-intensive commodity chains such as the textile industry. Moreover, the production in East Asian countries such as Taiwan and South Korea transformed from mere assembly of imported goods in specific export zones to a more domestically integrated form of production. This development has been associated with industrial upgrading and the generation of higher value added (Gereffi, 1999). For Western European firms, the competition from low-wage countries plays a more dominant role, as firms are able to relocate unskilled labour-intensive production activities to low-wage countries while keeping strategic functions concentrated in regions where the high-skilled workers and intangible capital they need are available (Feenstra, 1998 and Baldwin, 2006).

3. **Data**

We use the WIOD database because of its wide range of indicators and large country sample. It provides detailed information on hours worked by persons engaged, value added, and gross output. The database also provides world I/O-tables covering 35 industries. They are classified according to ISIC Rev. 3 for 40 countries and one extra region called "rest of the world" (RoW), which is added for balancing and calculation purposes (Dietzenbacher et al., 2013). The latter serves as a proxy for countries not included in the sample and is therefore not amenable to interpretation (Timmer, ed. 2012)[3]. Even though the country sample contains a large number of 40 countries, including important textile producing countries such as China, India and Indonesia, a few other leading textile producers, e.g., Bang-

[3] We exclude the RoW-region from our calculations throughout.

ladesh or Cambodia[4], are not covered. Nonetheless, this database is the most detailed source in this field of research and allows us to paint an accurate picture of the interconnectedness of the textile industry, both with other industries and with other countries. Moreover, it permits the detailed analysis of structural changes between the years 1995 and 2009 for Italy and Portugal and their respective international trade networks.

Note that vertical specialisation generally implies double counting if working on the value of trade flows, and thus on export and import values alone (Hummels et al., 2001 and Daudin et al., 2011). Those traded goods which already contain a high import content do not reflect how much value is added in the importing country. If they are then re-exported, this subsequently leads to a high trade-to-output ratio for the exporting country, even though value added really takes place with its import partners. With respect to the textile industry, vertical specialisation likely leads to an increased output share in global textile output for some countries, without a parallel increase in their value added share (and also in their employment share), thereby creating an upward bias.[5] To dilute problems related to this upward bias, we focus on trade in value added and hours worked in the textile industry (Jones et al., 2013). Doing so allows us to study trade linkages to some degree "net of vertical specialisation", focusing our analysis on the trade flow between the producer and the final user (Daudin et al., 2011). Furthermore, by means of network analysis applied to trade in value added and hours worked, we are able to determine whether vertical specialisation – where present – has led to trade diversification in the textile industry in cases where intermediate trade linkages of the textile industry grew more dispersed over the observation period. Alternatively we can judge whether it induced trade concentration, occurring when the value chain of the textile industry resides within a country.

In order to get a well-arranged overview of the most important economic variables for the two countries we focus on, the other countries are clustered into country groupings. In line with other studies, the most appropriate classification for our research context is the grouping of countries according to 'regional blocks', since proximity and regional trade agreements are important features in explaining fragmentation patterns (Johnson and Noguera, 2012). These 'regional blocks' can be described as economically integrated regions which are characterized by increasing trade volumes. They are defined according to geographic location (Baldwin, 2006b and Chortareas and Pelagidis, 2004). In what follows we therefore distinguish between:

[4] In 2011 for instance, Cambodia employed about 335,000, and Bangladesh about 2,000,000 workers in their textile industries, respectively. The latter thus was the second-largest exporter of textiles in the developing world at this time (OECD, 2013). To get an idea of the relative importance and size of the textile industry for the two economies mentioned, note that textile industry employment in India and Indonesia in 2009 amounted to about 7,200,000 and 1,500,000 workers, respectively.

[5] Examples are "distribution centres" of the textile industry, such as Belgium or France, which do not produce great volumes of textiles themselves, but re-export much. They do not account for much worldwide value added or for employment in the textile industry, such that their impact is overestimated.

1. West Europe, including Austria, Belgium, Denmark, Finland, France, Germany, Ireland, Italy, Luxembourg, Malta, Netherlands, Portugal, Spain, Sweden and the United Kingdom,

2. East Europe: Bulgaria, the Czech Republic, Cyprus, Estonia, Hungary, Greece, Latvia, Lithuania, Poland, Romania, Slovakia and Slovenia,

3. Americas: Brazil, Canada, Mexico and the United States,

4. Eurasia: Russia and Turkey,

5. East Asia and Pacific Region: Australia, Indonesia, Japan, Korea and Taiwan, and finally,

6. China and India: treated as one region.

To accentuate qualitative and quantitative attributes specific to Italy's and Portugal's textile industries, their national manufacturing sectors are used as a benchmark in the empirical part of this paper. Together with the geographic benchmark this helps us dig deeper into the nature and causes of structural change in the two countries' textile industries.

We use WIOD's multiregional input-output tables from 1995 and 2009 as well as price indices provided for the country sample in the socio-economic accounts on an industry level as our data (Erumban et al., 2012). We also take the labour data from the 2012 version of the socio-economic accounts. Specifically, we use hours worked, since this is a good measure for the amount of labour embodied in output. The deflation procedure was accomplished row-wise, using multiple price indices: intermediate demand levels were deflated using the intermediate demand industry-level price index. The industry gross output (value added) vectors were expressed in real prices using the corresponding gross output (value added) price indices. Since there are no price indices for final demand components (except for gross fixed capital formation), final demand was deflated using the corresponding intermediate delivery industry-level price indices. A consequence of omitting RoW from our analysis is that we create an upward bias in the technology structure underlying the multiregional input-output table. After the deflation procedure, we therefore make the following corrections to mitigate this bias: The value added vectors and the labour vectors, referring initially to the whole country sample including RoW, are down-scaled by the share of the reduced real gross output vector (excluding then intermediate and final demand deliveries of the 40 countries to RoW) in total real gross output (including RoW).[6] This also holds for value added and labour in both years. Since the real gross output is no longer equal to the sum of intermediate and final demand deliveries after row-wise deflation, this sum was furthermore used as a corrected version of the real output vector for analysis.

[6] Down-scaling implies that in 1995 just 87.3 (85.7) per cent of actual international trade in textile (manufacturing) goods were covered. Similarly, calculated based on nominal figures, 82.8 (83.3) per cent of international trade in textile (manufacturing) goods are included in 2009.

4. Method

4.1. Concentration Measure

We aim to measure the degree to which the textile industry is concentrated in a few countries around the world despite the fact that the textile industry is one of the most prominent examples of a globalized industry. We capture absolute concentration by the Hirschman Herfindahl Index (HHI), which originates in industrial economics and the analysis of market concentration. To our knowledge this is the most adequate index for our research question as it is a direct measure of concentration. Other indices, such as the Theil and the Gini Index, are inequality rather than concentration measures (Coulter, 1989). The difference between these two categories of indices is important for our example: whereas inequality indices are influenced by adding a country with a negligible share in the textile industry to the sample, a mere concentration index such as the HHI would not report a lower level of concentration (Palan, 2013). One drawback of all absolute measures is that the reference point for concentration is an equi-proportional distribution of employment (value added, gross output) as the reference point. For our country sample it is hardly convincing, however, to postulate that all countries, including large countries like China and small countries like Luxembourg, should have the same number of people employed, level of value added, and gross output in this industry. We use weighting-schemes to counteract this effect.

The unweighted HHI index takes the following form:

$$HHI = \sum_{i=1}^{k} \left(\frac{l_i}{\sum_{i=1}^{k} l_i} \right)^{\alpha} \qquad (1a)$$

In (1a), l denotes a vector of dimension $k \times 1$, and for k countries with $i = 1, \dots, k$ a generic element l_i contains hours worked in the textile industry. Most empirical studies on specialisation and concentration choose $\alpha = 2$ (e.g. Davis, 1998, Storper et al., 2002, Aiginger and Pfaffermayr, 2004, and Beine and Coulombe, 2007), even though it lacks theoretical meaning.[7] Note that the higher the level of α, the more weight is given to countries with high shares in the distribution and the lower is the impact of countries with smaller employment shares. In our sample, where there exist large differences with regard to the country size which imply predictable differences in shares of world employment (production) of countries, values of α close to two would distort the results. In order to counter this effect we could have chosen a level of α closer to one, thereby giving less weight to large shares in the distribution. However, this would still have had the disadvantage of postulating that every country ought to produce the same amount of textile goods, and ought to employ the same number of persons irrespective of country size. Therefore we opt for introducing a country-weighted index ($cwHHI$) which gives more weight to countries whose share of textile employment (and value added, respec-

[7] In industrial economics, $\alpha = 2$ is straight-forward since this determines the existence of a monopoly.

tively) is well above their share of manufacturing in world production. It also counteracts the effect of dispersion in size between countries:

$$cwHHI = \sum_{i=1}^{k} \left(cw^k \frac{l_i}{\sum_{i=1}^{k} l_i} \right)^2 \qquad (1b)$$

with:

$$cw^k = \frac{l_i}{\sum_{j=3}^{16} \bar{l}_j^k}$$ [8]

A good case in point is Portugal, which accounted for only .63 per cent of world textile employment in 1995. This share was still well above its share in manufacturing employment, which was only .33 per cent of world manufacturing employment. Countries such as Germany, which accounts for 2.25 per cent of total manufacturing yet only .57 per cent of textiles, on the contrary, get less weight. In (1b), for country k and for n industries, $\bar{l}^k$ is a vector of dimension $n \times 1$, which contains total hours worked in all industries.[9]

Thus, with $\alpha = 2$, the lower bound of the unweighted index is the equi-proportional distribution of the industry across all countries, i.e. $\frac{1}{k}$, and the upper bound is 1, where all employment (production) is concentrated in one country only. While the unweighted HHI tends to decrease with the number of countries, it increases with the dispersion in size between countries. Moreover, the relative size of countries is more important for the absolute value of the HHI than is the absolute number of countries, since the index weights each country by the relative employment share (Hall and Tideman, 1967). When applying the country-weighted Hirschman-Herfindahl index $cwHHI$ with $\alpha = 2$, the upper bound – implying total concentration of production in one single country – is 1, and it is $\frac{1}{k}$ when each country's textile share is equivalent to its share in world manufacturing and, moreover, when the textile industry is equally allocated between the countries under study.

4.2. International Textile Trade Network

Construction of the international textile trade network: To assess structural characteristics of textile trade and structural changes from 1995 to 2009, we construct an international textile trade network.[10]

[8] The employment shares with the weighting factors cw^k have to be standardized such that $\sum_{i=1}^{k} cw^k \frac{l_i}{\sum_{i=1}^{k} l_i} = 1$ in order to obtain a country-weighted Hirschman-Herfindahl Index with the same properties as the unweighted index.

[9] Note that in calculating cw^k summation just includes the manufacturing sector, whereas the agriculture, the mining as well as the service sector are excluded due to differences in productivity and economic development of the countries under study. Taking the whole economy as a benchmark would have distortive weighting factors.

[10] Since in the interpretation of our empirical results the manufacturing sector is used as a benchmark for studying the dynamics of the textile industry, we construct an international manufacturing trade network in parallel to the international textile trade network. Thus, methodically, all steps involved in the construction of the interna-

For k countries, let matrix Z of dimension $k \times k$ include total intra- and international intermediate transaction flows in constant prices of the textile industry. Similarly, matrix F of dimension $k \times k$ contains total intra- and international deliveries to final demand. Thus, one element z_{ih} (f_{ih}) of Z (F) with $i, h = 1, \dots, k$ shows the constant price value of deliveries of the textile industry from country i to country h, referring to intermediate and final demand deliveries, respectively. For constructing the international textile trade network, the identity given in (2) is used as a starting point:

$$Z + F = x \qquad (2)$$

In this single-industry multiregional I/O-model, vector x of dimension $k \times 1$ denotes the real gross output of the textile industry, which on the one hand is composed of deliveries, first to intermediate, and second to final demand. In a next step, we concatenate Z and F to a single matrix W of dimension $k \times 2k$, defined as $W \equiv [Z\ F]$. Matrix W is then normalized along rows, to obtain output coefficients of intra- and international trade in the textile industry:

$$\overline{W} = diag(We)^{-1}W \qquad (3)$$

In (3), e denotes the summation vector of dimension $2k \times 1$ and $diag(\cdot)$ is used as the symbol for a diagonalized vector. One generic element $\overline{w}_{ih}$ of $\overline{W}$ defines the share of textile exports from country i to country h in terms of country h's textile gross output.

As we decide to work on trade in value added and hours worked to dilute problems resulting from vertical specialisation, matrix $\overline{W}$ is modified. Fist, let v be a column-vector of dimension $k \times 1$ containing real value added of the textile industry in each country, and second, vector l of the same dimension holds employment for each country $i = 1, \dots, k,$. Combining in a next step $\overline{W}$ with v and l, we obtain the following matrices:

$$W^1 = diag(v)\overline{W} \qquad (4a)$$

$$W^2 = diag(l)\overline{W} \qquad (4b)$$

In (4a) one element w_{ih}^1 of W^1 denotes the constant price value added generated within country i's textile industry, as embodied in its deliveries to country h. Similarly, in (4b) one element w_{ih}^2 of W^2 signalises the labour intensity, measured in hours worked, of country i's exports of textiles to country h. Thus, system (4) shows intra-national and international trade flows of value added and hours worked generated within the textile industry.

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tional textile trade network as described in what follows, as well as the network measures implemented subsequently, are applied in the same manner to the construction and discussion of the international manufacturing trade network.

Based on (4), we next construct the international textile trade network. Studying its properties we obtain detailed information regarding the structure of trade which cannot be uncovered if focusing only on trade figures of individual countries. The basic concept for our network is a weighted directed graph G, which consists of a pair (V, X) where V is a finite and non-empty set of elements v_i called nodes and X is a finite set of elements $v_i v_h$ called edges, with $i, h = 1, \ldots, k$. A weighted directed graph is described by two functions $f_1, f_2: X \to V$ and to each $v_i v_h \in X$, a weight $a_{ih} > 0$ is assigned. Per definition a weighted directed graph G contains no self-loops (Harary et al., 1965). In the international textile trade network, each country i corresponds to a node in the graph and each trade flow between countries i and h to an edge. To characterize the international textile trade network by means of graph theory, the adjacency matrices A^1 and A^2 are derived from system (4) by setting each element of intra-national trade to zero.

Network measure – strength centrality: We apply our network measure – the concept of strength centrality – based on these adjacency matrices. In general, strength centrality is a local property of a single node, providing information about "the importance of a vertex [i.e. a node] in a network" (Newman, 2004: 2). Strength centrality constitutes a simple but convenient measure to study and analyse quantitative and qualitative properties of the textile industry within a multi-regional context and an intertemporal framework. Since the adjacency matrices are not symmetric, one has to distinguish between in-strength and out-strength for each matrix, defined as follows:

$$s^{1,IN} = (e^T A^1)^T \qquad (5a)$$

$$s^{2,IN} = (e^T A^2)^T \qquad (5b)$$

$$s^{1,OUT} = A^1 e \qquad (5c)$$

$$s^{2,OUT} = A^2 e \qquad (5d)$$

In-strength $s_i^{\cdot,IN}$ of a country i, as determined by (5a) and (5b), refers to product-embodied imports of value added (hours worked) of the textile industry, whereas out-strength $s_i^{\cdot,OUT}$, calculated in (5c) and (5d), refers to its product-embodied exports. We obtain detailed information about the structure of trade, its development over time as well as about trade linkages, by comparing in- to out-strength and analysing changes in strength centrality over time.

Net-trade Position: The net-trade position in the international textile trade network of a single country i can be analysed by means of a centrality coefficient, given by:

$$c_i^{\cdot} = \frac{s_i^{\cdot,IN}}{s_i^{\cdot,OUT}} \qquad (6)$$

A country i is called an out-central node if $s_i^{\cdot,OUT} > s_i^{\cdot,IN}$ and thus, if it is a net-exporter of product-embodied value added, respectively hours worked ($c_i^{\cdot} < 1$). If in contrast a single country's product-embodied exports in value added or hours are lower than its imports and its centrality coefficient is no less than 1, implying that $s_i^{\cdot,OUT} \leq s_i^{\cdot,IN}$, it is considered an in-central node.

Value Added Intensity and Labour Intensity: Comparing strength centrality for value added with that of labour, we get information about the qualitative properties of a country's textile production. We are then able to measure the value added- and labour-intensity of textile trade from the perspective of single countries. If a country is characterized by a relatively higher labour intensity in its imports than in its exports (i.e., exports are more value added-intensive), this indicates that the country is involved more in high-quality tasks. Vice versa, if a country imports relatively value added-intensive textile products while exporting labour-intensive textile goods, it specializes in low-quality production steps. As a measure for detecting the qualitative nature of textile production we use the ratio between the different value added strength centralities to labour strength centralities, or more formally:

$$q_i^{IN} = \frac{s_i^{1,IN}}{s_i^{2,IN}} \qquad (7a)$$

$$q_i^{OUT} = \frac{s_i^{1,OUT}}{s_i^{2,OUT}} \qquad (7b)$$

If $q_i^{IN} > q_i^{OUT}$ for a single country i, then its textile production patterns are labour-intensive, and if $q_i^{IN} \leq q_i^{OUT}$ this signalises a specialisation towards value added-intensive production steps. Taking changes over time into account, (7a) and (7b) can be used as productivity measures. A country increases its productivity, measured as the value added per domestic hour worked, if and only if $\Delta q_i^{OUT} > \left|\Delta q_i^{OUT}\right|$, with $\Delta q_i^{OUT} > 0$.

Since matrix W is just a concatenated form of matrices Z and F, it follows that the adjacency matrices A^1 and A^2 are also composed of both international real intermediate and international real final demand deliveries of the textile industry. This property allows us to split in- and out-strength as calculated in (5) further into strength centrality of trade in value added (labour) of intermediate textile goods and into strength centrality of international final demand deliveries within the textile industry. It holds that $s^{\cdot,IN} = s_F^{\cdot,IN} + s_Z^{\cdot,IN}$ and $s^{\cdot,OUT} = s_F^{\cdot,OUT} + s_Z^{\cdot,OUT}$, where sub-scripts F and Z refer to intermediate demand and final demand, respectively. Studying the different versions of strength centrality with respect to intermediate and final demand we gain deeper knowledge about the structural properties of international textile trade in value added and labour, and regarding changes therein, between 1995 and 2009. First, they provide information on whether single countries are located more up-stream or more down-stream in the international textile production chain. Second, we are able to measure the degree of vertical specialisation of single countries.

Upstreamness and Downstreamness: Drilling yet deeper, a country is expected to be located upstream if its intermediate and final demand exports of value added (labour) are higher than its intermediate and final demand imports. More formally, if: $s_{Z\ i}^{\cdot,IN} \leq s_{Z\ i}^{\cdot,OUT}$ and $s_{F\ i}^{\cdot,IN} \leq s_{F\ i}^{\cdot,OUT}$ and thus, if it is a net exporter both in intermediate and final textile goods. On the contrary, for a single country to be a downstream producer, it must hold that it is a net importer, and therefore that $s_{Z\ i}^{\cdot,IN} > s_{Z\ i}^{\cdot,OUT}$ and $s_{F\ i}^{\cdot,IN} > s_{F\ i}^{\cdot,OUT}$ (OECD, 2012). Furthermore, a country is located mid-stream in the international textile production chain in the remaining two cases: (1) if $s_{Z\ i}^{\cdot,IN} \leq s_{Z\ i}^{\cdot,OUT}$ and $s_{F\ i}^{\cdot,IN} > s_{F\ i}^{\cdot,OUT}$, and (2) if $s_{Z\ i}^{\cdot,IN} > s_{Z\ i}^{\cdot,OUT}$ and $s_{F\ i}^{\cdot,IN} \leq s_{F\ i}^{\cdot,OUT}$. To distinguish whether a country is a mid-upstream or a mid-downstream producer, its net-trade position as calculated in (6) is decisive. If a country is located mid-stream in the international textile production chain, to be classified as a mid-upstream producer it must hold that $s_i^{\cdot,OUT} > s_i^{\cdot,IN}$. On the contrary, for a mid-downstream producer it is true that $s_i^{\cdot,OUT} \leq s_i^{\cdot,IN}$. Hence, only if total out-strength is larger (smaller) than total in-strength and the country is a net exporter (importer) does this qualify it as a mid-upstream (mid-downstream) producer. This signalises that the country is more (less) active in production and relatively less (more) dependent on foreign producers. Changes in net-trade positions over time then indicate movements along the international production chain: If a country moves in the downstream direction, its trade surplus shrinks, turns into a trade deficit, or the trade deficit rises. Conversely, if a country moves in the upstream direction in the observation period, its trade deficit decreases, turns into a trade surplus, or its trade surplus increases.

Vertical Specialisation: To measure the degree of vertical specialisation, we calculate the following centrality coefficients:

$$c_{Z,Z\ i}^{\cdot} = \frac{s_{Z\ i}^{\cdot,IN}}{s_{Z\ i}^{\cdot,OUT}} \qquad (8a)$$

$$c_{Z,F\ i}^{\cdot} = \frac{s_{Z\ i}^{\cdot,IN}}{s_{F\ i}^{\cdot,OUT}} \qquad (8b)$$

$$c_{Z,Z+F\ i}^{\cdot} = \frac{s_{Z\ i}^{\cdot,IN}}{s_i^{\cdot,OUT}} \qquad (8c)$$

The centrality coefficient given in (8a) describes the relation between value added (labour) embodied in imports of intermediate textiles, and the exports of value added (labour) embodied in intermediate textile deliveries. Again, if $c_{Z,Z\ i}^{\cdot} \geq 1$, the respective country is a net importer of value added used in intermediate production, respectively hours worked, and conversely, if $c_{Z,Z\ i}^{\cdot} < 1$, the country exports more of value added (labour) than it requires itself in its intermediate demand sector. Similarly, in (8b) the centrality coefficient $c_{Z,F\ i}^{\cdot}$ indicates the import content embodied in final demand exports of value

added (labour). Finally, the centrality coefficient given in (8c) measures the extent to which a single country i is dependent on imports of value added and labour, and relates this to its total textile exports (both intermediate and final demand deliveries) of value added and labour. As put forth by Stehrer and Stöllinger (2013: 8), vertical specialisation can be measured "as the value added [labour] created in other countries which enters production in [a specific] country […] as imported intermediate inputs. Vertical specialisation can be calculated with respect to the foreign inputs in production of […] final goods, final goods plus exported intermediates […] or total exports which then include both intermediate and final goods exports (though one might split them up as well)." Keeping this in mind, the centrality coefficients as calculated in system (8) exactly provide us with different measures of vertical specialisation, similar to the ones introduced first by Hummels et al. (2001). The higher the respective measures, the more vertically specialised is a single country within the international textile production chain.

5. Empirical Results

This section is dedicated to a detailed discussion of the structures of Italy's and Portugal's textile industries and changes therein from 1995 to 2009.

5.1. Descriptive Analysis

Global employment and gross output increased from 1995 to 2009, whereas value added declined, as illustrated in Table 1. This contrary development of gross output and value added could be a first hint that both vertical specialisation and vertical trade increased. The observed development was not evenly distributed across the regional blocks, however. All regions except for China and India decreased their gross output, value added, and employment, and therefore growth occurred only in the latter region. While West Europe was the regional block with the highest share of both gross output and value added in 1995, two thirds of world employment were at that time already concentrated in China and India. By 2009, not only were major shares of labour located in these two countries, but also about half of the value added and two thirds of gross output. This implies that more capital-intensive production also came under international pressure during the observation period. The drop in significance of both, the Americas and the East Asia and Pacific Region, was even larger than for West Europe with regard to gross output and value added. These two regions were successful in retaining relatively more employment than West Europe, however.

	Gross Output		Value Added		Employment	
	1995	2009	1995	2009	1995	2009
World	815,640	1087,007	256,242	234,849	85,576	111,562
Percentage of						

World Textile						
West Europe	26.47	15.76	28.12	23.27	4.38	1.71
East Europe	2.82	1.57	3.31	2.63	3.99	1.71
East Asia and Pacific Region	24.73	7.24	23.11	10.10	8.92	4.33
Eurasia	3.65	.50	3.98	.50	4.93	2.64
Americas	24.68	6.80	26.85	14.54	12.23	8.41
China and India	17.65	68.14	14.63	48.97	65.55	81.20
cwHHI	.094	.509	.090	.299	.252	.423
HHI	.092	.396	.096	.207	.233	.335

Table 1: Descriptive Analysis of the Textile Industry. Note that nominal values are in Mio. constant US-$ and 1995 = 100. Employment is expressed in million hours worked.

Analysing overall concentration, the values could theoretically range from .025 (even distribution of both the manufacturing sector and the textile industry across all 40 countries) to 1 (with the manufacturing sector and textile industry being located in a single country only). As can be seen from Table 1, the level of concentration was very low for both gross output and value added in 1995 – irrespective of whether we take manufacturing weights into account. Concentration increased for all variables under study from 1995 to 2009, indicating that institutional changes and the reduction of transportation costs facilitated concentration. Interestingly, the development of manufacturing-weighted concentration was more accentuated than the unweighted HHI. This is due to the fact that China's value added share in world manufacturing was only .19 whereas its share in textiles was .41 in 2009 (compared to shares of .10 in textiles and .05 in manufacturing in 1995). Concentration of employment already took place in the 1990s with the development being more modest compared to value added and gross output. This suggests that low-wage, low-skill employment was concentrated even before institutional changes occurred but the capital needed to acquire high proportions of value added and gross output, respectively, was transferred after 1995. Remarkably, the increase in concentration was highest with respect to gross output.

Turning to the development of Italy and Portugal (Table **2**), it is obvious that Italy's significance (and its share of West Europe) was much higher than that of Portugal. This is due to country size differences. While Italy accounted for less than a fifth of West Europe's manufacturing gross output, value added and employment, respectively, the textile industry was of high relevance with about a third of West Europe's textile industry being located in Italy in 1995. Until 2009, Italy's manufacturing sector's share of West European value added and gross output declined, while the textile industry gained in importance. This is evidence that other European countries were de-specializing even faster than Italy in the textile industry. With regard to employment, the share of both Italy's manufacturing and textile industries in West Europe increased until 2009 – suggesting that structural change differed from the developments in other West European countries. Note also that, while absolute values of all three

variables declined until 2009, leading to a decline of the importance of the textile industry in Italy's manufacturing sector, relative figures rose.

	Gross Output		Value Added		Employment	
	1995	2009	1995	2009	1995	2009
Italy						
Total	72,349 (715,585)	68,822 (812,779)	24,173 (214,136)	20,082 (211,254)	1,248 (8,561)	767 (7,247)
Share of West Europe	33.51 (15.92)	40.17 (14.52)	33.54 (14.58)	36.75 (12.54)	33.31 (18.78)	40.18 (20.40)
Portugal						
Total	11,520 (67,207)	7,118 (76,828)	3,259 (17,855)	2,404 (20,716)	534 (1,873)	323 (1,434)
Share of West Europe	5.33 (1.49)	4.15 (1.37)	4.52 (1.22)	1.02 (1.23)	14.26 (4.11)	16.92 (4.04)

Table 2: Descriptive Analysis of Italy and Portugal in terms of gross output, value added and labour for 1995 and 2009. Gross Output values and value added values are expressed in millions of constant US-$, where 1995 = 100. Employment is expressed in million hours worked. Note that figures in brackets correspond to values for the whole manufacturing sector

With regard to Portugal, the significance for West Europe was much lower, yet the importance of the textile industry for its own economy was much higher than for any other West European country. Therefore the difference between the low importance in gross output – and even more so in value added – and the importance of Portugal for West Europe's textile employment (which actually increased between 1995 and 2009) is remarkable. It also demonstrates that employment in Portugal was less productive than in Italy, where we observed hardly any differences in the shares of any variables. The importance of Portugal's textile industry for the manufacturing sector as a whole was without comparison worldwide in 1995: the share of all three variables was the highest in the sample, yet the importance of its textile industry declined significantly over time. With regard to Italy's manufacturing sector, the textile industry had been of minor importance – yet the decline of this industry was much more pronounced in other countries, which is shown by the fact that Italy improved in the ranking analysis in Appendix A.1.

5.2. Trade Network Results

Real Trade Volumes: Table 3 reports real trade volumes for 1995 and 2009, which give a first idea of the structure of international textile trade from the perspectives of Italy and Portugal.

	1995		2009	
	In-Strength	Out-Strength	In-Strength	Out-Strength
Value Added				

Italy	2,881 (47,844)	7,364 (54,231)	3,738 (64,373)	5,871 (59,053)
Portugal	776 (7,801)	1,398 (5,244)	873 (12,030)	949 (7,386)
Employment				
Italy	887 (3,382)	380 (2,168)	958 (3,533)	224 (2,026)
Portugal	68 (347)	229 (550)	90 (438)	128 (511)

Table 3: Strength Centrality for Italy and Portugal in terms of value added and labour for 1995 and 2009.
Value added is expressed in millions of constant US-$, where 1995 = 100. Employment is expressed in million hours worked.
Figures in brackets correspond to values for the whole manufacturing sector.

Both Italy and Portugal experienced deep changes from 1995 to 2009 regarding their volumes of textile trade as expressed in terms of value added and labour. Italy observed a significant drop by one fifth of exported value added, while imports increased by 29.74 per cent. Changes in value added embodied in textile trade volumes are not reflected in changes in Italy's national manufacturing sector, where exports increased by 8.89 per cent, while value added embodied in Italy's manufacturing imports rose by 34.55 per cent. Regarding our second variable, labour, we find a massive decrease of 41.01 per cent in labour embodied in Italian textile exports over the observation period. Labour imports in textiles, on the contrary, grew by 8 per cent. In Italy's manufacturing sector, exports of labour dropped by only 6.56 per cent, and imports increased by 4.48 per cent.

For Portugal, the slump in value added embodied in textile exports was above the level observed for Italy, with a decrease of 32.13 per cent from 1995 to 2009. However, imports of value added increased by only 12.45 per cent. Similar to Italy, manufacturing trade volumes of value added evolved differently within the observation period: Exports of value added went up by 40.84 per cent, while value added embodied in manufacturing imports grew by 54.21 per cent. As regards traded labour in the textile industry, changes in Portugal were even more pronounced than in Italy. The former's labour exports in the textile industry slumped by 44.39 per cent, while imports rose by 31.76 per cent. Thus, contrary to Italy, Portugal increased its labour imports far more than its value added imports, indicating a continuous labour outsourcing process in the textile industry. In the manufacturing sector as a whole, labour embodied in exports dropped by –7.05 per cent, while labour embodied in manufacturing imports increased by 26.2 per cent from 1995 to 2009. Hence, changes in value added and labour embodied in real trade volumes of textiles for the two countries in the observation period are partly different to changes observed in the national manufacturing sectors – both in direction and in dimension. This indicates that structural shifts in the textile industry are rather industry-specific.

Net-trade Position: Focusing next on the net-trade position in the international textile trade network, as calculated by the centrality coefficient in (6), Italy was a net exporter of value added in both years, while it was a net importer of labour over the observation period, as illustrated in Figure 1. These re-

sults differ slightly from trade positions observed in the manufacturing sector as a whole, where Italy was a net exporter of value added in 1995, and turned into a net importer in 2009. With respect to traded labour within the manufacturing sector, Italy was a net importer in both years. For Portugal different results obtain – it was a net exporter of both value added and labour in 1995 and 2009 in textiles, while in the manufacturing sector as a whole it was a net importer of value added and vice versa a net exporter of labour in 1995 and 2009. Portugal's trade surplus in the textile industry was rather large in terms of embodied labour, and Italy's trade surplus was comparatively strong regarding embodied value added. This suggests that Italy's textile industry was oriented towards value added-intensive production steps, while Portugal's was oriented more towards labour-intensive production steps, as discussed in more detail below.

Intra-regional and Inter-regional Trade Patterns in 1995 and 2009: We next discuss the evolution of Italy's and Portugal's trade patterns with regional blocks in order to gain a better understanding of the structural changes in the international textile trade network during the observation period. These patterns are illustrated in Figure 1. The following paragraph gives insights into how the net-trade positions with respect to bilateral trade changed from 1995 to 2009. Furthermore, it is interesting to know where exports of value added and labour went, where imports came from, and which changes in bilateral trade relations were observed from the perspective of the two countries.

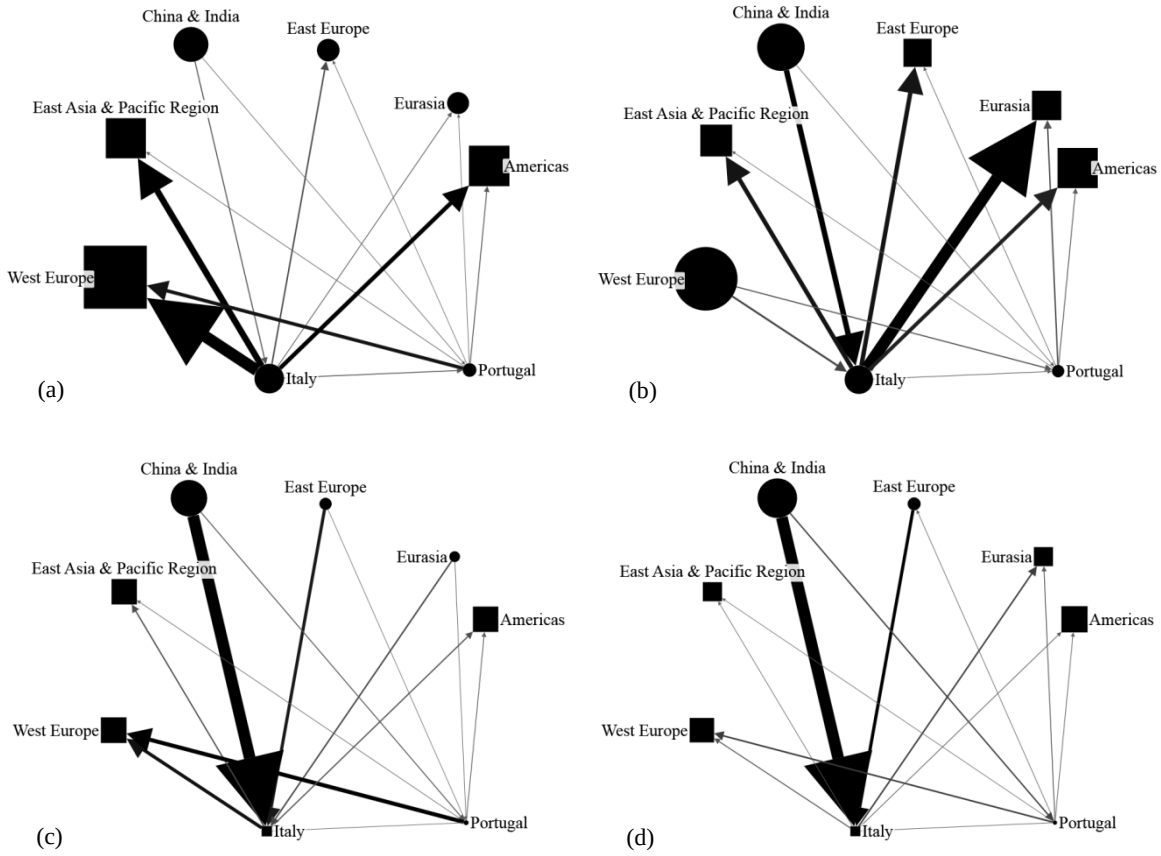

Figure 1: Bilateral textile trade relations from the perspective of Italy and Portugal in terms of value added in 1995 (a) and in 2009 (b), and in terms of hours worked in 1995 (c) and in 2009 (d). The size of the nodes reflects 1/100 of the total strength,

or more precisely, the sum of out- and in-strength. Nodes with circular shape are out-central nodes, while rectangular nodes are in-centrals. The width of the edges indicates the absolute value of net trade flows and the direction of arrows depends on whether a country/region is a net-importer or exporter. Note that West Europe excludes Italy and Portugal.

Figure 1 shows Italy's and Portugal's net trade flows of value added and labour in textiles in 1995 and 2009. In 1995, the largest trading region for both Italy and Portugal in terms of value added was intra-regional trade with West Europe, i.e. the closest neighbours. As shown in

Figure 1a-b, both Italy and Portugal were net exporters of value added to other West European countries in 1995, but turned into net importers in 2009, which was accompanied by both increasing value added imports in the textile industry, and by decreasing exports. Results differ in some respects for the manufacturing sector, which is illustrated in Appendix A.3. Italy and Portugal were net importers of value added in the form of intra-regionally traded manufacturing goods in both years, signalling again the significance of the textile industry for the two countries. Regarding the volume of value added embodied in textile trade, other West European countries remain both countries' most important trading partners in 2009. Portugal's second most intensive trade linkage in terms of value added embodied in textile imports in both years was Italy, and even though imports decreased during the observation period, Portugal remained a net importer. Intra-regional trade also accounted for the largest fraction in terms of labour embodied in textile exports from Italy and Portugal. Both countries were net exporters of labour to other West European countries in 1995 and in 2009 (Figure 1c-d), despite the fact that trade volumes declined over the observation period. Similarly, both countries held trade surpluses in terms of inter-regionally traded labour embodied in manufacturing goods. Contrary to Italy's trade deficit in terms of labour in an international comparison, it was thus a net exporter in terms of labour with respect to this single regional block. Italy furthermore constituted an important destination for Portugal's labour exports in 1995. These did, however, decrease in volume until 2009. With respect to imported labour, the most important source for Portugal in 1995 was West Europe. For Italy, West Europe did not constitute such an important source of labour imports in the textile industry already in 1995.

Both countries exhibit similar inter-regional textile trade relations in 1995, apart from a few exceptions which will be discussed below. These patterns also evolved rather similarly until 2009 in terms of geography. But the same patterns were not necessarily reflected in the national manufacturing sectors. With respect to value added, in 1995 Italy and Portugal were net exporters to East Asia and the Pacific Region, to the Americas, East Europe, and Eurasia. Both were net importers only with respect to China and India. As regards the net-trade position in bilateral trade of manufacturing goods (Appendix A.3) with regional blocks other than West Europe, Italy was a net exporter to all regional blocks in terms of value added in 1995 and turned into a net importer only with respect to China and India in 2009. Portugal on the other hand in 1995 had trade surpluses in the manufacturing sector only

in bilateral trade with East Europe and the Americas. It succeeded in retaining these surpluses until 2009. It furthermore turned into a net exporter to Eurasia in terms of value added.

Regarding the intensity of trade linkages in the textile industry, especially export levels to the East Asia and Pacific Region as well as to the Americas were comparatively high. These bilateral trade linkages therefore constituted important destinations for both countries' textile exports of value added in 1995. Until 2009, Eurasia and East Europe gained in importance for Italy's and Portugal's value added textile exports. Exports to the East Asia and Pacific Region as well as to the Americas declined. Still, exports remained greater than imports. Inter-regional imports in value added in Italy mainly came from China and India, East Europe and Eurasia in 1995. This was unchanged in 2009, except for a substantial slowdown in imports from Eurasia. China and India as well as the Americas constituted important trading partners for Portugal in terms of imported value added in the textile industry in 1995. While import volumes from China and India grew until 2009, those from the Americas decreased at the expense of East Europe.

In terms of inter-regionally traded labour in 1995, both Italy and Portugal were – similar to traded value added – net exporters to the East Asia and Pacific Region, and to the Americas, but net importers in bilateral trade with East Europe, Eurasia, and China and India. By 2009, shifts in net-trade positions could be observed with respect to some regional blocks: Portugal turned into a net exporter in bilateral trade with East Europe, and both countries turned into net exporters in bilateral trade with Eurasia. In terms of labour embodied in the trade of inter-regional manufacturing goods in 1995, Italy's exports exceeded imports only in bilateral trade with the Americas. The same holds true for 2009 (seen Appendix A.3). Furthermore, Italy turned into a net exporter in bilateral trade with the East Asia and Pacific Region. Portugal's trade surpluses in terms of labour embodied in textiles were not reflected in the manufacturing sector as a whole, where Portugal – similar to Italy – was a net exporter in bilateral trade with the Americas during the whole observation period. In 2009, exports exceeded imports also with respect to Eurasia.

In Italy, the largest part of labour embodied in inter-regional textile imports came from India and China, whereas in Portugal this was only true for 2009, where imports from this regional block replaced West Europe as the largest import partner. Imports from this region in fact increased over the observation period for both countries. Apart from this, Portugal's labour imports accelerated only from the East Asia and Pacific Region, while traded volumes per se remained at a relatively low level. For Italy the volume of labour embodied in textile imports, apart from China and India, increased only for East Europe, which in 2009 was its second most important import source. Inter-regionally traded labour embodied in textile exports from Portugal in 1995 was mainly targeted towards the Americas and the East Asia and Pacific Region. Until 2009 exports to Eurasia and East Europe gained in importance at the expense of exports to the East Asia and Pacific Region and the Americas. Italy's most important inter-regional textile export destinations in 1995 with respect to embodied labour were the Americas,

the East Asia and Pacific Region, and East Europe. Until 2009, traded labour with the Americas and the East Asia and Pacific Region decreased substantially, while bilateral trade volumes of embodied labour increased with East Europe and Eurasia.

Value Added Intensity and Labour Intensity: We next discuss results regarding the qualitative nature of textile production. As illustrated in Table 4, Italy's exports in both years were value added-intensive relatively to its imports. Its exports from 1995 to 2009 became even more value added-intensive, whereas the labour intensity of its imports increased only slightly. Since the increase of value added intensity in exports is larger than in imports, this signals productivity gains within Italy and a growing specialisation in value added-intensive production tasks, which in the textile industry are associated with high-level products. Compared to Italy, production patterns in Portugal were different in 1995 and 2009 and also evolved in a different direction. For both years, its exports were more labour-intensive compared to its imports, even though its exports became more value added-intensive and its imports more labour-intensive. Since the decrease in value added intensity of imports is larger than the increase in value added intensity of exports, this implies that Portugal experienced productivity losses during the observation period. Even though exports became more value added-intensive over time, exports in both years were more labour-intensive than imports. Portugal thus was involved in lower quality production tasks in the textile industry than Italy. For the manufacturing sector as a whole, Italy's exports were more value-added intensive compared to its imports in both 1995 and 2009, while the opposite was the case for Portugal. Italy's imports became more value added-intensive from 1995 to 2009, which is also true for its exports. Since the increase in value added intensity of exports is larger than in imports, Italy experienced productivity gains in the manufacturing sector as well. Yet, compared to the textile industry, its productivity gains in the manufacturing sector were small. For Portugal, the value intensity in both imports and exports increased as well. However, the decrease of labour intensity in imports is larger than in exports, signalling that Portugal's manufacturing sector – in contrast to the textile industry – did not account for massive productivity gains over the observation period.

	1995		2009	
	q_i^{IN}	q_i^{OUT}	q_i^{IN}	q_i^{OUT}
Italy	3.2462 (14.1462)	19.362 (25.0125)	3.8998 (18.2179)	26.1698 (29.1482)
Portugal	11.4105 (22.4964)	6.0971 (9.5317)	9.7381 (27.4903)	7.4411 (14.4433)

Table 4: Value added/Labour intensity of textile imports and exports for Italy and Portugal in 1995 and 2009. Figures in brackets are values for the whole manufacturing sector.

Upstreamness and Downstreamness: We next concentrate on the positions of Italy and Portugal in the international textile production chain. In terms of value added, Italy was an upstream producer in both

1995 and 2009, while it consistently ranked as a downstream producer in terms of labour. Italy's up-stream position in the textile industry in terms of value added was not reflected in production patters of the manufacturing sector as a whole. There, it it was a middle-upstream producer in 1995, and turned into a downstream producer. In terms of labour it was a down-stream producer in both years. Portugal on the contrary did not change position in the international textile production chain from 1995 to 2009. Concerning value added and labour, it stayed a middle-upstream producer. The results for Portugal's manufacturing sector differ for the two variables. In terms of value added, Portugal was a down-stream producer, and in terms of labour, an up-stream producer in both years. Neither Italy nor Portugal experienced a change in their positions in the international textile production chain. This however does not rule out that they nonetheless shifted slightly up- or downstream. Taking a closer look at the development of their net-trade positions over the observation period lets us conclude that both countries moved downstream. Empirically, this is confirmed by decreases of the trade surpluses in terms of trade value added for Italy (-52.41 per cent) and for Portugal (-87.8 per cent). Regarding labour, Italy's trade deficit even rose by 44.75 per cent from 1995 to 2009, while Portugal exhibited a drop in its trade surplus of 76.52 per cent.

Vertical Specialisation: In a last step, we take a closer look at whether Italy and Portugal have increased their vertical specialisation, or have become more vertically integrated during the observation period. As shown in Table 5, Italy increased its value added import content of intermediate textile exports from 1995 to 2009. Contrary to a general increase in outsourcing activities in the intermediate textile production, Italy's vertical specialisation in terms of the value added import content of final demand textile products decreased. Together with the results regarding the country's movement along the international textile production chain, this indicates continuous outsourcing of value added during the observation period going hand in hand with a down-stream movement. Italy's intermediate exports still got more value added-intensive than its intermediate imports from 1995 to 2009, which is consistent with observed productivity gains and specialisation towards value added-intensive production tasks. Altogether, Italy decreased its degree of vertical specialisation in terms of value added, which was also the case for Portugal. However, vertical specialisation coefficients in terms of value added developed rather differently for Portugal than for Italy. Both the value added import content of intermediate and final demand textile exports dropped from 1995 to 2009, signalling an increase of vertical integration in Portugal's textile industry. The decrease of the value added import content of final demand textile exports exceeds that for intermediate exports. Together with Portugal's initial down-stream position in terms of value added in 1995, this supports the picture of a move into an even more downstream direction.

	c_{Z,Z_i}		c_{Z,F_i}		$c_{Z,Z+F_i}$	
	1995	2009	1995	2009	1995	2009
Value added						
Italy	0.5574	0.6171	0.3852	0.2395	0.2278	0.1725
	(1.06)	(1.115)	(0.9828)	(1.0103)	(0.51)	(0.53)
Portugal	2.5714	2.0323	0.4239	0.3437	0.3639	0.2939
	(1.9197)	(1.329)	(1.3474)	(1.6171)	(0.7917)	(0.7295)
Hours Worked						
Italy	2.4683	4.391	1.7057	1.7043	1.0087	1.2278
	(1.8748)	(1.6661)	(1.7381)	(1.5095)	(0.9019)	(0.792)
Portugal	1.3701	2.3443	0.2259	0.3964	0.1939	0.3391
	(0.8322)	(0.7503)	(0.5841)	(0.913)	(0.3432)	(0.4118)

Table 5: Measures of Vertical Specialisation for Italy and Portugal in 1995 and 2009 in terms of value added and hours worked. Figures in brackets correspond to values for the whole manufacturing sector.

As regards our second variable, vertical specialisation in terms of labour in Portugal's textile industry increased particularly in the intermediate sector. On the contrary, the labour imports embodied in final demand textile exports decreased, and vertical specialisation overall increased from 1995 to 2009, as indicated by the third measure. Hence, despite the fact that the country remained an upstream producer in terms of labour over the observation period, increased outsourcing of labour went hand in hand with a downstream movement along the international textile production chain. Furthermore, Portugal continuously substituted imported labour embodied in textile exports for domestic labour. In Italy, except for imported labour embodied in final demand exports, vertical specialisation accelerated. Thus, Italy's specialisation towards more value added-intensive downstream production led to increased vertical integration. Conversely, the labour required for intermediate production activities was gradually outsourced over the course of the observation period. Overall, Italy's textile industry became more vertically specialized in terms of labour. Comparing the changes in our measures of vertical specialisation for both countries over time, we again find support for the observation that value added-intensive textile production became more important relative to labour-intensive production in both countries. This is because value added-intensive production steps became either more vertically integrated in both countries, or were at least outsourced to a lesser degree than labour-intensive production steps.

The results for the manufacturing sector as a whole differ from those in Italy's textile industry. All vertical specialisation indicators in terms of value added rose, suggesting that Italy's manufacturing sector as a whole became more dependent on international production linkages in terms of value added creation. This furthermore indicates that the country had a comparative advantage in terms of value added-intensive production within the textile industry both in 1995 and in 2009, even though its

amount decreased over the observation period. For Portugal, the development of vertical specialisation in the manufacturing sector was rather similar to that of the textile industry regarding value added. The value added import content of intermediate exports increased, whereas there was an increase in vertical integration in terms of value added final demand exports. Overall, Portugal's manufacturing value added exports (both to the intermediate and the final demand sector) became more dependent on foreign producers. In terms of labour, results for Italy's manufacturing sector are completely different to the textile industry, since vertical specialisation decreased for all three indicators. In Portugal, it was particularly the development of the degree of vertical specialisation of intermediate manufacturing goods which differed from the results for the textile industry: While in the textile industry there was a growing dependence on imported labour, the manufacturing sector as a whole became more vertically integrated and labour was less outsourced. However, the overall degree of vertical specialisation in Portugal's manufacturing sector, and the labour import content of final demand exports – like in the textile industry – increased.

6. Conclusion

The aim of this paper was to contribute to a better understanding of the quantitative and qualitative aspects of structural change observed within Italy's and Portugal's textile industries, driven by changes in the technological and in the institutional environment. From a methodological point of view, it is particularly the combination of concentration measures with network analysis which constitutes an appropriate tool set to answer the research questions. The empirical results gained from this approach are significant also with respect to the different benchmarks chosen. Taking on the one hand the manufacturing sector as a benchmark, and focusing on the other hand on a multiregional context, allowed us to uncover structural shifts of textile production for the two countries, triggered by technological and institutional change. Beyond this we succeeded in determining country-specific structural properties of the textile industry as well as changes during the observation period by including gross output, value added and labour as variables in our analysis. To the best of our knowledge such a comprehensive industry-level study on textile production, addressing a variety of different aspects of structural change has not existed hitherto. Using the measures we brought together for this purpose helped us to highlight structural change as a multifaceted process, and to uncover its very nature in the two countries under study, without masking the international context.

As discussed at the beginning, the institutional shock related to trade liberalisation, together with technological change in the textile industry, exposed particularly developed countries to problems which manifested in tremendous structural shifts. However, we show that the textile industry in developed countries does not necessarily have to suffer from the observed institutional and technological changes. A certain historical path dependency regarding the structural properties of textile production proves decisive in determining whether developed countries suffer more or less from these changes. We find

that the textile industry in 1995 already exhibited a high level of concentration in terms of labour, which even increased until 2009. A similar picture emerges for gross output and value added from 1995 to 2009. We show that the textile industry lost in importance in both countries. This crystallised into a decreased gross output and strong declines in value added generation and employment. However, Italy partly counteracted these slumps through adapting production and strengthening specialisation in value added-intensive production steps leading to related productivity gains, and an extension of its comparative advantage in high-level products. On the contrary, Portugal's textile industry was oriented towards labour-intensive production in 1995. Despite slight efforts to specialise more in value added-intensive textile production, the dominance of labour-intensive textile production caused its textile industry to suffer from the changes in the institutional and technological environment. This also led to massive outsourcing processes. Furthermore, productivity gains in Portugal were modest compared to Italy. Based on this evidence we conclude that textile producing firms in both countries can only stabilize their own situation if they are productive, innovative and able to modernize their production. While Italy seemed to proceed in the right direction, Portugal's textile industry constitutes a textbook example of the negative effects of structural change. Stabilizing the situation in either country's textile industry, however, requires taking country-specific action. We consider identifying structural characteristics of the textile industry as well as changes in structure specific to Italy and Portugal, to be a precondition to the formulation of effective policy measures.

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Appendix

A.1 Ranking for countries' shares of textile industry in manufacturing

Gross Output				Value Added				Labour			
1995		2009		1995		2009		1995		2009	
PRT	17,14	TUR	29.49	PRT	18.25	TUR	28.99	PRT	28.53	IND	45.80
TUR	16,24	IND	14.25	IND	17.24	BGR	19.38	TUR	26.70	TUR	31.07
EST	15,73	IDN	10.72	GRC	16.70	IND	16.25	BRA	26.56	BRA	27.92
IND	14,16	LUX	10.44	LTU	15.00	PRT	11.60	BGR	25.14	BGR	21.64
IDN	13,47	BGR	9.96	TUR	14.04	GRC	10.62	IND	24.11	CHN	21.03
LTU	12,45	PRT	9.26	BGR	13.65	IDN	10.59	CYP	22.87	MEX	17.65
LVA	12,37	ITA	8.47	CYP	13.25	ITA	9.51	ROM	22.79	PRT	17.25
CYP	12,11	CHN	8.36	EST	13.13	ROM	8.73	GRC	20.55	ROM	16.75
GRC	12,07	GRC	7.19	BRA	12.41	BRA	8.05	LTU	19.96	IDN	15.16
BGR	11,36	BRA	6.43	IDN	12.39	CHN	7.99	EST	17.63	GRC	12.05
CHN	11,24	CYP	5.88	MLT	11.47	CYP	7.64	POL	16.96	LTU	11.78
ITA	10,11	ROM	5.63	LVA	11.34	LUX	7.17	LVA	16.08	ITA	8.96
ROM	8,46	LTU	5.52	ITA	11.29	EST	6.73	KOR	15.54	EST	7.51
MLT	8,41	EST	5.47	CHN	10.75	LTU	6.58	SVN	14.89	POL	6.61
BRA	8,41	SVN	4.54	SVN	10.21	BEL	5.33	CHN	14.79	HUN	6.52
SVN	7,75	LVA	4.40	ROM	10.18	LVA	4.87	HUN	14.66	SVK	6.20
TWN	7,11	BEL	3.68	POL	9.02	MLT	4.32	ITA	14.58	LVA	6.18
KOR	6,93	KOR	3.36	LUX	8.63	POL	4.13	IDN	13.05	KOR	5.91
LUX	6,72	MEX	3.11	KOR	7.35	MEX	3.94	MEX	12.78	LUX	5.46
HUN	6,59	GBR	3.01	HUN	7.28	SVN	3.82	TWN	11.35	TWN	4.95
POL	6,55	POL	2.98	CZE	6.84	ESP	3.38	CZE	11.29	ESP	4.85
CZE	6,25	MLT	2.95	TWN	6.74	FRA	3.20	SVK	11.17	SVN	4.68
BEL	5,84	RUS	2.95	ESP	5.87	KOR	3.10	MLT	10.04	CZE	4.61
ESP	5,42	ESP	2.92	SVK	5.84	GBR	2.70	ESP	9.84	CYP	4.40
AUS	5,08	CZE	2.44	BEL	5.53	CZE	2.69	JPN	9.70	AUS	4.37
MEX	4,95	FRA	2.37	MEX	5.45	AUT	2.49	RUS	9.46	RUS	3.84
SVK	4,77	AUS	2.18	GBR	4.91	TWN	2.38	BEL	8.34	BEL	3.65
GBR	4,44	AUT	1.85	AUS	4.84	SVK	2.30	IRL	8.23	JPN	3.43
USA	4,40	CAN	1.79	AUT	4.24	CAN	2.12	AUS	7.75	MLT	2.99
AUT	4,14	NLD	1.61	USA	4.22	AUS	2.02	USA	7.68	USA	2.92
FRAU	3,86	DNK	1.58	FRA	4.21	RUS	1.70	FRA	7.55	AUT	2.85
JPN	3,73	SVK	1.47	JPN	3.80	DNK	1.63	CAN	7.08	FRA	2.84
DNK	3,63	USA	1.36	DNK	3.70	NLD	1.59	AUT	5.62	CAN	2.78
RUS	3,14	DEU	1.35	CAN	3.65	DEU	1.53	GBR	5.47	FIN	2.28
CAN	2,94	HUN	1.15	RUS	3.23	USA	1.43	DNK	4.74	IRL	2.12
GER	2,72	JPN	1.07	IRL	3.08	HUN	1.38	FIN	4.40	NLD	1.89
NLD	2,48	TWN	1.06	NLD	2.52	JPN	1.16	GER	3.73	GBR	1.89
IRL	2,46	FIN	0.84	GER	2.51	FIN	0.90	NLD	3.37	DNK	1.72
FIN	1,85	SWE	0.82	FIN	2.31	IRL	0.69	LUX	3.05	GER	1.51
SWE	1,08	IRL	0.56	SWE	1.10	SWE	0.44	SWE	1.80	SWE	1.36

A.2 Strength Centrality: Single Country Values and Totals for Regions.

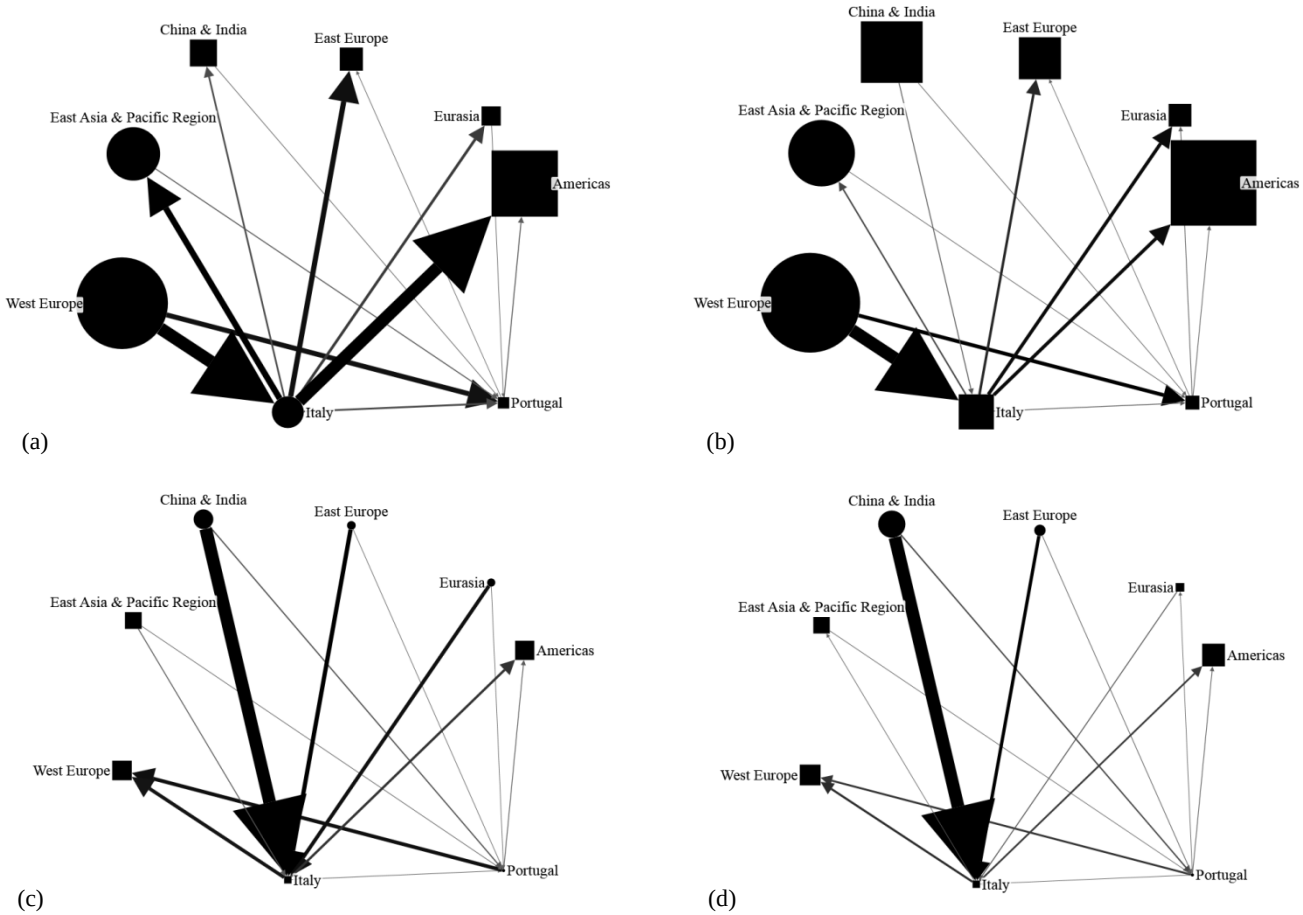
	Value Added				Employment			
	In-Strength		Out-Strength		In-Strength		Out-Strength	
	1995	2009	1995	2009	1995	2009	1995	2009
East Asia & Pacific Region								
Australia	779 (12,634)	1,114 (26,742)	436 (6,149)	199 (7,812)	526 (1,438)	515 (2,335)	30 (268)	15 (258)
Indonesia	633 (10,847)	910 (12,980)	2 (12)	1 (3)	177 (902)	328 (1,607)	513 (3,111)	855 (2,318)
Japan	5,989 (55,822)	4,232 (61,533)	1,873 (102,955)	1,613 (144,797)	3,986 (11,286)	1,672 (7,067)	109 (2,338)	99 (1,890)
South Korea	1,639 (28,975)	1,133 (49,429)	4,127 (23,378)	1,321 (74,190)	821 (2,696)	408 (3,711)	851 (2,279)	145 (3,241)
Taiwan	701 (24,269)	360 (32,875)	2,506 (23,004)	1,042 (34,262)	198 (1,919)	102 (2,039)	359 (1,957)	181 (2,690)
Total 17t18 (*Total Manufacturing*)	9,741 (132,547)	7,749 (183,559)	8,944 (155,498)	4,176 (261,064)	5,708 (18,241)	3,025 (16,759)	1,862 (9,953)	1,295 (10,397)
West Europe								
Austria	1,255 (16,622)	1,224 (25,111)	895 (15,108)	1,132 (31,073)	189 (826)	157 (984)	32 (411)	25 (520)
Belgium	1,957 (33,988)	1,587 (40,580)	2,432 (37,071)	2,674 (42,896)	296 (1,685)	270 (1,937)	76 (767)	35 (610)
Germany	9,788 (108,857)	5,805 (163,635)	5,536 (149,776)	7,559 (248,126)	2,955 (8,968)	1,925 (10,573)	207 (3,768)	185 (4,542)
Denmark	865 (12,572)	413 (18,212)	774 (13,844)	431 (17,375)	258 (737)	98 (645)	27 (377)	11 (323)
Spain	1,336 (27,409)	2,714 (50,689)	968 (20,775)	2,299 (31,469)	278 (1,605)	789 (2,674)	65 (829)	113 (1,074)
Finland	359 (6,935)	448 (11,422)	233 (10,493)	216 (21,976)	87 (487)	96 (616)	10 (244)	7 (244)
France	3,771 (67,559)	4,097 (99,942)	3,306 (58,253)	4,538 (84,626)	868 (3,730)	1187 (5,132)	182 (1,792)	88 (1,450)
United Kingdom	3,725 (63,159)	4,308 (90,267)	3,342 (66,431)	3,245 (80,611)	1,281 (4,428)	1,438 (5,149)	122 (2,168)	82 (1,715)
Ireland	476 (7,860)	621 (14,824)	377 (12,507)	145 (25,109)	49 (385)	85 (531)	28 (346)	5 (241)
Italy	2881 (47,844)	3738 (64,373)	7364 (54,231)	5871 (59,053)	887 (3,382)	958 (3,533)	380 (2,168)	224 (2,026)
Luxembourg	102 (2,350)	128 (3,214)	203 (2,230)	167 (2,549)	5 (68)	4 (73)	2 (50)	3 (53)
Malta	56 (720)	39 (916)	40 (320)	14 (421)	6 (38)	2 (35)	3 (25)	1 (24)
Netherlands	1,781 (35,547)	1,517 (43,168)	1,431 (40,484)	1,221 (58,112)	398 (2,162)	264 (2,020)	47 (1,000)	28 (963)

Portugal	776 (7,801)	873 (12,030)	1398 (5,244)	949 (7,386)	68 (347)	90 (438)	229 (550)	128 (511)
Sweden	896 (16,299)	699 (22,729)	291 (20,070)	371 (46,209)	257 (850)	149 (887)	13 (548)	16 (502)
Total 17t18 (*Total Manufacturing*)	30,024 (455,522)	2,8211 (661,112)	28,590 (506,837)	30,832 (756,991)	7,882 (29,698)	7512 (35,227)	1,423 (15,043)	951 (14,798)
East Europe								
Bulgaria	15 (878)	78 (3,311)	57 (690)	12 (42)	2 (134)	9 (238)	53 (349)	104 (285)
Cyprus	77 (778)	135 (1,257)	123 (235)	63 (267)	21 (69)	9 (58)	18 (20)	3 (17)
Czech Republic	428 (6,241)	771 (20,668)	391 (4,023)	640 (18,294)	57 (448)	122 (1,184)	146 (912)	91 (1,371)
Estonia	74 (640)	84 (1,601)	57 (357)	88 (973)	12 (71)	18 (85)	33 (153)	21 (133)
Greece	766 (6,456)	946 (11,947)	482 (1,243)	256 (1,657)	82 (414)	117 (631)	47 (97)	19 (99)
Hungary	175 (3,637)	492 (15,104)	168 (2,026)	100 (9,040)	19 (284)	37 (797)	74 (446)	70 (1,215)
Lithuania	65 (742)	211 (2,141)	118 (468)	215 (1,853)	13 (124)	21 (131)	70 (209)	51 (191)
Latvia	44 (444)	109 (154)5	46 (319)	31 (503)	6 (73)	11 (98)	23 (112)	10 (80)
Poland	264 (6,197)	1,304 (27,938)	1,149 (6,486)	1735 (23,433)	25 (397)	314 (1,456)	479 (1,438)	293 (2,163)
Romania	347 (2,212)	1,044 (9,340)	401 (1,694)	46 (206)	23 (164)	80 (613)	424 (801)	426 (821)
Slovakia	82 (1,877)	340 (8,337)	137 (1,968)	335 (11,052)	24 (222)	71 (487)	56 (418)	57 (549)
Slovenia	169 (2,384)	172 (3,933)	331 (2,003)	89 (2,983)	17 (135)	35 (190)	53 (220)	11 (225)
Total 17t18 (*Total Manufacturing*)	2,506 (32,486)	5,686 (107,122)	3,460 (21,512)	3,610 (70,303)	301 (2,535)	844 (5,968)	1,476 (5,175)	1,156 (7,149)
Americas								
Brazil	503 (11,218)	437 (22,133)	360 (7,969)	99 (5,141)	145 (735)	229 (1,668)	136 (1,400)	93 (1,673)
Canada	1,899 (44,027)	2,505 (78,714)	1,142 (49,998)	1,211 (65,882)	716 (2,915)	844 (4,002)	83 (1,863)	34 (1,177)
Mexico	1,253 (19,857)	1,662 (59,516)	1,024 (15,329)	547 (13,113)	123 (922)	244 (2,900)	502 (320,0)	800 (5,456)
United States	9,290 (174,062)	8,098 (232,842)	3,655 (119,113)	4,382 (255,827)	5,627 (21,945)	5,607 (30,614)	231 (4,132)	218 (4,286)
Total 17t18 (*Total Manufacturing*)	12,945 (249,164)	12,702 (393,205)	6,181 (192,409)	6,239 (339,963)	6,611 (26,517)	6,924 (39,184)	952 (10,595)	1,145 (12,592)
Eurasia								
Russia	1,731 (12,871)	5,189 (33,581)	123 (7,808)	2 (693)	346 (1,363)	1,742 (2,748)	183 (3,970)	12 (1,282)

Turkey	490 (8,170)	4,752 (16,619)	3,303 (8,287)	195 (751)	219 (724)	2,169 (2,012)	638 (841)	364 (1,397)
Total 17t18 (*Total Manufacturing*)	2,221 (21,041)	9,941 (50,200)	3,426 (16,095)	197 (1,444)	565 (2,087)	3,911 (4,760)	821 (4,811)	376 (2,679)
China & India								
China	3,482 (31,131)	3,188 (18,0798)	8,276 (30,349)	19,696 (157,789)	489 (2,007)	448 (7,102)	10,408 (27,745)	9,504 (44,718)
India	220 (6,533)	481 (26,972)	2,265 (5,727)	3,210 (15,415)	87 (750)	149 (2,923)	4,706 (8,510)	8,386 (19,590)
Total 17t18 (*Total Manufacturing*)	3,702 37,664	3,669 207,770	10,541 36,076	22,906 173,204	576 2,757	597 10,025	15,114 36,255	17,890 64,308

Note that figures in brackets correspond to values for the whole manufacturing sector.
Value added is expressed in constant millions of US-$, where 1995 = 100. Employment is expressed in million hours worked.

A.3 Net Trade Flows of the International Manufacturing Network from the perspective of Italy and Portugal



Bilateral trade relations in manufacturing goods from the perspective of Italy and Portugal in value added in 1995 (a) and in 2009 (b), and in hours worked in 1995 (c) and in 2009 (d). The size of nodes reflects 1/1000 of the total strength, or more precisely, the sum of out- and in-strength. Nodes with circular shape are out-central nodes, while rectangular nodes are in-centrals. The width of the edges indicates the absolute value of net trade flows and the direction of arrows depends on whether a country/region is a net-importer or exporter. Note that West Europe excludes Italy and Portugal.