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Restructuring the International Textile Production and Trade Network. The Role of Italy and Portugal

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Abstract

Production and trade processes in the textile industry have been undergoing tremendous changes in structure due to both changes in technology (i.e. increased mechanization and automation processes) and in the institutional environment (i.e. the assignment of the WTO treaty in 1994). This paper studies the restructuring process in the textile industry from the perspective of two major textile producing countries in the EU15, i.e. Italy and Portugal between the two years 1995 and 2009. As a starting point, a detailed descriptive analysis of the global distribution of the textile industry and changes therein is provided. By means of two international textile trade networks (ITTNs), showing (1) trade in value added and (2) trade in labour, we next discuss spatial trade patterns and changes therein. Focusing on the ITTNs, we then figure out how these countries' textile industries were affected in terms of specialisation patterns, movements along the global value chain and vertical specialisation. Combining the merits of a multiregional I/O-framework with network analysis both qualitative and quantitative aspects of the experienced restructuring process are figured out. This paper contributes to a better understanding of changes in national economic structures resulting from changes in the institutional and technological change without masking the international context.

JEL: C67, F14, O12
Keywords: International trade network, concentration, textile industry, structural change, network analysis, multiregional input-output model

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Restructuring the International Textile Production and Trade Network.

The Role of Italy and Portugal.

Marlies Schütz and Nicole Palan[1, 2]

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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 to a decrease of trade costs such as costs of communication, transportation and of coordination. Fostered by these changes, manufacturing production processes have been fragmenting continuously, and internationally, leading to increased vertical specialisation (Hummels et al., 2001). Besides, these fragmentation processes, i.e. the increase in vertical specialisation, induced an increase in trade of intermediate goods and services, exploiting the comparative advantages of firms involved at various stages of the production process (Jones and Kierzkowski, 1990), allowing thereby a finer division of labour (Feenstra and Hanson, 1996). Worldwide competition thus increasingly plays out at the level of production activities *within* industries, rather than in terms of competitive advantages *between* industries. This becomes evident in the increased geographical concentration of whole industries but also in the rising agglomeration of single stages of the production process (Fujita and Thisse, 2006 and 2013): Whether agglomeration of production steps occurs in economic centres or in the periphery strongly depends on the size of the wage gap between the areas and the level of trade costs. Thus, if wage differentials are large, concentration of production that needs only low-skilled workers is expected to take place in the low-wage periphery, whereas economic centres are left with fewer workers who mainly serve in strategic functions of the production process. Thus the increased importance of both global value chains and "supply-chains" between developed and developing countries (Baldwin, 2012) are likely to have altered not only the ways in which international trade is organized but have also affected the specialisation and concentration patterns of countries.

A prime example for these developments is the textile industry, which is one of the first industries newly industrialising countries are usually entering, due to its low technology and capital content. Increased mechanization and automation processes as well as changes in the institutional setting due to the reduction of export quotas con-

stitute important drivers for restructuring of this industry since the early 1990s (Kowalski and Molnár, 2009). Facing increased international competition in textile production activities, the European Commission 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 output, employment and value added in European textile producing countries. 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 [gross output and value added] for some years to come." (European Commission, 2004b: 7) Our special interest for the developments in Italy and Portugal is owed to (1) the textile industry's significance for their national economic structures, and (2) these two countries' size role for the European textile industry. They are thus expected to have faced the most intense restructuring process, which is reflected in the fact that more than a third of the EU-15 textile production was allocated in Italy in 1995 and that its share even rose until 2009. As concerns Portugal, the importance in absolute figures is not as noteworthy as for Italy. Yet, in 1995 not a single other country in our sample showed a higher share of textiles in the manufacturing sector than Portugal – irrespective whether employment, gross output or value added were taken as a measure.

Seizing this diagnosis, the main purpose of this paper is to study the restructuring process in the textile industry experienced since the assignment of the WTO treaty in 1994 from the perspective of Italy and Portugal. Concentrating in a first step on quantitative changes of the restructuring process, we answer the following questions: Has international textile trade become more concentrated or, on the contrary, more fragmented from 1995 to 2009? Which spatial trade patterns and shifts therein do we observe for Italy and Portugal in terms of internationally traded value added and labour? In a second step, we focus on qualitative aspects of the restructuring process, including (1) specialisation patterns in textile production (as well as their development from 1995 to 2009), (2) Italy's and Portugal's position in terms of up-/downstreamness and inter-temporal movements along the global value chain of textile production, and (3) possible tendencies towards increased fragmentation or contrary, towards decreased vertical specialisation. In studying multiple aspects of

the restructuring process, this paper contributes to a better understanding of changes in national economic structures in an international context, resulting from changes in the institutional and technological environment.

In studying the restructuring process, we apply a combination of a multiregional I/O-framework with network analysis. We consider these as two particular useful tools, which allow us to set the research focus on an international context and to evaluate at the same time country-specific aspects of the restructuring process. More in detail, we develop two international textile trade networks (ITTNs) – one for trade in value added and the other one for trade in labour. Sticking not solely to trade flows in studying the ITTNs, but to trade flows of value added and labour is a main advantage of our paper, since it allows us to study trade linkages to some degree "net of vertical specialisation" (Daudin et al., 2011). In context to our research question, we identify a range of recent papers in the field of multiregional I/O-analysis of special interest, which have focused on restructuring of production, skills and resources to an international level due to institutional and technological changes. Similar to our paper, Stehrer (2012) develops two input-output measures for trade in value added and the factor content of trade. He applies them to a single-year world input-output table and within a detailed empirical investigation studies trade patterns across countries. Furthermore, we consider the use of an inter-temporal framework rather than a static analysis as another advantage of our paper, since then we are able to highlight changes in economic structure. We limit our investigation of the restructuring process to changes between two years – one at the beginning of agreement to reduce the quantitative restrictions on trade (1995) and one at the end of the transition period (2009). In a similar vein, Stehrer et al. (2012) as well as Los et al. (2014) focus on an inter-temporal framework and for selected years study international patterns of trade. Contrary to our paper, Stehrer et al. (2012) as well as Los et al. (2014) do not focus on an industry level but on a sector or even more aggregate level.

The paper proceeds as follows. Starting with a discussion on the method and modelling framework in section 2 this is followed by an explanation of data handling and related preparatory work in section 3. Section 4 discusses empirical results, and section 5 concludes.

2. Method

2.1. Concentration Measure

We first 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) as it is a direct measure of concentration compared to inequality indices such as the Theil and the Gini Index (Coulter, 1989).[3] The HHI index takes the following form:

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

In (1a), l denotes a vector of dimension $k \times 1$, and for k countries with $i, h = 1, \dots, k$ 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). In our sample, where large differences exist with respect to the country size which imply predictable differences in shares of world employment (production) of countries, we opt for introducing a country-weighted index ($cwHHI$). Thereby we give more weight to countries whose share of textile employment (and value added, respectively) is above their share of manufacturing in world production and less weight to countries with a lower share of the textile industry in their respective economy[4]:

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

with:

[3] One drawback of all absolute measures is that the reference point for concentration is the equi-proportional distribution. For our country sample this 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.

[4] 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 accounted for 2.25 per cent of total manufacturing yet only .57 per cent of textiles, on the contrary, get less weight.

$$cw^k = \frac{l_i}{\sum_{j=3}^{16} \bar{l}_j^k}$$ [5]

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.[6]

2.2. International Textile Trade Networks

To assess characteristics of the restructuring process in the textile industry from the perspective of Italy and Portugal, we construct two international textile trade networks (ITTNs).[7] One network shows value added trade in the textile industry and the other one refers to embodied labour in international textile trade flows. The basic concept for constructing each of our ITTNs is a weighted directed graph G, which consists of a pair (V, X) where V is a finite and non-empty set of elements i called nodes and X is a finite set of elements ih 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 $ih \in X$, a weight $w_{ih} > 0$ is assigned. By definition a weighted directed graph G contains no self-loops (Harary et al., 1965). In our case, each node of V corresponds to countries involved in international trade of value added, respectively labour, while the set of edges X contains international trade linkages between the nodes, weighted by real trade volumes w_{ih}. To map the ITTNs by means of graph theory, two adjacency matrices A^1 (showing international trade of value added in the textile industry) and A^2 (showing international trade of labour in the textile industry) are derived, as de-

[5] 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.

[6] Note that in calculating cw^k summation just includes the manufacturing sector for industry $j = 3, \ldots, 16$, 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.

[7] Papers within the field of network analysis, where trade networks are investigated within first, an international context and second, a commodity-specific context include Barigozzi et al. (2010) or more recently, De Benedictis et al. (2014). Both for a weighted directed and binary directed version of the network, topological characteristics of the former are studied. Therefore a variety of centrality, density and clustering measures are applied. Different to our paper, the research interest in Barigozzi et al. (2010) and De Benedictis et al. (2014) is not in theoretical phenomena related to international trade and production. Also different from our paper, in these works no trade in value added or factor inputs are focused on. Another difference to Barigozzi et al. (2010) and De Benedictis et al. (2014) is that in our paper the development of the network – and hence, the changes in economic structure – do take centre stage, whereas the focus in Barigozzi et al. (2010) and De Benedictis et al. (2014) is on a static time horizon.

scribed in more detail in Appendix A.A. Based on the adjacency matrices defined in system A.A.4, we study both quantitative and qualitative properties of the ITTNs.

In network analysis there exist multiple measures to characterise the structure of networks. Distinguishing between measures referring to the structure of the network as a whole (global measures) and measures describing properties of single nodes (local measures), we are first and foremost interested in the latter, since these allow us to zoom into the ITTNs from the perspective of our two case study countries, without at the same time losing sight of the entire network structures. One class of local measures are centrality measures: Depending on the characteristics of the graph, a diversity of popular centrality measures exists.[8] In general centrality measures share the fact that they provide information about "the importance of a vertex [i.e. a node] in a network" (Newman, 2004: 2). In the following we apply strength centrality to the ITTNs as explained in more detail in Appendix A.B. We decided for this measure, since it constitutes a simple but convenient measure to determine and compare the level of interaction of single nodes in the ITTNs in terms of our structural variables (value added and labour) based on the intensity of linkages.

2.3. Strength Centrality-Based Measures – node analysis

Since we want to dig yet deeper into the structure of the ITTNs and changes in structure over time, we excavate strength centrality and derive a few further measures from it. Even though some of these measures are not tools of conventional network analysis, they allow us to figure out multiple characteristics of the ITTNs from the perspective of single nodes (i.e. countries). These measures provide information about (1) the net-trade position, (2) the labour and value added intensity, (3) upstreamness and downstreamness and (4) the degree of vertical specialisation of single nodes.

Net-trade Position: The net-trade position of a single country i can be analysed by means of a centrality coefficient. This is calculated for each variable 1 (value added) and 2 (labour) from the strength centralities in system $(A.B.1)$ as:

$$c_i^{\cdot} = \frac{s_i^{\cdot,IN}}{s_i^{\cdot,OUT}} \qquad (2)$$

[8] They include strength (in the weighted case) or degree centrality (in the unweighted, binary case), Eigenvector centrality, closeness and betweenness centrality measures (Borgatti, 2005).

A country i is called an out-central node if $c_i^{\cdot} < 1$ and hence, $s_i^{\cdot,OUT} > s_i^{\cdot,IN}$. It is thus a net-exporter of product-embodied value added, respectively labour then. If in contrast a single country's product-embodied exports in value added or labour 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. This measure provides us with information on the the significance of textile production within the respective country.

Value Added Intensity and Labour Intensity: Since nodes (i.e. countries) are the same for the two ITTNs, by comparing strength centralities for the ITTN in terms of value added with strength centralities of the ITTN in terms of labour, we get information about the qualitative properties of a single country's textile production. We are then able to figure out the value added and labour intensity of textile trade from the perspective of single countries. As a measure for detecting this qualitative property of textile production we use the ratios between in-strength and the ratios between out-strength of the two ITTNs. More formally for a single node i:

$$q_i^{IN} = \frac{s_i^{1,IN}}{s_i^{2,IN}} \qquad (3a)$$

$$q_i^{OUT} = \frac{s_i^{1,OUT}}{s_i^{2,OUT}} \qquad (3b)$$

The higher q_i^{IN} (q_i^{OUT}) for a single country i, the higher the value added intensity, respectively the lower the labour intensity of its imports (exports). If then a single country i is characterized by a comparatively higher labour intensity in its imports than in its exports (i.e. exports are more value added-intensive than imports) such that $q_i^{IN} \leq q_i^{OUT}$, this indicates that the country is involved more in high-quality production steps. Vice versa, if a country imports relatively value added-intensive textile goods while exporting labour-intensive ones and therefore $q_i^{IN} > q_i^{OUT}$, it specialises in low-quality production steps.

Since matrix W is derived just by adding matrices Z and F (see Appendix A.A), 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. Let $\overline{Z} \equiv Z \oslash W$ and $\overline{F} \equiv F \oslash W$ be two matrices of dimension $k \times k$ where one generic element $\overline{z}_{ih}$ ($\overline{f}_{ih}$) with $i, h = 1, \ldots, k$ corresponds to the share of intermediate (final) demand textile deliveries in total textile deliveries from country i to country h. Using

this definition, we are able to split in- and out-strength as calculated in system $(A.B.1)$ further into strength centrality of (1) trade in value added (labour) of intermediate textile goods and (2) trade in value added (labour) of final demand textile goods. More formally this reads:

$$s^{\cdot,IN} = \underbrace{e^T\left(\overline{Z} \otimes A^{\cdot}\right)}_{s_Z^{\cdot,IN}} + \underbrace{e^T\left(\overline{F} \otimes A^{\cdot}\right)}_{s_F^{\cdot,IN}} \qquad (4a)$$

$$s^{\cdot,OUT} = \underbrace{\left(\overline{Z} \otimes A^{\cdot}\right)e}_{s_Z^{\cdot,OUT}} + \underbrace{\left(\overline{F} \otimes A^{\cdot}\right)e,}_{s_F^{\cdot,OUT}} \qquad (4b)$$

where subscripts Z and F refer to intermediate demand and final demand, respectively. Studying the different versions of strength centrality with respect to intermediate ($s_Z^{\cdot,IN}$ and $s_Z^{\cdot,OUT}$) and final demand ($s_F^{\cdot,IN}$ and $s_F^{\cdot,OUT}$) we gain deeper knowledge about structural properties of international textile trade in value added and labour. Furthermore, changes in structure between 1995 and 2009 from the perspective of single nodes are captured then.

Upstreamness and Downstreamness: In a next step, we figure out the position of single nodes within the ITTNs as regards their position along the international textile production chain. Assigning single nodes a position along the international textile production chain helps to characterize production patterns in the textile industry. We see whether single nodes are involved either in downstream production activities or in upstream production activities in terms of value added creation and labour. In particular, differences in position between the two variables are of interest, since this reveals country-specific specialisation patterns in the textile industry. Table 1 summarises the criteria for single nodes to be assigned a position along the international textile production chain.

	$s_Z^{\cdot,IN}{}_i \leq s_Z^{\cdot,OUT}{}_i$	$s_Z^{\cdot,IN}{}_i > s_Z^{\cdot,OUT}{}_i$
$s_F^{\cdot,IN}{}_i \leq s_F^{\cdot,OUT}{}_i$	Up-Stream	Mid-Stream
$s_F^{\cdot,IN}{}_i > s_F^{\cdot,OUT}{}_i$	Mid-Stream	Down-Stream

Table 1: Criteria for a single node's position along the international textile production chain.

Following the OECD (2012), 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 and thus, if it is a net exporter both in interme-

diate and final textile goods. On the contrary, for a single country to be a downstream producer, it must be a net importer in both intermediate and final demand textile goods. Furthermore, a country is located mid-stream in the international textile production chain in the remaining two cases. To distinguish whether a country is a mid-upstream or a mid-downstream producer, its net-trade position as calculated in (2) is decisive. To be classified as a mid-upstream producer for a single country i it holds that $s_i^{\cdot,OUT} > s_i^{\cdot,IN}$. On the contrary, for a mid-downstream producer $s_i^{\cdot,OUT} \leq s_i^{\cdot,IN}$. 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. Furthermore, 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 during the observation period, its trade deficit decreases, turns into a trade surplus, or its trade surplus increases.

Vertical Specialisation: 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, to measure the degree to which textile production steps are fragmented in an international context, we calculate the following centrality coefficients:

$$c_{Z,Z_i}^{\cdot} = \frac{s_{Z}^{\cdot,IN}{}_i}{s_{Z}^{\cdot,OUT}{}_i} \qquad (5a)$$

$$c_{Z,F_i}^{\cdot} = \frac{s_{Z}^{\cdot,IN}{}_i}{s_{F}^{\cdot,OUT}{}_i} \qquad (5b)$$

$$c_{Z,Z+F_i}^{\cdot} = \frac{s_{Z}^{\cdot,IN}{}_i}{s_i^{\cdot,OUT}} \qquad (5c)$$

The centrality coefficient given in (5a) 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 for a single node i, $c^{\cdot}_{Z,Z_i} \geq 1$, the respective country is a net importer of value added used in intermediate production, respectively hours worked, and conversely, if $c^{\cdot}_{Z,Z_i} < 1$, the country exports more of value added (labour) than it requires itself in its intermediate demand sector. Similarly, in (5b) the centrality coefficient for a single node i $c^{\cdot}_{Z,F_i}$ indicates the import content embodied in final demand exports of value added (labour). Finally, the centrality coefficient given in (5c) measures the extent to which a single node 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. Similar to the measures of vertical specialisation introduced by Hummels et al. (2001), the higher the respective centrality coefficients, the more vertically specialised is a single country (and the higher is thus the fragmentation) within the international textile production chain.

3. Data

Data is used from the World Input-Output Database (WIOD) for the following reasons. One of its main advantages over other databases is that it includes a wide range of different indicators within a single database. By using only WIOD-data we avoid thus differences in methodology and limited comparability (which would be the case if mixing databases). It offers detailed data on employment, value added and gross output and hence exactly on the three structural variables we need as a basis for the empirical analysis. The database also provides multiregional I/O-tables covering 35 industries (classified according to ISIC Rev. 3) and 40 countries as well as one extra region called "rest of the world" (RoW)[9]. The large country sample included in the WIOD is beneficial to our empirical analysis, since in contrast to other databases in this field of research (e.g. OECD), major textile producing countries such as India, China and Indonesia are covered by the sample. The source data for constructing our international textile trade networks are two multiregional I/O-tables for 1995 and

[9] The latter region is added for balancing and calculation purposes (Dietzenbacher et al., 2013) and serves as a proxy for countries not included in the sample. It is therefore not amenable to interpretation (Timmer, ed. 2012) We exclude the RoW-region from our calculations throughout.

2009. WIOD fits especially well the purpose of this work: On the basis of its multiregional I/O-tables, in contrast to conventional bilateral trade data, it is possible to draw a relatively accurate picture of the international structure of textile trade, distinguishing as well between trade in intermediate demand and final demand textile goods, which proves to be important to answer our research question. Another reason for using WIOD-data is that they report also price indicators for various variables so that we are able to deflate all the data used in this paper and to concentrate on the restructuring process adjusted for price changes.

The value added and the labour data for the country sample on an industry level are taken from the 2012-version of the socio-economic accounts (Erumban et al., 2012). Specifically, we use hours worked, since this is a good measure for the amount of labour embodied in real trade volumes. The deflation procedure was accomplished row-wise, using multiple price indices.[10] A consequence of omitting RoW from our empirical analysis is that we create an upward bias in the technology structure underlying the multiregional I/O-table. After the deflation procedure, we therefore make a few corrections to mitigate this bias.[11] 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 used in the following as a corrected version of the real gross output vector for the analysis.

In order to concentrate our analysis on Italy and Portugal, the other countries are clustered into country groupings (i.e. regional blocks). In line with other studies, the most appropriate classification for our research context is the grouping of countries according to trade costs (Baldwin, 2006 and Chortareas and Pelagidis, 2004). Furthermore, the recent debate on the "distance puzzle" proves a classification as per mere distance measures inferior to a grouping according to trade costs (Bosquet

[10] 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 vectors were deflated using the corresponding intermediate delivery industry-level price index.

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

and Boulhol, 2015). Chaney (2013) moreover presents evidence on the firm-level that it is easier for countries to enter markets where their trading partners are already located, implying a network characteristic where cultural and spatial proximity could be of an advantage. Factors influencing the costs of transportation are trade imbalances, the absolute volume of trade, infrastructure, as well as fuel prices (that can be very volatile). One database that tries to capture this variety of factors is the ESCAP World Bank[12] database on International Trade Costs (ESCAP, 2013). This is the most suitable database for our purpose as it provides bilateral trade costs for all countries in our sample but Taiwan (for which the trade costs of China are taken as a proxy) and data is available on an annual basis between 1995 and 2009.[13] However, since data is not available at the industry level, we use data for the manufacturing sector, which gives information on symmetric bilateral trade costs. For our sample, the coefficients of variation in trade costs could be minimized by clustering countries in the following way (For details see Appendix A.D):

1. Central Europe (CE): Austria, Belgium, France, Germany, Italy, Netherlands, Slovenia, Spain and United Kingdom.

2. Periphery West and North Europe (PWNE): Denmark, Finland, Greece, Ireland, Luxembourg, Malta, Portugal and Sweden.

3. Periphery East Europe (PEE): Bulgaria, Czech Republic, Hungary, Poland, Romania, Slovakia.

4. Baltic and Eurasian Countries (BEC): Cyprus, Estonia, Latvia, Lithuania, Russia and Turkey.

5. Americas (A): Brazil, Canada, Mexico and the United States.

[12] International trade costs in this setting capture all additional costs involved in trading goods bilaterally, relative to those involved in trading goods domestically. These additional costs are shipping and logistic costs, both tariff and non-tariff costs (such as costs with trade procedures and regulations) as well as costs from differences in language, culture and currencies.

[13] The drawbacks of other databases are the following: The CEPII provide bilateral trade costs, but they are held constant over time as the primary focus is on accounting for the costs of distance that are treated as constant (Mayer and Zignano, 2011). The OECD database on Maritime Transport Costs provides annual data at the industry level, but data is not available for country pairs, i.e. EU-15 is treated as an entity for imports. Furthermore, there does not exist data for non-OECD countries, above all the Eastern European Countries. Imports are not reported for Canada.

6. East Asia and Pacific Region (EAPR): Australia, Indonesia, Japan, Korea and Taiwan.

7. China and India (CI) are treated as one region.

4. Empirical Results

This section reports our empirical results. To start with, a descriptive analysis of the global distribution of the textile industry and changes therein from 1995 to 2009 is provided. Then a detailed discussion of the restructuring process from the perspective of Italy and Portugal follows.

4.1. Descriptive Analysis

Global employment and gross output increased from 1995 to 2009, whereas value added declined, as illustrated in Table 2. This contrary development of gross output and value added could be a first hint that both vertical specialisation and vertical trade increased and that it is advisable to look at trade in value added rather than trade in gross output in our further analysis. The observed development was not evenly distributed across the regional blocks, however. All regions except China and India decreased their gross output, value added, and employment substantially and therefore growth occurred only in the latter region leading to vast relocation processes in the time span of 15 years. There are remarkable differences with regard to the distribution of value added (and gross output) on the one hand and employment on the other hand, giving further motivation to study the development of both variables. Whereas less than 15 per cent of global value added occurred in China and India in 1995, almost two third of global working hours already were concentrated in these two countries, implying that workers and machines were far less productive than in other areas in the world. By 2009, 4 out of 5 working hours in the world were carried out in these two countries and even more noteworthy is that value added more than tripled in 15 years, implying also a major increase in productivity over time. Back in 1995, the three regional blocks Central Europe, East Asia and the Pacific Region as well as Americas each still accounted for about 25 per cent of value added and gross output respectively, yet only 25 per cent of global employment. By 2009, less than 15 per cent of global employment and less than 50 per cent of

global value added occurred in these three regions. This implies that more capital-intensive production also came under international pressure during the observation period. The drop in significance of both, Americas and the East Asia and Pacific Region, was even larger than for Central Europe with regard to gross output and value added. These two regional blocks were successful in retaining relatively more employment than Central Europe, however.

	Gross Output		Value Added		Employment	
	1995	2009	1995	2009	1995	2009
World	815,640	1,087,007	256,242	234,849	85,576	111,562
Percentage of World Textile						
Central Europe	24.44	14.76	26.13	21.68	3.73	1.40
Periphery West and North Europe	2.88	1.43	3.09	2.44	.99	.45
Periphery East Europe	1.80	1.03	2.03	1.57	3.39	1.48
East Asia and Pacific Region	24.73	7.24	23.11	10.10	8.92	4.33
Baltic and Eurasian Countries	3.83	.61	4.17	.70	5.18	2.74
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 2: 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 2, the level of concentration was very low for both gross output and value added in 1995 – irrespective of whether we take country-specific weights into account.[14] Concentration increased for all three

[14] Interestingly, the development of country-weighted concentration was more accentuated than the unweighted HHI. This discrepancy is especially due to the fact that China's value

variables, indicating that institutional changes and the reduction of transportation costs facilitated concentration as predicted in models of economic geography (Krugman, 1991). 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 only after 1995. Remarkably, the increase in concentration was highest with respect to gross output.

4.2. Trade Network Results

Internationally Traded Value Added and Labour: Table 3 reports real trade volumes for 1995 and 2009, which give a first idea of the structure of the ITTNs and the changes thereof from the perspective of Italy and Portugal.

	1995		2009	
	In-Strength	Out-Strength	In-Strength	Out-Strength
Value Added				
Italy	2,881	7,364	3,738	5,871
Portugal	776	1,398	873	949
Employment				
Italy	887	380	958	224
Portugal	68	229	90	128

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.

Both countries experienced deep changes from 1995 to 2009 regarding volumes of value added and labour embodied in traded textiles. Italy observed a significant drop by one fifth of exported value added, while imports increased by almost 30 per cent. Regarding our second variable, labour, we find a massive decrease of 41.01 per cent in labour exports embodied in Italian traded textiles during the observation period. Labour imports in textiles, on the contrary, grew by 8 per cent. Hence, contrary to value-added, employment was not sustained during the observation period in Italy's textile industry, indicating the increased pressure from low-wage countries. For

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).

Portugal, the slump in value added embodied in textile exports was above the level observed for Italy, with a decrease of almost a third from 1995 to 2009. However, imports of value added increased by only 12.45 per cent. 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, showing that labour was continuously outsourced in the textile industry.

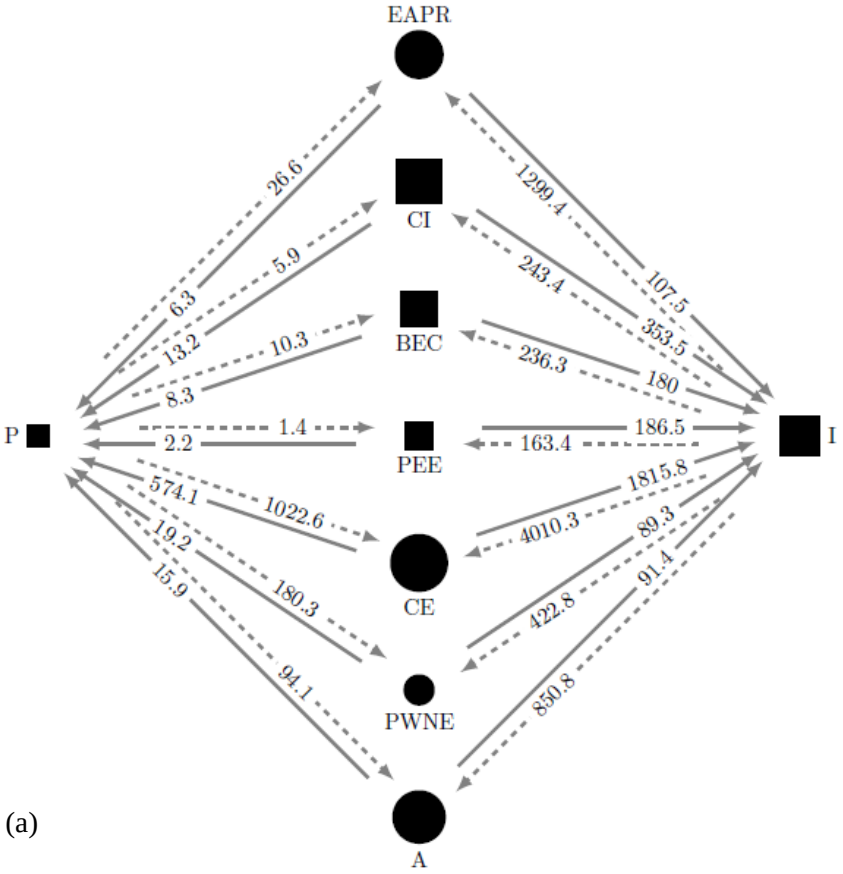
Net-trade Position: Focusing next on the net-trade position in the ITTNs, as calculated by the centrality coefficient in (2), Italy was a net exporter of value added in both years, while it was a net importer of labour during the observation period, as illustrated in

Figure 1. For Portugal different results obtain – it was a net exporter of both value added and labour in 1995 and 2009 in textiles. In the ITTNs, Portugal's centrality coefficient of traded labour was rather small (and thus its trade surplus rather large) compared to traded value added, and Italy's centrality coefficient was relatively small (i.e. its trade surplus was comparatively strong) regarding embodied value added. This gives a first hint that Italy's textile industry was oriented towards value added-intensive production steps, while in Portugal textile production involved comparatively labour-intensive production steps, as discussed in more detail below.

Spatial trade patterns within the ITTNs in 1995 and 2009: In order to put the developments of the individual countries into an international context, we illustrate the spatial dimension of trade in value added and labour as can be seen from

Figure 1. In both years, the largest trading partner for Italy in value added trade concerning both imports and exports was Central Europe, i.e. the countries characterized by the lowest level of bilateral trade costs. Trade with Central Europe also accounted for the most intense trade relation in terms of embodied labour exports from Italy in both years. Yet, as concerns the absolute traded volume with Central Europe, exports of value added and labour decreased during the observation period and only Italy's value added imports from Central Europe increased. Turning to the developments of Portugal, even though being not a member of this regional block, Central Europe was also the most important trading partner for Portugal in terms of value added exports and imports in both years. This can be explained by the fact that for Portugal bilateral trade costs were lowest with this region too. Similar to the situation observed in Italy, trade volumes decreased during the observation period –

except for value added imports from Central Europe. With respect to traded labour in 1995, bilateral trade between Portugal and Central Europe constituted for the largest part of labour embodied in traded textiles in both directions. However, by 2009 Central Europe was no longer Portugal's most important import source but this was overtaken by China and India. For Italy, already in 1995 Central Europe did not constitute such an important source of labour. In both years the largest volume of labour imports in the textile industry came from China and India. For both countries labour imports from China and India increased during the observation period, going hand in hand with a significant decrease in trade costs. In general, it can be observed that changes in the intensity of trade linkages to regional building blocks were deeply bound to changes in overall trade costs. With respect to the development of spatial trade patterns to other regional blocks, inter-country differences as well as differences between variables are observable to a small dimension, while inter-temporal changes were more significant. For instance, Baltic and Eurasian Countries as well as Periphery East Europe for both countries gained in importance as destinations for their value added exports during the observation period, going hand in hand with a significant drop in bilateral trade costs with these countries. Also for trade in labour – similar to trade in value added – exports from Italy and Portugal to the former two regional blocks increased sharply. This indicates higher domestic demand for textile goods in these regional blocks. For both countries, imports of value added and labour from Baltic and Eurasian Countries and Periphery East Europe slumped, whereas imported value added from Periphery East Europe went up. Even though trade costs to Periphery West and North Europe declined, and especially for Portugal this regional block in 1995 constituted for its 2nd largest export destination, a sharp decrease in bilateral trade of both value added and labour, more for Portugal than for Italy was observed. Except for an increase in Portugal's imports of labour from East Asia and the Pacific Region and an increase in Italy's imports of value added from Americas, bilateral trade with these two regional blocks dropped. Hence, despite decreasing trade costs, these regional blocks seemed to have become more independent from international trade in value added indicating an increased competitiveness. Comparing trade in value added with trade in labour, inter-temporal changes in the latter variable in general were more pronounced during the observation period. To sum up, the level of trade costs seems to be a decisive factor for the shape and even more so for the development of international trade patterns during the transition phase.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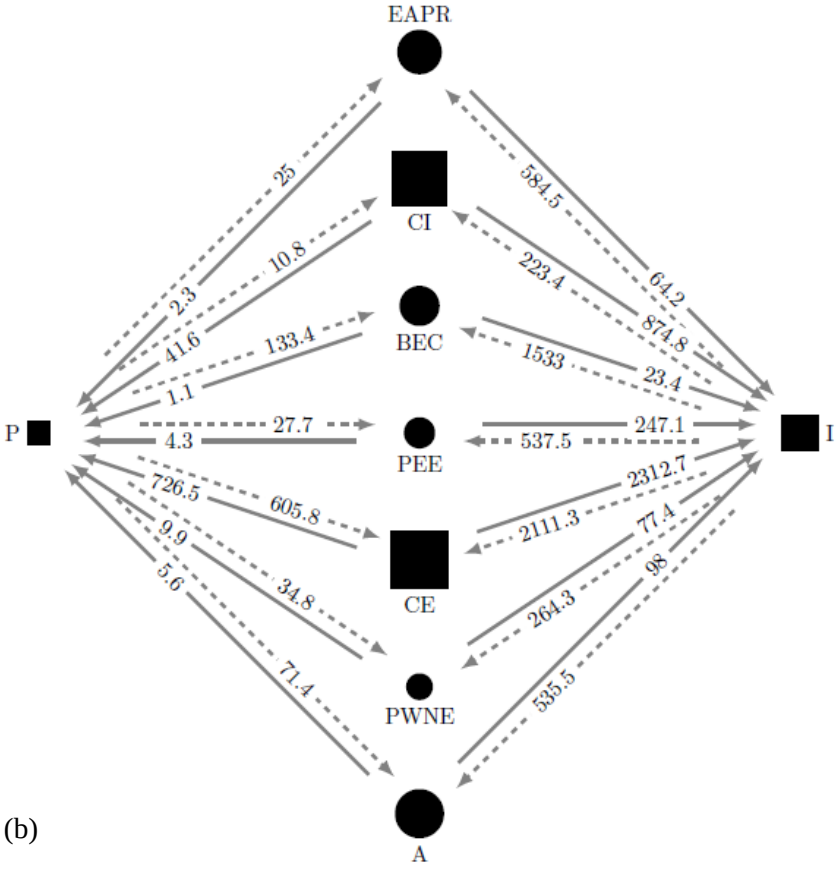
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64.2
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(b)

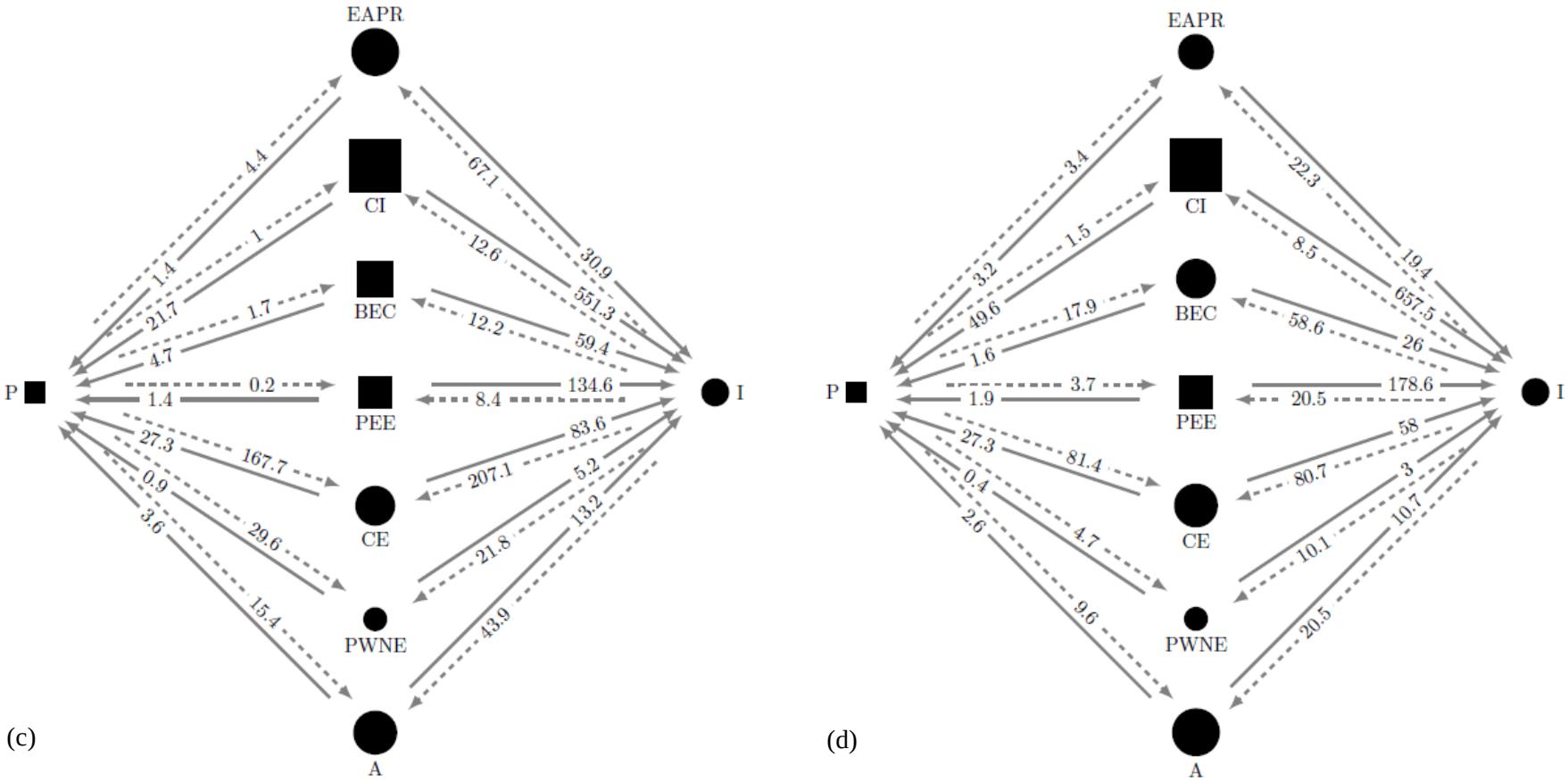

Figure 1: Bilateral textile trade relations from the perspective of Italy (abbreviated as I) and Portugal (abbreviated as P) in terms of value added in 1995 (a) and in 2009 (b), and in terms of hours worked in 1995 (c) and in 2009 (d). The size of the nodes reflects the total strength, or more precisely, the sum of out- and in-strength ranked in descending order. Nodes with circular shape are in-central nodes, while rectangular nodes are out-centrals. Edges which are illustrated as dotted lines are Italy's and Portugal's exports to the regional blocks, while edges illustrated as solid lines are Italy's and Portugal's imports from the regional blocks. Note also that Central Europe excludes Italy and Periphery West and North Europe excludes Portugal.

Value Added Intensity and Labour Intensity: We next discuss results regarding the qualitative nature of the restructuring process in the textile industry, through comparing strength centralities from the two ITTNs. As illustrated in Table 4, Italy's exports in both years were more value added-intensive relatively to its imports. Its exports from 1995 to 2009 became even more value added-intensive, while the value added-intensity of its imports increased only slightly. Since the increase of value added intensity in exports is larger than in imports, this signals a growing specialisation in value added-intensive production steps, which in the textile industry are associated with high-level products. Compared to Italy, production patterns in Portugal were different in 1995 and 2009 but evolved in a similar direction. For both years, its exports were more labour-intensive compared to its imports. Even though exports became more value added-intensive over time, compared to imports they remained relatively labour-intensive. Portugal thus was involved rather in lower quality production steps in the textile industry. Since the decrease in value added intensity of imports is larger than the increase in value added intensity of exports, this implies that also Portugal slightly specialised towards value added-intensive production steps during the observation period.

	1995		2009	
	q_i^{IN}	q_i^{OUT}	q_i^{IN}	q_i^{OUT}
Italy	3.2480	19.3789	3.9019	26.2098
Portugal	11.4118	6.1048	9.700	7.4141

Table 4: Value added/Labour intensity of textile imports and exports for Italy and Portugal in 1995 and 2009.

Keeping in mind the specialisation patterns of Italy's and Portugal's textile industries, we next concentrate on the positions of Italy and Portugal in the international textile production chain as well as patterns of vertical specialisation.

Upstreamness and Downstreamness: Regarding traded value added, Italy was an upstream producer in both 1995 and 2009, while it consistently ranked as a downstream producer in terms of labour. For Portugal it was observed that concerning both value added and labour, it stayed a middle-upstream producer. Neither Italy nor Portugal experienced a change in their positions in the international textile production chain. This however does not rule out that they 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 traded value added for Italy (-52.41 per cent) and for Portugal (-87.8 per cent). Regarding labour, Italy's trade deficit rose by even 44.75 per cent from 1995 to 2009, while Portugal exhibited a drop in its trade surplus of 76.52 per cent. Put differently, both countries specialised more on downstream activities in the textile industry, which are associated with value-added intensive but labour-saving production steps.

Vertical Specialisation: To back results gained hitherto, in a last step, we take a closer look at whether Italy and Portugal have increased their vertical specialisation and have thus outsourced production activities within the textile industry or whether the textile industries of the two countries have become less fragmented during the observation period. As shown in the 3rd column of Table 5, Italy decreased its overall degree of vertical specialisation in terms of value added, signalling that only a few highly specialised production steps remained within the country. Furthermore, the value added import content of intermediate textile exports rose from 1995 to 2009. Contrary to this increase in outsourcing activities in the production of intermediate textile goods, Italy's vertical specialisation with respect to the value added import content of final demand textile goods decreased. Together with the results regarding the country's movement along the global textile production chain, this confirms that continuous fragmentation of value added took place during the observation period, going hand in hand with a down-stream movement and an increasing specialisation towards value-added intensive production steps. Regarding the situation for Portugal, vertical specialisation coefficients in terms of value added developed rather differently compared to Italy. Both the value added import content of intermediate and final demand textile exports dropped from 1995 to 2009, indicating a decreased fragmentation in Portugal's textile industry. The decrease of the value added import content of intermediate demand textile exports exceeded that for final demand textile exports. Together with Portugal's initial mid-upstream position in terms of value added in 1995, this supports the picture of a move into a downstream direction. Overall for Portugal a growing vertical integration was observed between the two years (3rd column of Table 5).

	c_{Z,Z_i}		c_{Z,F_i}		$c_{Z,Z+F_i}$	
	1995	2009	1995	2009	1995	2009
Value added						
Italy	0.557	0.6171	0.3852	0.2395	0.2278	0.1725
Portugal	2.5714	2.0323	0.4239	0.3437	0.3639	0.2939
Hours Worked						
Italy	2.4683	4.391	1.7057	1.7043	1.0087	1.2278
Portugal	1.3701	2.3443	0.2259	0.3964	0.1939	0.3391

Table 5: Measures of Vertical Specialisation for Italy and Portugal in 1995 and 2009 in terms of value added and hours worked.

As regards our second variable, in Portugal's textile industry overall vertical specialisation increased from 1995 to 2009, as shown in the 3rd column of Table 5. In particular, it was the intermediate sector where Portugal continuously substituted imported labour embodied in textile exports for domestic labour, while labour imports embodied in final demand textile exports increased to a lesser degree. Hence, despite the fact that the country remained a mid-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. In Italy, except for imported labour embodied in final demand exports, fragmentation accelerated. Thus, Italy's specialisation towards more value added-intensive downstream production went hand in hand with increased vertical integration only in final demand exports. Contrary to this development, 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 specialised in terms of labour.

Comparing 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.

5. Conclusions

The aim of this paper was to contribute to a better understanding of the restructuring process in international textile production from the perspective of Italy and Portugal. From a methodological and analytical point of view, using the measures we brought together for answering the research question helped us to investigate changes in economic structure as a multifaceted process and to figure out both quantitative and qualitative aspects related to this. Focusing on an international context allowed us nevertheless to highlight country-specific aspects of the experienced restructuring process. By including three different variables, namely gross output, value added and labour into our research, we were further able to reconcile empirical results and to study international textile production and changes therein from different angles. To the best of our knowledge such a comprehensive industry-level study on textile production within an international context, addressing a variety of quantitative and qualitative aspects of changes in economic structure has not existed hitherto.

As discussed at the beginning, institutional changes related to trade liberalisation, together with technological change in the textile industry, exposed particularly developed countries to problems which manifested in a tremendous restructuring process. However, we show that the textile industry in developed countries does not necessarily have to suffer *exclusively* from the observed institutional and technological changes. Given that developed countries perceive of distinct path dependencies regarding structural properties of textile production, which beyond doubt is the case for such an 'old' industry, proves decisive in determining whether they suffer more or less from these changes.

In an international context, 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 from gross output and value added from 1995 to 2009. Concerning results of spatial trade patterns of value added and labour, our results from comparing trade of Italy and Portugal with regional blocks is also in line with other empirical papers such as Johnson and Noguera (2012). They found evidence that fragmentation occurs along regional blocks as both proximity and regional trade agreements are important drivers of location processes. For Portugal trade costs on average were twice as high as for Italy. Put differently, Italy during the transition phase had access to its trade partners more easily, whereas Portugal faced difficul-

ties to sustain its position in international textile trade of value added and labour due to easier access of low-wage countries to international distributors of textiles. Results for our two case study countries further proved significant as we show that the textile industry lost in importance for both of them. Quantitatively, this crystallised into a decreased gross output and strong declines in value added generation and employment. However, from a more qualitative point of view, Italy partly counteracted these slumps through adapting production and strengthening specialisation in value added-intensive production steps. This probably also led to an extension of its comparative advantage in high-level products. On the contrary, Portugal's textile industry in 1995 was heavily oriented towards labour-intensive production. Despite slight efforts existed to specialise more in value added-intensive textile production, the dominance of labour-intensive textile production caused its textile industry to suffer a lot from changes in the institutional and technological environment, going hand in hand with massive outsourcing processes.

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. This was also confirmed by some reports of the European Commission, such as Dachs et al. (2011) or Scheffer (2012). While Italy seemed to proceed in the right direction, Portugal's textile industry constitutes a textbook example of the negative effects of restructuring processes. We suggest that stabilizing the situation in either country's textile industry, however, requires taking country-specific action. We consider identifying structural characteristics of the textile industry in an international context as well as changes in economic structure specific to Italy and Portugal, to be a first step towards the formulation of effective policy measures.

Literature

Aiginger, K. and M. Pfaffermayr (2004), The Single Market and Geographic Concentration in Europe, in: *Review of International Economics,* vol. 12(1), 1-11.

Baldwin, R. (2006), Multilateralising Regionalism: Spaghetti Bowls as Building Blocs on the Path to Global Free Trade. in: *The World Economy*, vol. 29(11), 1451-1518.

Baldwin, R. (2012), *Global supply chains: Why they emerged, why they matter, and where they are going*, CEPR Discussion Papers 9103, C.E.P.R. Discussion Papers.

Baldwin, R. and J. Lopez-Gonzalez (2013), Supply-Chain Trade: A Portrait of Global Patterns and Several Testable Hypotheses, *NBER Working Paper 18957*, NBER, Cambridge MA.

Barigozzi, M., G. Fagiolo and D. Garlaschelli (2010), Multinetwork of international trade: A commodity-specific analysis. in: *Physical Review E* 81, 046104 (2010).

Beine, M. and S. Coulombe (2007), Economic integration and the diversification of regional exports: evidence from the Canadian-U.S. Free Trade Agreement, in: *Journal of Economic Geography*, vol. 7(1), 93-111.

Borgatti, S.P. (2005), Centrality and Network Flow, in: Social Networks vol. 27(1), 55-71.

Bosquet, C. and H. Boulhol (2015), What is really puzzling about the "distance puzzle", in: *Review of World Economics*, vol. 151 (1), 1-21.Brun, J.-F., Carrere, C., Guillaumont, P. and J de Meldo (2005), Has Distance Died? Evidence from a Panel Gravity Model, in: *World Ban Economic Review*, vol. 19 (1), 99-119.

Chaney, T. (2013), The Network Structure of International Trade, in: *American Economic Review,* vol. 104(11), 3600-3634.

Chortareas, G.E. and T. Pelagidis (2004), Trade flows: a facet of regionalism or globalization? in: *Cambridge Journal of Economics*, vol. 28(2), 253-271.

Coulter, P.B. (1989), *Measuring Inequality. A Methodological Handbook*, Westview Press.

Dachs, B., Zahradnik, G. and M. Weber (2011), *Sectoral Innovation Watch, Textile and Clothing Sector*, Final Sector Report, European Commission.

Daudin, G., Rifflart, C. and D. Schweisguth (2011), Who produces for whom in the world economy, in: *Canadian Journal of Economics*, vol. 44(4), 1403-1437.

Davis, D.R. (1998), The Home Market, Trade, and Industrial Structure, in: *American Economic Review*, vol. 88(5), 1264-1276.

De Benedictis, L., Nenci, S., Santoni, G., Tajoli, L., and C. Vicarelli (2014), Network Analysis of World Trade using the BACI-CEPII dataset, Banque de France Working Paper No. 471.

Dietzenbacher, E., Los, B., Stehrer, R., Timmer, M. and G. De Vries (2013), The Construction of World Input-Output Tables in the WIOD Project, in: *Economic System Research*, vol. 25(1), 71-98.

Erumban, A., Gouma, R., De Vries, G., De Vries, K. and M. Timmer (2012), *WIOD Socio-Economic Accounts: Sources and Methods.*

ESCAP World Bank (2015), International Trade Costs, World Bank 2015.

European Commission (2004a), *The Challenge of 2005: European textiles and clothing in a quota free environment*, High Level Group Report and First Recommendations.

European Commission (2004b), *Textiles and clothing after 2005 – Recommendations of the High Level Group for textiles and clothing*, Communication from the Commission to the Council, the European Parliament, the European Economic and Social Committee and the Committee of the Regions.

Feenstra, R.C. and G. Hanson (1996), Globalization, Outsourcing and Wage Inequality, in: *American Economic Review*, vol. 86(2), 240-45.

Fujita, M. and J.-F. Thisse (2006), Globalization and the Evolution of the Supply Chain: Who Gains and Who Loses, in: *International Economic Review,* vol. 47(3), 811-836.

Fujita, M. and J.-F. Thisse (2013), *Economics of Agglomeration. Cities, Industrial Location and Globalization*, 2nd ed, Cambridge, Cambridge University Press.

Hanson, G.H., Mataloni, R.J. and M.J. Slaughter (2005), Vertical Production Networks in Multinational Firms, in: *The Review of Economics and Statistics*, vol. 87(4), 664-678.

Harary F., Norman, R. and D. Cartwright (1965), *Structural Models: An Introduction to the Theory of Directed Graphs*, New York/London/Sydney: John Wiley & Sons, Inc.

Hummels, D., Ishii, J. and K.-M. Yi (2001), The nature and growth of vertical specialisation in world trade, in: *Journal of International Economics,* vol. 54(1), 75-96.

Johnson, R.C. and G. Noguera (2012), Proximity and Production Fragmentation, in: *American Economic Review*: Papers and Proceedings, vol. 102(3), 407-411.

Jones, R. and H. Kierzkowski (1990), The Role of Services in Production and International Trade: A Theoretical Framework, in: ch. 3 in Jones, R. and A. Krueger (eds.): *The Political Economy of International Trade, Festschrift in honor of Robert Baldwin, 31-48,* Oxford: Blackwells.

Kowalski, P. and M. Molnár (2009), Economic Impacts of the Phase-Out in 2005 of Quantitative Restrictions under the Agreement on Textiles and Clothing, *OECD Trade Policy Papers*, No. 90, OECD Publishing.

Krugman, P. (1991), Increasing returns and economic geography, in: *Journal of Political Economy,* vol. 99 (3), 183-199.

Los, B., Timmer, M. and G. De Vries (2014), *The Demand for Skills 1995-2008: A Global Supply Chain Perspective*, OECD Economics Department Working Papers, No. 1141, OECD Publishing.

Mayer, T. and S. Zignano (2011), Notes on CEPII's distances measures: The GeoDist database, CEPII Working Paper Nr. 2011-25.

Newman, M. (2004), Analysis of Weighted Networks, in: *Physical Review* E 70, 056131.

OECD (2012), *Mapping Global Value Chains*, Trade and Agriculture Directorate, Trade Committee.

Scheffer, M.R. (2012), *Synthesis Report for the European Textile and Clothing Sector,* Final Report ENTR/2010/16.

Stehrer, R. (2012), *Trade in Value Added and the Value Added in Trade*, WIOD Working Paper No. 8.

Stehrer, R., Foster, N. and G. De Vries (2012), *Value Added and Factors in Trade: A Comprehensive Approach*, wiiw Working Papers, No. 80, June 2012.

Stehrer, R. and R. Stöllinger (2013), *Positioning Austria in the Global Economy: Value Added Trade, International Production Sharing and Global Linkages*, FIW-Research Report, No. 2, October 2013.

Storper, M., Chen, Y. and F. De Paolis (2002), Trade and the location of industries in OECD and European Union, in: *Journal of Economic Geography*, vol. 2(1), 73-107.

Timmer, ed. (2012), *The World Input-Output Database (WIOD): Contents, Sources and Methods*.

Appendix

A.A Derivation of the ITTNs

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 matrix 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 adjacency matrices of the international textile trade networks, the identity given in $(A.A.1)$ is used as a starting point:

$$[Z + F]e = x \qquad (A.A.1)$$

In $(A.A.1)$, e corresponds to a summation vector of dimension $k \times 1$ and vector x of the same dimension denotes real gross output of the textile industry, which is composed of deliveries, first to intermediate, and second to final demand. In a next step, we concatenate matrices Z and F to a single matrix W of dimension $k \times k$, defined as $W \equiv [Z + F]$. Matrix W is then normalised along rows, to obtain output coefficients of intra- and international trade in the textile industry:

$$\overline{W} = diag(x)^{-1} W \qquad (A.A.2)$$

In $(A.A.2)$, $diag(\cdot)$ is used as the symbol for a diagonalised vector. One generic element $\overline{w}_{ih}$ of $\overline{W}$ defines the share of textile deliveries from country i to country h in country h's textile gross output.

As we decide to construct our networks on the basis of trade in value added and hours worked to dilute problems resulting from vertical specialisation, matrix $\overline{W}$ is modified once more. Fist, let v be a 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:

$$W^1 = diag(v)\overline{W} \qquad (A.A.3a)$$

$$W^2 = diag(l)\overline{W} \qquad (A.A.3b)$$

In $(A.A.3a)$ 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 $(A.A.3b)$ 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. System $(A.A.3)$, which shows intra-national and international trade flows of value added and hours worked generated within the textile industry, is already quite similar to our two adjacency matrices A^1 (mapping the ITTN in terms of traded value added) and A^2 (mapping the ITTN in terms of labour), except that self-loops finally have to be corrected for. This is finally accomplished by setting each element of intra-national trade equal to zero. More formally:

$$A^1 = W^1 - diag(w^1) \qquad (A.A.4a)$$

$$A^2 = W^2 - diag(w^2) \qquad (A.A.4b)$$

In $(A.A.4a)$, w^1 and w^2 correspond to vectors of dimension $k \times 1$ which include elements of the main diagonal of W^1 and W^2.

A.B Strength-Centrality

Since the adjacency matrices defined in $(A.A.4)$ are not symmetric in the case of a directed graph, one has to distinguish between in-strength and out-strength for each matrix, given by:

$$\mathrm{s}^{1,\mathrm{IN}} = \left(\mathrm{e}^{\mathrm{T}}\mathrm{A}^1\right)^{\mathrm{T}} \qquad (A.B.1a)$$

$$\mathrm{s}^{2,\mathrm{IN}} = \left(\mathrm{e}^{\mathrm{T}}\mathrm{A}^2\right)^{\mathrm{T}} \qquad (A.B.1b)$$

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

$$\mathrm{s}^{2,\mathrm{OUT}} = \mathrm{A}^2\mathrm{e} \qquad (A.B.1d)$$

In-strength $\mathrm{s}_{\mathrm{i}}^{\cdot,\mathrm{IN}}$ of a country i, as determined by $(A.B.1a)$ and $(A.B.1b)$, refers to the volume of imports of value added (labour) embodied in traded textiles, whereas out-strength $\mathrm{s}_{\mathrm{i}}^{\cdot,\mathrm{OUT}}$, calculated in $(A.B.1c)$ and $(A.B.1d)$ signalises exports of value

added (labour) embodied in traded textiles. The higher in-strength or out-strength for a single node in the ITTNs, the more important is its position in the respective ITTN.

A.C Trade Costs for Italy and Portugal with Country Clubs

	Trade Costs Italy		Trade Costs Portugal	
	1995	2009	1995	2009
World	102,01	87,36	208,46	183,03
	(.30)	(.34)	(.33)	.28)
Central Europe	64,63	56,44	97,50	82,36
	(.10)	(.27)	(.22)	(.35)
Periphery West and North Europe	87,06	86,42	130,29	107,93
	(.20)	(.09)	(.23)	(.41)
Periphery East Europe	98,46	62,82	210,20	118,68
	(.08)	(.20)	(.08)	(.29)
East Asia and Pacific Region	126,83	122,89	232,56	194,56
	(.04)	(.14)	(.21)	(.17)
Baltic and Eurasian Countries	144,38	101,53	230,91	167,79
	(.17)	(.22)	(.27)	(.18)
Americas	120,71	119,62	235,58	196,01
	(.18)	(.13)	(.20)	(.10)
China and India	126,32	108,71	256,67	206,10
	(.04)	(.07)	(.15)	(.21)

Trade Costs. Data from ESCAP database on International Trade Costs. The coefficients of variation for the respective clubs are reported in brackets. Missing data for 1995 were estimated by using data from 1996 and 1997.
Data for Taiwan are not available; therefore data for China were taken as a proxy.

A.D 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 and Pacific Region								
Australia	779	1,114	436	199	526	515	30	15

Indonesia	633	910	2	1	177	328	513	855
Japan	5,989	4,232	1,873	1,613	3,986	1,672	109	99
South Korea	1,639	1,133	4,127	1,321	821	408	851	145
Taiwan	701	360	2,506	1,042	198	102	359	181
Total 17t18	9,741	7,749	8,944	4,176	5,708	3,025	1,862	1,295
Central Europe								
Austria	1,255	1,224	895	1,132	189	157	32	25
Belgium	1,957	1,587	2,432	2,674	296	270	76	35
France	3,771	4,097	3,306	4,538	868	1,187	182	88
Germany	9,788	5,805	5,536	7,559	2,955	1,925	207	185
Italy	2,881	3,738	7,364	5,871	887	958	380	224
Netherlands	1,781	1,517	1,431	1,221	398	264	47	28
Slovenia	169	172	331	89	17	35	53	11
Spain	1,336	2,714	968	2,299	278	789	65	113
United Kingdom	3,725	4,308	3,342	3,245	1,281	1,438	122	82
Total 17t18	26,663	25,162	25,605	28,628	7,169	7,023	1,164	791
Periphery West and North Europe								
Denmark	865	413	774	431	258	98	27	11
Finland	359	448	233	216	87	96	10	7
Greece	766	946	482	256	82	117	47	19
Ireland	476	621	377	145	49	85	28	5
Luxembourg	102	128	203	167	5	4	2	3
Malta	56	39	40	14	6	2	3	1
Portugal	776	873	1,398	949	68	90	229	128
Sweden	896	699	291	371	257	149	13	16
Total 17t18	4,296	4,167	3,798	2,549	812	641	359	190
Periphery East Europe								
Bulgaria	15	78	57	12	2	9	53	104
Czech Republic	428	771	391	640	57	122	146	91
Hungary	175	492	168	100	19	37	74	70
Poland	264	1,304	1,149	1,735	25	314	479	293
Romania	347	1,044	401	46	23	80	424	426
Slovakia	82	340	137	335	24	71	56	57
Total 17t18	1,311	4,029	2,303	2,868	150	633	1,232	1,041
Americas								

Brazil	503	437	360	99	145	229	136	93
Canada	1,899	2,505	1,142	1,211	716	844	83	34
Mexico	1,253	1,662	1,024	547	123	244	502	800
United States	9,290	8,098	3,655	4,382	5,627	5,607	231	218
Total 17t18	12,945	12,702	6,181	6,239	6,611	6,924	952	1,145
Baltic and Eurasian Countries								
Cyprus	77	135	123	63	21	9	18	3
Estonia	74	84	57	88	12	18	33	21
Latvia	44	109	46	31	6	11	23	10
Lithuania	65	211	118	215	13	21	70	51
Russia	1,731	5,189	123	2	346	1,742	183	12
Turkey	490	4,752	3,303	195	219	2,169	638	364
Total 17t18	2,481	10,480	3,770	594	617	3,970	965	461
China & India								
China	3,482	3,188	8,276	19,696	489	448	10,408	9,504
India	220	481	2,265	3,210	87	149	4,706	8,386
Total 17t18	3,702	3,669	10,541	22,906	576	597	15,114	17,890

Note that value added is expressed in constant millions of US-$, where 1995 = 100. Employment is expressed in million hours worked