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GLOBAL VALUE CHAINS AND LABOUR IN THE BALTICS AND EASTERN EUROPE

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Abstract

In this paper, I investigate the effect of globalization of production associated with changes in labour composition by skill types in the Baltics and Eastern Europe for 1995-2011.More specifically, I first examine the level and direction – global versus regional – of production fragmentation as a result of the rise of global value chains. Then I consider employment structure changes of low, medium and high skilled labour and compare the developments with the core European Union and other developed countries. For my analysis, I apply the input-output model analysis based on data from World Input-Output Database.

I find that production fragmentation in the Baltics and Eastern Europe is twice as high as in the world on average. Regional integration in value chains, especially with other European Union countries, is still prevalent; however, global dimension gains strength in a much faster manner. Changes in labour composition by skill types associated with increasing production fragmentation are detrimental to low skilled labour. Share of low skilled labour contribution to world final use of manufacturing goods decreases both in manufacturing and service sectors. Yet, relative to Western Europe and other developed countries, the decline is much less pronounced.

I finish with a conclusion that the Baltic and Eastern European countries are relatively more abundant in low skilled labour compared to the core European Union countries, thus having a comparative advantage in low skilled tasks and activities. Absolute wage disadvantage and higher labour mobility in these countries are likely to trigger brain drain of the medium and high skilled to the core European Union countries. As a result, the economies could suffer as skilled workers are critical for productivity, economic growth and innovation.

1. Introduction

Globalisation has permanently changed the way how we see international trade today. Pervasive trade liberalisation combined with increasingly open economic policy directions have paved the way for a more integrated world. Developments in transport and communication technology and subsequent fall in respective costs have given further rise to globalisation and international fragmentation of production. All these effects combined have led to a rapid expansion of world trade. In 1995, the world trade as a percentage of gross domestic product was 77% while already ten years later in 2014 it had increased by 15 percentage points reaching 92% of gross domestic product (World Trade Organization, 2016).

Not only has world trade substantially increased, global value chains have emerged as a result of globalisation. Global value chains stand for *the full range of activities undertaken to bring a product or service from its conception to end use and how these activities are distributed over geographic space and across international borders* (Sydor, 2011). In other words, few goods and services today are produced in one location only and then delivered straight to a final user. A good or service is rather produced in several stages where some value is added in each of a number of locations; i.e. a value chain is *sliced up* (Krugman, Cooper, Srinivasan, 1995).

Slicing up of a value chain revolves around an opportunity for companies to become more efficient and lower costs in a world where competitiveness in international markets determines survival. Even though companies could become more competitive through sourcing from more effective domestic producers, in many occasions it is not the best alternative (Organization for Economic Cooperation and Development, 2007). Thus, production fragmentation through offshoring to foreign countries has arisen. Production fragmentation has, in turn, caused an explosion in trade in intermediate goods as often firms offshore an intermediate stage of production process. This is highly typical to manufacturing industries (Timmer, Los, Stehrer, and Vries, 2013a); however, services are often overlooked, but also play a major role, particularly supporting global value chains through communications, finance, information and other business services (Kommerskollegium, 2013).

Production fragmentation has made the analysis of the processes of trade and production more complicated. Not only has a new measurement “trade in value added” been

created, but also the nature of trade has shifted from goods to tasks or activities performed by production factors such as labour and capital (Feenstra, 2010). Such changes have led to a necessity to rethink the application of the concept of comparative advantage.

This context is very important for Eastern European countries[1] since transition of their economies and access to the European Union as well as further global integration has affected Eastern European production patterns and labour markets. Yet, very little attention has been paid to Eastern European region in the context of global value chains. My contribution to the literature is through assessment of how production fragmentation in world final use of manufacturing goods[2] has affected labour market structure in Eastern European countries from 1995 to 2011. I use input-output analysis, focusing specifically on manufacturing industries as they are regarded as a leading indicator of nature of world trade in global value chains (Baldwin, 2006).

For the analysis, I use input-output model with the fundamental input-output identity developed by Wassily Leontief (1936). This framework regained acclaim in recent economic analysis (e.g. Timmer et al., 2013a) as world input-output databases became increasingly available. I use data from World Input-Output Database which consists of world input-output tables and complementary socio-economic accounts with information on production factors for years 1995-2011, 40 countries and 35 industries.

My first objective is to study the level of production fragmentation in Eastern European countries and the nature of fragmentation (global versus regional). While many authors before have already concluded that production fragmentation increases, I attempt to benchmark the level of fragmentation compared to processes in the world. Taking into account that production fragmentation alters the patterns of trade, policy makers might reconsider the existing trade policies.

My second objective is to assess how trade integration can be associated with employment structure changes in Eastern European labour used by skill types (low, medium and high skilled) to produce world final use of manufacturing goods. Most of the studies before have focused on effects of trade integration on the core European Union member state

[1] Eastern European countries in this paper are classified as follows: Baltic countries – Estonia, Lithuania, Latvia; Central European countries – Czech Republic, Hungary, Poland, Slovakia; South Eastern European countries – Bulgaria, Romania, Slovenia.

2 It is necessary to look at world final use of manufacturing goods because it allows to precisely trace back value added in final goods by avoiding double counting through intermediate goods (Benkovskis, Woerz, 2015).

labour markets. However, as of writing this paper, no other work which focused on Eastern European labour market skills distribution, imposed by globalization process, was available, especially in comparison to the old European Union member states. Given the flexibility of Eastern European labour markets, policy makers might be interested in the trends of skills distribution in order to introduce necessary educational and labour market reforms (Svejnar, 2002).

Following this, my research question is as follows: How has the rise of global value chains affected low, medium and high skilled labour in Eastern European countries?

The remainder of the paper is structured as follows: section two outlines my hypotheses in presence of previous literature; section three outlines input-output model and respective data; section four presents results on production fragmentation and labour hour contribution developments; section five puts results in context of trade theory; and section six concludes the paper.

2. Review of literature

2.1 Global value chains in classical trade theories and models

David Ricardo back in 19th century introduced a concept of comparative advantage in trade, saying that countries will specialize in producing that good in which they have a comparative advantage. In Ricardian model, differences in technology determined comparative advantage of one or another country. Heckscher-Ohlin model used the same comparative advantage concept only they argued that differences in factor endowments (labour versus capital) determined comparative advantage through advantageous relative costs of a particular factor.

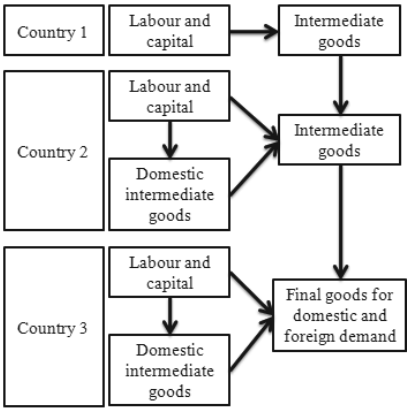
Global value chains (GVCs) are driven by the same concept of specialization or comparative advantage. Feenstra and Hanson (1999) use a slightly modified version of Heckscher-Ohlin model to study reduction in relative employment and wages of low skilled labour in the U.S. in 1980's. What authors do is they separate the process of production in several activities as if it occurred within a single industry. The activities, thus, happen where they can be most efficiently carried out. Grossman and Rossi-Hansberg (2008) further extended activities to tasks, which are disaggregated activities, thus paving the way for analysing the effects on labour by skill intensity.

What arises from development of GVCs is that it becomes increasingly harder to determine who reaps the benefits and who suffers from GVCs. That, in turn, contributes to uncertainty for labour and difficulty for policy makers to predict and prepare the type of necessary labour market and trade policies in order to cope with possibly negative effects of globalization.

2.2 Evidence of international production fragmentation

Over the past twenty years, empirical data has continuously shown stronger support for the existence of international production fragmentation. Figure 1 shows a simplified schematic outline of international production fragmentation. Many authors have examined and shown that the share of imported intermediates used in production of domestic exports also known as foreign value added (VA) in domestic exports has been increasing.

Figure 1. A simplified depiction of international production fragmentation.



Source: Hummels, Ishii and Yi (2001) and Timmer, Los and Vries (2014b) and author's adaption.

Hummels et al. (2001) present one of the first and well-known attempts to tackle international production fragmentation. The authors conceptualize vertical specialization as a proxy for production fragmentation. They develop an accounting framework to estimate vertical specialization share of total exports, in other words, the share of imported intermediate inputs or foreign VA in domestic exports. Using input-output tables, Hummels et al. (2001) depict vertical specialization of ten Organization for Economic Cooperation and Development countries and four emerging countries. They uncover that from 1970 to 1990 the vertical specialization share of total exports in the studied countries grew by 30%. In a more recent example, Bems, Johnson and Yi (2011) assess the extent to which vertical linkages (international trade in intermediate goods) were responsible for the Great Recession of 2008-2009. Similarly to Hummels et al. (2001), the authors present a framework for accounting for vertical linkages but they use Leontief production functions and consumer preferences. Their conclusion is that the net effect of vertical linkages significantly worsened the extent to which the crisis prevailed.

Particular attention in studying international production fragmentation has been drawn to countries such as the United States, Germany and China. Feenstra (1998) uses a set of measures characterizing foreign outsourcing, e.g. trade to VA imports of multinational firms and imported intermediate inputs. The author shows the share of imported intermediate inputs to total intermediate inputs in all manufacturing industries in the United States doubled from 4.1% to 8.2% in the period from 1974 to 1993. The increase in individual industries, e.g. non-electrical industrial machinery, is even more pronounced where the share of imported intermediate inputs almost tripled from 4.1% to 11% in the same time period. Sinn (2006)

disentangles an export puzzle where Germany is among world's top exporters while the economy stagnates. He attributes this to a finding that the country adds an increasingly lower domestic value to the goods it exports stemming from excessive wages in Germany compared to Eastern Europe to which Germany offshores (the import share of Germany's exports increased from 27% in 1991 to 39% in 2002). Chinese export structure has been studied by Koopman, Wang and Wei (2012) and others. For example, Koopman et al. (2012) estimate foreign VA in Chinese manufacturing exports from 1997 to 2002. They use and improved accounting framework of Hummels et al. (2001) with Leontief's input-output equations. While Hummels et al. (2001) assumed that the share of imported inputs is the same for production of exports and domestic goods, Koopman et al (2012) refute the assumption by claiming that importing intermediates is pervasive in China. The results show that foreign VA in Chinese exports are 50% which is twice as high as what would be obtained by using Hummels et al. (2001) framework.

Manufacturing industries are a typical target of international production fragmentation studies due to their international contestability (Timmer, et al., 2013a). Manufacturing industries have been investigated by already mentioned Koopman et al. (2012) as well as Johnson and Noguera (2012a), Timmer et al. (2013a) and Timmer, Erumban, Los, Stehrer and Vries (2014a). Johnson and Noguera (2012a) develop a framework for transforming gross export flows to VA flows in order to present a VAX ratio (domestic content of exports). They find that VAX ratios are significantly lower for manufacturing industries compared to service ones. The conclusion is that manufacturing industries increasingly use intermediate inputs from other sectors, including service sectors. Similarly, Timmer et al. (2013a, 2014a) claim there is substantial international production fragmentation in manufacturing industries across Europe with foreign VA in production of manufacturing goods increasing rapidly since 1995. By using an accounting method to obtain VA trade, Timmer et al. (2013a) finds that service industries, e.g. business services, significantly contribute in form of intermediate inputs to production of manufacturing goods.

Although there is a growing consensus on international production fragmentation particularly in manufacturing industries with strong evidence from various countries, some scholars remain unconvinced. Alongside with the international production fragmentation hypothesis several authors have developed alternative explanations in favour of regional production fragmentation. Johnson and Noguera (2012b) suggest that trade within a certain geographical region is fragmented to a greater extent compared to the trade with countries

outside that region. They show that VA to gross exports (VAX ratio, see above) for Europe is persistently smaller over time if trade only inside Europe is taken into account. Baldwin and Lopez-Gonzalez (2014) strongly claim that international value chains are regional rather than global. By examining I2E (import to export) and I2P (import to produce) trade patterns in countries available in the World Input-Output Database they name the United States, Germany and China as regional hubs. A similar conclusion is drawn by Sturgeon, Biesebroeck and Gereffi (2008) who study the global automotive industry. They apply GVC analysis from governance, power and institutional perspectives. The authors infer that regional production integration is the prevailing trend in that industry. The authors of Timmer et al. (2014a) note that the international production fragmentation is not complete. They argue that foreign VA within value chains is more likely to originate from countries in geographical proximity or in the same trading bloc (Timmer, Los and Vries, 2013b). However, they also conclude in the same study that international production fragmentation has progressed to a higher degree relative to its regional equivalent.

Most of the studies on production fragmentation in Eastern European (CESEE) have focused on regional (East-West) integration. Cieslik (2014) studies post-Soviet CESEE countries and their integration in GVCs. The author concludes that countries are increasingly integrated in GVCs but in many cases through connections to Western Europe, Germany in particular. By using methodology from Koopman et al. (2012) and World Input-Output Database, Amador, Cappariello and Stehrer (2015) contrarily argue for continuous stronger regional integration among European countries. Similar conclusions are drawn by Iossifov (2014) who employs the same methodology as Amador et al. (2015). But the author further claims that CESEE countries have formed value chains among themselves as CESEE countries are top trade partners to other countries of the region.

I recognize both the hypothesis for international production fragmentation globally, supported by a majority of papers, as well as the alternative hypothesis for regional production fragmentation. Since the consensus inclines towards global production fragmentation, my first hypothesis for production fragmentation in CESEE is as follows: (1) production fragmentation prevails in Eastern European countries and (2) they are integrated in the value chains globally rather than regionally.

2.3 Impact of international production fragmentation on employment and labour composition

Empirical data has continuously shown that production fragmentation has a persistent effect on labour composition in the countries which offshore inputs. However, consensus is lacking on the direction and extent of its effects. In general, Gorg and Hanley (2005) as well as Crino (2009) present intuitively comprehensible results of offshoring exhibiting negative effects on employment. Gorg and Hanley (2005) examine plant-level data on the Irish electronics industry in generalized method of moments regression analysis and conclude that offshoring has significant negative short run effects on domestic labour demand. The results hold even in case of employee mobility within the industry. Crino (2009) distinguishes between material and service offshoring of multinational companies and conclude that both material and service offshoring have negative effect on employment. While material offshoring increases the risk of job losses, the effect of services offshoring on employment is negative but essentially negligible.

A contrarian view originates from Mitra and Rajan (2010) study. The authors employ a two sector general equilibrium model with labour mobility and search frictions in order to examine how offshoring influences sectoral level and whole economy's unemployment level. They find that offshoring has a positive effect on unemployment on both sector and economy wide levels associated with increased productivity and reduced costs due to offshoring. However, these positive effects hold true in presence of inter-sector labour mobility. In case inter-sector labour mobility is restricted, the positive effects are reversed.

Several authors have investigated the effect not only on employment but also on employment by skill levels in manufacturing and services. The results with respect to labour composition by skills coincide in most of studies. Feenstra (1998), Crino (2009), Timmer et al. (2013a, 2014a) depict negative effects of offshoring on low skilled workers in developed countries. Feenstra (1998) argues that offshoring contributes to lower relative demand for the unskilled and enhanced skill intensity in a developed country as the offshored activities are unskilled relative to average skill level in the country. Also, both Feenstra (1998) and Crino (2009) make a similar conclusion that offshoring, especially service offshoring in Crino (2009) study, favours more skilled workers in developing countries as offshored activities from developed countries are perceived as relatively skilled to developing countries' workers.

Although Timmer et al. (2013a, 2014a) argue similarly as above mentioned authors, he presents several important differences. First of all, Timmer et al. (2013a) conclude that international production fragmentation does not lead to total job destruction in advanced countries. He shows that decline in direct and indirect low-skilled employment associated with manufacturing industries due to offshoring is offset by an increase in direct and indirect jobs involved in service industries which are high skilled in nature. Secondly, international production fragmentation has a widespread effect on distribution of factor income across and within countries (Timmer et al., 2013a, 2014a). Developed countries, e.g. the EU 15, increasingly specialize in activities carried out by medium and high skilled workers.

With respect to evidence on changes in employment and labour composition in CESEE as a result of offshoring, majority of papers examine how fragmentation and offshoring to CESEE countries affect employment in developed countries; however, something can be inferred about processes in CESEE as well. Such papers are Geishecker (2006), Kandilov and Grennes (2010), Marin (2010) and Gal (2009). Geishecker (2006) using general method on moments demonstrates offshoring to CESEE countries hurts low skilled (manual) workers in Germany's manufacturing industries during 1990's. Kandilov and Grennes (2010) who study service exports from Western Europe to CESEE also claim that offshored services are usually less skill intensive. Marin (2010) studies offshoring to CESEE by Germany and Austria and its effects on employment by using survey data from 660 firms. The author acknowledges that recently the discussion about impact of offshoring has extended to high skilled workers. Indeed, the author uncovers that offshoring affects job losses but they are minor (less than 0.5% of total employment in Germany and 1.5% – in Austria). In turn, Marin (2010) argues that, at such small costs, offshoring increases German and Austrian firm competitiveness. Similarly, Gal (2009) recognizes that increasingly more skill intensive tasks are offshored to CESEE because of convergence to the old EU countries while preserving lower costs; however, the author abstains from assessment of the trend. On contrary, while Jurgens and Krzywdzinski (2009) findings about low skilled job losses in Germany's automobile industry coincided with the ones of Geishecker (2006), the authors concluded that the effect on overall employment is positive. Similar to Marin (2010), the authors say that offshoring contributes to German firm competitiveness.

Taking into account mixed evidence of the impact of international production fragmentation on employment and labour composition my second hypothesis is as follows: (1) international production fragmentation can be associated with a negative distributional

effect on the employment of the low skilled workers in Eastern Europe but (2) it is much less pronounced compared to processes in the Western Europe (and other developed countries). The hypothesis is derived on an assumption that developments in European countries, especially the European Union members, among which are CESEE countries as well, converge over time.

2.3.1 Drivers of employment structure changes by skill level

Many authors have tried to decompose employment structure changes by skill level in order to uncover the drivers of the observed processes in international trade. There are three proposed drivers of changes: technological advancement, changing trade patterns and consumption (sometimes also investment). The first two have brought about heated debates among scholars for which driver is the dominant one. Consumption as a driver for compositional changes in labour patterns is present but has been rarely and poorly acknowledged.

Berman, Bound and Griliches (1994), Bernard and Jensen (1997) and Timmer et al. (2014b) argue that the main driver of structural changes has been technological improvements. Berman et al. (1994) using Annual Survey of Manufactures study U.S. manufacturing over 1980's. They find a strong positive correlation between skill upgrading from unskilled to skilled and investment in computer technology and research and development. Timmer (2014b) also finds that downward pressure on low skilled and medium skilled workforce in developed countries stem from advances in technology. However, he concludes that changing trade patters significantly reinforce the effects brought about by technological improvements.

Feenstra and Hanson (1995), Wood (1995) and Sachs, Shatz, Deardorff and Hall (1994) all represent supporters of trade pattern modifications as a driver of labour composition changes. In a theoretical model, Feenstra and Hanson (1995) examine outline that trade has an effect on employment through the extent to which high skilled and low skilled labour is contained in imports. Thus, a shift away from the unskilled (production) labour is explained by increasing share of imports. On average, all of the above mentioned authors compute that trade accounts for one fifth to one fourth of decline in employment on the unskilled over a time period from 1950-1990's.

Unlike other authors mentioned in 2.2.1 section, Timmer et al. (2014b) presents some evidence on consumption effect as well as developing countries using structural

decomposition analysis for 1995-2008. Regarding the consumption effect, Timmer et al. (2014b) conclude that it positively affects demand for labour of all skill levels in both advanced and emerging countries. However, consumption effect is not strong enough to counter the negative effect on the low skilled rooting from the remaining two effects. The evidence for developing countries is more ambiguous as compared to developed countries case. Technological advancement and consumption aspects yield the same results as in the developed countries cases. On contrary, the trade pattern hypothesis does not amplify the effect from improvement in technology. For developing countries, changing trade patterns induce an increase in lower skilled jobs.

3. Methodology

Globalization and respective rise of global value chains (GVCs) has changed the nature of international trade. Trade in tasks as outlined by Grossman and Rossi-Hansberg (2008) has substituted traditional trade in products. Such major transformations call for adjustments to collection of trade statistics as it has been known by now. However, official trade statistics still fail to provide information on supplying industries and use of imports (Timmer, Dietzenbacher, Los, Stehrer, and Vries, 2015). Thus, a new "movement" of compiling databases for GVC analysis in form of input-output (I-O) tables has arisen. I use one such database – World Input-Output Database (see section 3.1 for further details).

The first high impact paper which used I-O model to analyse the changing patterns of international trade was authored by Hummels et al. (2001). Since then, rise of trade statistics in I-O form and continuous improvements of data have allowed describing and analysing trends in global supply chain trade (Timmer et al., 2015). Some of the examples of supply chain trade analysis include Baldwin and Lopez-Gonzalez (2014) as well as Timmer et al. (2013a). Another important analysis aspect empowered by I-O model is domestic value added (VA) in gross exports. Examples of this kind of research include Koopman et al. (2012 and 2014) as well as Johnson (2014). Recently the analysis has also shifted in direction of labour market implication in presence of GVC. Timmer et al. (2013a, 2014b) are one of the pioneers for this research perspective.

Databases are in I-O table form due to substantial practical advantages. I-O tables have been developed as they can be combined with I-O analysis (Timmer, Dietzenbacher, Los, Stehrer and Vries, 2014c). It was first developed by Wassiliy Leontief in 1936 (Leontief, 1936). After Leontief (1936), such authors as Isard (1951), Moses (1955) and more recently Blair and Miller (1985, 2009) have contributed in developing and explaining the I-O model. Use of I-O analysis is highly practical because the method allows accounting for direct and intermediate inputs in production through links across countries and sectors. In addition, the methodology allows observing factor inputs required to produce final demand. Thus, in order to decompose VA in production as well as labour hours used in production of world final use of manufacturing goods, Leontief's fundamental I-O identity is used in vast majority of GVC research papers, including this one. It should be noted that the outlined model is an accounting framework, not an economic model. However, accounting identity framework approach is well accepted among scholars and has been used in many papers published in top

economic journals (e.g., Grossman, Rossi-Hansberg, 2008, Bems, Johnson, Yi, 2011, Koopman, Jang, Wei, 2014 have published in the American Economic Review.).

I will follow the recent approach of Timmer (2013a, 2014a) which is built on Johnson and Noguera (2012a) and previously mentioned studies in order to perform GVC analysis. In the following sub-section, I first introduce the data available to me in order to explain the concept of I-O framework better. Then in sub-section 3.2 I introduce the I-O model and present the accounting framework decomposition needed to perform GVC analysis.

3.1 Data

In order to carry out my analysis, I use the recently compiled data publicly available on World Input Output Database (WIOD)[3]. I use two sets of data for my analysis: world input-output tables (WIOT) and socio-economic accounts (SEA). WIOT is solely used for production fragmentation and VA calculations while WIOT together with SEA are used for computations of labour hours used in production of world final use of manufacturing goods.

The database has time series data of WIOT covering the EU 27 countries and 13 other major world economies for a time period from 1995 to 2011 (Figure A.1 in Appendix A). The countries featured in the database cover approximately 80% of world's gross domestic product in 2008 (Timmer, 2014a). In order to make the I-O analysis feasible, the remaining countries are united in an additional fictional country called "Rest of World". Additionally, each country is broken down in 35 industries based on Statistical Classification of Economic Activities in the European Community (NACE) revision 1.1 (Figure A.2 in Appendix A). The main data sources are national supply and use tables merged together with national accounts data and bilateral international trade data (see more in Timmer, 2012). The crucial information available in WIOT is as follows: intermediate consumption by country industries, VA by country industries, final consumption by five major categories (e.g., households and government) and total output. A schematic representation of a WIOT can be seen in Figure 2.

[3] www.wiod.org

Figure 2. Schematic Representation of a World Input-Output Table.

			Intermediate use				Final use						Total use
			Country 1		Country M		Country 1			Country M			
			Industry 1	Industry N	Industry 1	Industry N	Households	Government	Firms	Households	Government	Firms	
Supply	Country 1	Industry 1											
		Industry N											
	Country M	Industry 1											
		Industry N											
Value added by labour and capital													
Total output													

Source: Timmer et al. (2015) and author's adaption.

The tables can be read in the following way. Columns represent use of production in country industries. Products can be used as intermediate inputs in further production locally or outside country's borders or as final products to satisfy domestic or foreign final demand of households, government or firms. Rows of the table, on the other hand, show origins of the above mentioned intermediate or final products or country industries. Importantly, I-O model carries with itself an important identity: total output in each country industry equals total uses of output from that industry (Timmer et al., 2015).

WIOD also provides complementary socio-economic accounts (SEA) data on factors of production. In this paper, I will overlook capital and consider labour only, which could impede with the results. SEA covers the same countries and industries as WIOT. Unfortunately, data in SEA is available only up to year 2009. The main data source for SEA is European Database of Capital, Labour, Energy, Material and Services (known as EU KLEMS) (Timmer, 2012). But it is thoroughly extended to a larger set of countries by the same methodology as EU KLEMS[4]. The crucial information available at SEA is hours worked by employees of different skill type (reported as a share in total hours). Skill types are classified as low skilled, medium skilled and high skilled. A proxy for skill level is educational attainment (Timmer et al., 2013a). Educational attainment is derived from International Standard Classification of Education (ISCED). Skill levels are classified as follows: low skilled workers correspond to ISCED categories 1 and 2 as level of education, medium skilled workers – to ISCED categories 3 and 4 as level of education and high skilled workers – to ISCED categories 5 and 6 (Timmer, 2013a).

However, data in I-O form has several drawbacks, which could affect reliability of the results. First of all, availability of recent data is an issue. Collection and processing of input-

[4] EU KLEMS database originally contains data on 15 OECD countries.

output data on such a large scale is very time consuming which is reflected in data availability (2011 for value added analysis while 2009 for labour accounts analysis). Secondly, construction of input-output tables requires making several improvable assumptions (Timmer et al., 2015). Some examples include import proportionality assumption across industries and homogeneity of production across industries.

3.2 Decomposition of the input-output analysis

In a setting where many countries are present, the I-O model is in a matrix form. As to dimensions, N denotes countries, S – sectors and F – production factors. Each sector produces one good so S × N denotes total products in the world economy. I define *i* as the source country, *j* as the destination country, *s* as the source sector and *t* as the destination sector in order to account for flow of intermediate and final goods across sectors and countries. Further I assume that output in each sector equals use so market clearing condition holds as follows:

$$y_i(s) = \sum_j f_{ij}(s) + \sum_j \sum_t m_{ij}\,(s,t) \quad (1)$$

where $y_i\,(s)$ represents output in country *i* sector *s*, $f_{ij}\,(s)$ represents goods produced in sector *s* for final use in a country *j*, $m_{ij}\,(s,t)$ represents goods produced in sector *s* for intermediate use in a country's *j* sector *t*. In case *i* = *j*, respective goods are used domestically. Namely, total output equals total consumption: intermediate plus final use.

The market clearing condition (1) can be presented in a comprehensive global I-O system using matrix algebra as follows:

$$\begin{pmatrix} \boldsymbol{y_1} \\ \boldsymbol{y_N} \end{pmatrix} = \begin{pmatrix} \boldsymbol{A_{11}} & \cdots & \boldsymbol{A_{1N}} \\ \vdots & \ddots & \vdots \\ \boldsymbol{A_{N1}} & \cdots & \boldsymbol{A_{NN}} \end{pmatrix} \times \begin{pmatrix} \boldsymbol{y_1} \\ \boldsymbol{y_N} \end{pmatrix} + \begin{pmatrix} \sum_j \boldsymbol{f_{1j}} \\ \sum_j \boldsymbol{f_{Nj}} \end{pmatrix}$$

where $\boldsymbol{y}$is an ((S × N) × 1) vector which contains output in each country's each sector. $\boldsymbol{f_n}$ is a an ((S × N) × (S × N)) diagonal matrix which contains final demand of all countries for output from each country's each sector where n^{th} element is global demand of goods from country's sector *n*.$\boldsymbol{A}$ is an ((S × N) × (S × N)) matrix which contains intermediate input coefficients. Each coefficient $\boldsymbol{A_{ij}}$ is an (S × S) matrix consisting of $a_{ij}\,(s,t)$ elements. Each element represents country *i* sector *s* output which is used as an intermediate input in country *j* sector *t* as a share of total output in country *j* sector *t*. Thus, diagonal sub-matrices show

domestic intermediate inputs and foreign intermediate inputs are the rest. $A \times y$represents total intermediate inputs used.

The above market clearing condition in a matrix form can be transformed to obtain Leontief's I-O identity (2) as follows:

$$y = A \times y + f_n$$

$$I \times y - A \times y = f_n$$

$$(I - A) \times y = f_n$$

$$\boldsymbol{y} = (\boldsymbol{I} - \boldsymbol{A})^{-1} \times \boldsymbol{f_n} (2)$$

In this identity, $\boldsymbol{I}$ is an ((S × N) × (S × N)) matrix where there are ones on the diagonal and the rest are zeros. $\boldsymbol{I}$ is known as the identity matrix. $\boldsymbol{(I - A)^{-1}}$ is known as Leontief's inverse. Each element is this matrix shows the total contribution of a sector in various production stages in producing one unit of final output of a product. This can be shown as follows. Let $\boldsymbol{z_n}$be a column vector where all elements are zero, except for element *n* which represents final use of products from country industry *n*. Thus, to produce $\boldsymbol{z_n}$, intermediate inputs are needed which can be represented as $\boldsymbol{A \times z_n}$. Then to produce intermediate inputs $\boldsymbol{A \times z_n}$, $\boldsymbol{A^2 \times z_n}$intermediate inputs are needed, etc. In the end, final use or output in industry *n* is a sum of all direct and indirect inputs $\sum_{k=0}^{\infty} \boldsymbol{A^k \times z_n}$which converges to $\boldsymbol{(I - A)^{-1} \times z_n}$.

Since I am interested in VA by each country's each sector to the final demand of a product, I create $\boldsymbol{p_n}$which is a diagonal vector consisting of direct VA coefficients, which are VA per one unit of gross output in country *i* sector *s*, on the diagonal denoted as $p_i\,(s)$. Thus, I can arrive at the final identity (3) as follows, where $\boldsymbol{v_n}$ is VA by country's *i* sector *s* per one unit of final demand:

$$\boldsymbol{v_n} = \boldsymbol{p_n} \times (\boldsymbol{I} - \boldsymbol{A})^{-1} \times \boldsymbol{f_n} (3)$$

I will also analyse a production factors – labour – involved in producing one unit of final demand. In that case $\boldsymbol{p_n}$represents direct labour input coefficients, which are direct hourly labour input per one unit of gross output in country *i* sector *s*, defined as $p_i\,(s)$. In a similar manner, $\boldsymbol{v_n}(3)$ represents labour hours used in production of final use by country *i* sector *s* per one unit of final demand.

4. Analysis of results

In this section I conduct a positive analysis of empirical results where I describe the results obtained. First, I start by analysing production fragmentation patterns in Eastern European (CESEE) countries. Then I move on to an analysis of CESEE country labour hours used in production of world final use of manufacturing goods (hereinafter: labour contribution).

4.1 Production fragmentation in Eastern European countries

In this section I analyse the extent of production fragmentation in CESEE countries in order to answer my first hypothesis: (1) production fragmentation prevails in Eastern European countries and (2) they are integrated in the value chains globally rather than regionally.

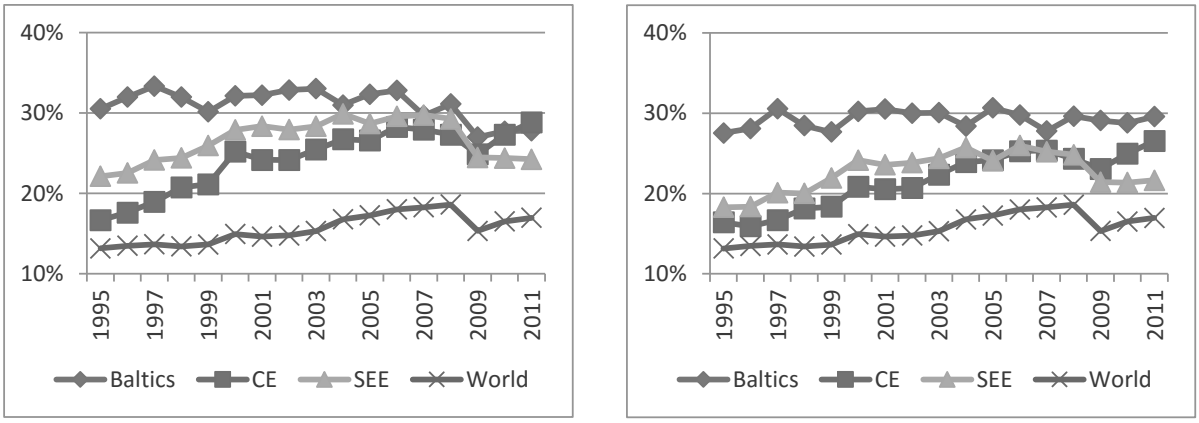
In order to analyse the degree of production fragmentation, I first use a broad outsourcing measure developed by Feenstra and Hanson (1999)[5]. I use the measure to estimate the share of imported intermediate inputs in total intermediate inputs used by a particular country industry (backward trade) as well as share of exported intermediate inputs in total intermediate inputs supplied (forward trade). Figure 3.A and 3.B show the obtained results for CESEE country clusters such as the Baltics, Central Europe (CE) and South Eastern Europe (SEE) over the period studied[6].

In comparison with the world average, production fragmentation is around twice as prevalent in CESEE countries (Figure 3.A and 3.B). Back in 1995, the Baltic countries had a more widespread use and supply of foreign intermediates compared to other CESEE clusters (30% versus 15-20% for CE and SEE). Backward and forward trade in intermediate inputs has grown faster both for CE and SEE over the period of 1995-2011. For CE countries backward and forward trade in intermediates has close to almost doubled while for SEE countries it had increased by a third up to 2008. On the contrary, both backward and forward trade for the Baltic countries has remained steady at around 30% up to 2008. A drop in 2009 for the Baltics and SEE can be associated with the global recession which affected trade in intermediate inputs particularly (Bems et al.,2011).

[5] I use the particular measure as it corresponds to the data available.
[6] Baltics – Estonia, Latvia, Lithuania, Central Europe (CE) – Czech Republic, Hungary, Poland, Slovakia, South Eastern Europe (SEE) – Bulgaria, Romania, Slovenia.

Figure 3. Intermediate inputs as a share of total intermediate inputs in the Baltics, Central Europe and South Eastern Europe.

3.A (left): Imported intermediate inputs as a share of total intermediate inputs used by the Baltics, Central Europe and South Eastern Europe and world. 3.B (right): Exported intermediate inputs as a share of total intermediates supplied by the Baltics, Central Europe and South Eastern Europe and world.



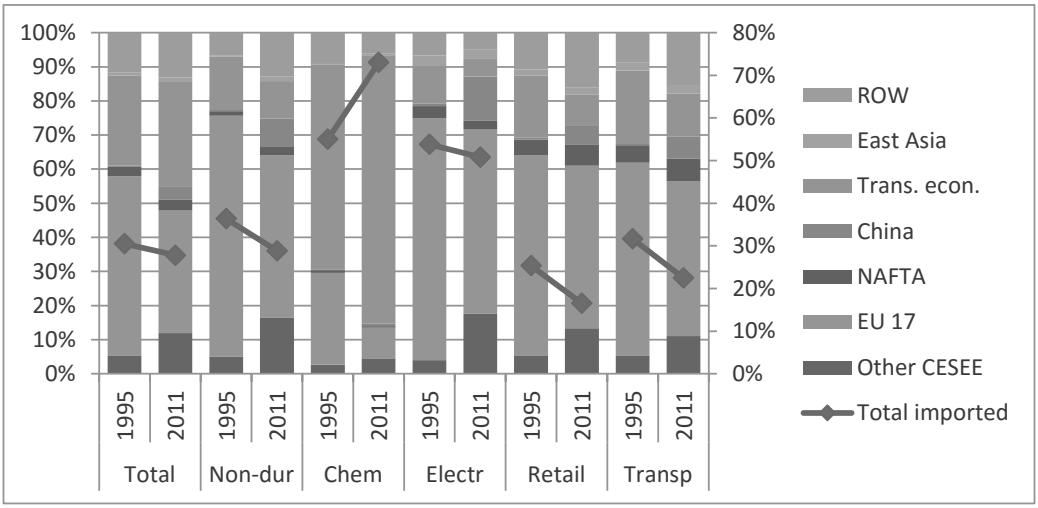
Source: World Input-Output Database (WIOD) and author's calculations.

My conclusion of increased production fragmentation is in line with Hummels et al. (2001), who found that imported intermediate input share increased by a third over 1970-1990 in ten Organization for Economic Cooperation and Development (OECD) and four developing economies. A similar increase can be observed for SEE countries over 1995-2011 while for CE countries the increase has been much more rapid. Hummels et al. (2001) further explained that heterogeneity characterized the levels of imported intermediate shares across countries with smaller countries exhibiting higher initial shares. While I can confirm Hummels et al. (2001) hypothesis for the beginning of the period studied, it does not hold for the end of the period. Indeed, in 1995 the Baltic countries (which were the smallest economies GDP-wise) had the highest use and supply of foreign intermediates' share. However, by 2011 CE and SEE had managed to catch up with the Baltics, thus reflecting swiftly increasing competitiveness of CE and SEE (Burnete, 2015). The Baltics have not been able to keep up in this respect.

The obtained results indicate that CESEE countries are more involved in value chains comparing with world average. So the first part of the first hypothesis is confirmed. Yet the question remains whether involvement is more pronounced in global or regional context. In the following analysis emphasis is put on the Baltic countries while results of CE and SEE can be found in Appendix B.

As to the question about global versus regional integration (second part of the first hypothesis), I look at the use of intermediate inputs from and supply of intermediate inputs to other regions[7] of the world in total, three manufacturing and two services industries[8]. In accordance to literature, I determine global versus regional integration using relative volume of inter and intra region trade (see Sapir, 1992 and Wei, 1996). I define regional integration in case most of trade in foreign intermediates happens intra regionally (within the same trading bloc[9]) while global integration – in case most of trade in intermediates happens inter regionally.

Figure 4. Use of imported intermediate inputs (backward trade) from regions (left hand axis) and share of imported intermediates to total intermediate inputs in the Baltics (right hand axis).



Notes: Classified by NACE rev. 1.1, manufacturing industries are non-durable (Non-dur: sub-sections DB-DD, DN), chemical (Chem: sub-sections DF-DI), electrical (Electr: subsection DL). Service industries are retail (Retail: section G) and transport (Transp: section I). Total represents all industries.
Source: WIOD and author's calculations.

Figure 4 shows the total backward trade in intermediates in the Baltics has slightly decreased between 1995 and 2011 (see also Figure 3.A). But the situation is not entirely homogenous on the industry level. For instance, use of imported intermediates in chemical industry has increased by almost half. Increase in exports of chemical industry as well as historical pattern of sourcing inputs outside the Baltics (mostly Russia) could explain the

[7] Other CESEE countries are CESEE minus Baltics, EU 17 are EU 27 minus ten CESEE countries, NAFTA – Canada, U.S. and Mexico, Trans. econ. – Brazil, Russia, India, Indonesia, Australia and Turkey, East Asia – Japan, Korea, Taiwan, ROW – countries not otherwise mentioned.
[8] Industries are selected according to top export manufacturing commodities and services of Baltic countries as reported by United Nations Comtrade (2014).
[9] Here: Other CESEE and EU 17.

swift increase in imported intermediates (see e.g. Kasjanovs, 2013). Despite the decreases, the share of imported intermediates still remains much higher in manufacturing industries compared to service industries.

Most of the imported intermediates come from regional sources: the EU 17 and other CESEE countries. But the share of imported intermediates coming from the EU 17 has decreased for all industries. At the same time, the importance of other CESEE countries has risen among themselves. More importantly, shares of global players' – China's, NAFTA's and rest of world's countries' –have gradually increased.

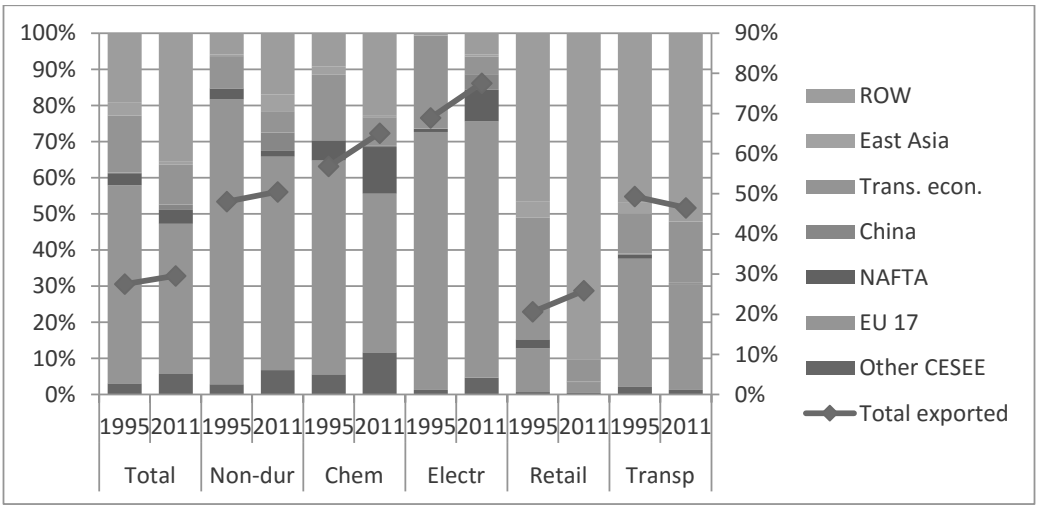
As to CE and SEE, backward trade in intermediates has increased (see Figure B.1and B.2 in Appendix B). Similarly as in the Baltics, manufacturing industries drive the growth in higher use of imported intermediates, especially electrical industry. Also, regional trading bloc accounts for at least half of intermediate inputs in most cases.

The industry analysis presented above is in line with the findings of Hummels et al. (2001) and Campa and Goldberg (1997). Hummels et al. (2001) uncovered that chemical industry accounted largely for the increase in imported intermediates. Likewise, Campa and Goldberg (1997) concluded that electrical and chemical industries use most of imported intermediate inputs in United Kingdom and Canada over 1974-1993. My analysis similarly shows that both chemical and electrical industries are the biggest users of imported intermediates as well as are the biggest suppliers of exported intermediates (see Figure 5 on exported intermediates).

The Baltic countries are increasingly more involved in forward trade in intermediates (Figure 5): the share of exported intermediates has shrunk only for transport industry. Again, intermediates are more excessively exported in manufacturing industries.

Destination-wise, the picture is similar to one in Figure 4. Overall, most of the intermediates go to the regional EU 17 and other CESEE economies; however, the importance of regional integration decreases. China's presence is less apparent in forward trade. However, substantially bigger share of exported intermediates goes to rest of world's countries in 2011 compared to 1995, especially in retail industry. Unfortunately, WIOD data does not provide more precise destinations but it could be linked to stronger forward trade with neighbouring countries such as Belarus or Ukraine which are not featured in WIOD.

Figure 5. Supply of intermediate inputs (forward trade) to regions (left hand axis) and share of exported intermediates to total intermediate inputs supplied by the Baltics (right hand axis).



Source: WIOD and author's calculations.

Similar to the Baltics, CE and SEE also become more involved into global value chains (GVCs)with forward trade, especially in electrical industries where the shares of exported intermediates have doubled over the period (Figures B.3 and B.4 in Appendix B). CE and SEE have been internationally acknowledged as global location for electrical equipment production (Plank & Staritz, 2013, Radosevic, 2004). Again, as in the Baltics most of exported intermediates end up in the EU region, except for service industries.

The geographical analysis of GVCs shows a controversial picture. Many authors have presented evidence in favour of regional value chains (e.g. Hummels et al (2001) among OECD countries, Johnson and Noguera (2012a, 2012b) among NAFTA, Asian and European countries). My analysis cannot deny importance of countries in the same trading union and geographical proximity as a source and destination of intermediate inputs. Most of the intermediate inputs are imported from and exported to the EU 17, other CESEE and Russia (component of transition economies). Moreover, Sinn (2006), Johnson and Noguera (2012a, 2012b) and Amador (2015) particularly highlight the relationships within Europe. For instance, Sinn (2006) demonstrated how share of imported intermediates in Germany has increased from 27% in 1991 to 39% in 2002. Additionally, he claimed that most of the value comes from CESEE countries. Indeed, in 2011 out of all the intermediates exported by CESEE countries more than 13% end up in Germany (up from 11% in 1995).

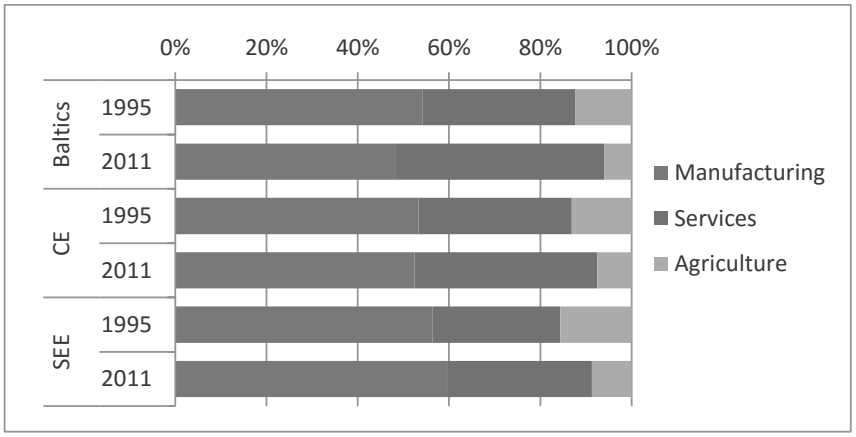
However, there is also a global dimension in CESEE value chains. Although Timmer et al. (2013b) does not deny regional value chain hypothesis in Europe, he also notes that recently value chain connections have grown much faster outside local regions. Similar conclusions are drawn by Cieslik (2014). This corresponds also to my findings presented in Figure 4 and 5 where China, NAFTA and rest of world countries are gaining increasingly larger shares as both source and destination of intermediate inputs from the Baltics.

The obtained results show that although GVC dimension is gaining strength in CESEE countries, currently they are still strongly regionally integrated. So the second part of first hypothesis is rejected.

4.2 Value added in Eastern European countries

The conclusions of section 4.1 refer to integration in value chains and direction of it in CESEE countries but do not infer anything about respective changes in labour market. But before moving to labour distribution, I analyse the value added (VA) contribution of various CESEE industries to world final use of manufacturing. VA analysis is a necessary preliminary step as value is created by two factors inputs: capital and labour; in the next section, I analyse the latter.

Figure 6. Structure of VA by aggregate industries in the Baltics, CE and SEE to world final use of manufacturing goods



Notes: Classified by NACE rev. 1.1, manufacturing industries are section D. Service industries are section F-P. Agriculture are sections A-C.
Source: WIOD and author's calculations.

Figure 6 depicts aggregate industries that contribute their VA to world final use of manufacturing goods, using accounting framework developed by Timmer (see Methodology section 3.2). My analysis is restricted to world final use of manufacturing goods since

production fragmentation is more apparent in manufacturing industries. However, this does not mean that the analysis ignores service industries. Figure 6 reveals that service industries of CESEE contribute a lot to world final use of manufacturing products.

Both in 1995 and 2011 most VA comes from manufacturing industries; however, the share is on a declining pattern for the Baltic and CE countries. On the other hand, service industries indirectly add increasingly more value to world final use of manufacturing goods at the expense of agricultural VA in all country clusters.

In light of the above analysis, next sub-section is devoted to different skill type labour inputs in manufacturing and service industries. I focus on finding out whether manufacturing workers are losing to service workers in the presence of current GVC and VA developments.

4.3 Trends in Eastern European countries' labour hours used in production of world final use of manufacturing goods

In this section I analyse developments in labour contribution to world manufacturing (labour contribution) by skill types in CESEE countries in order to answer my second hypothesis: (1) international production fragmentation can be associated with a negative distributional effect on the employment of the low skilled workers in Eastern Europe but (2) it is much less pronounced compared to processes in the Western Europe (and other developed countries).

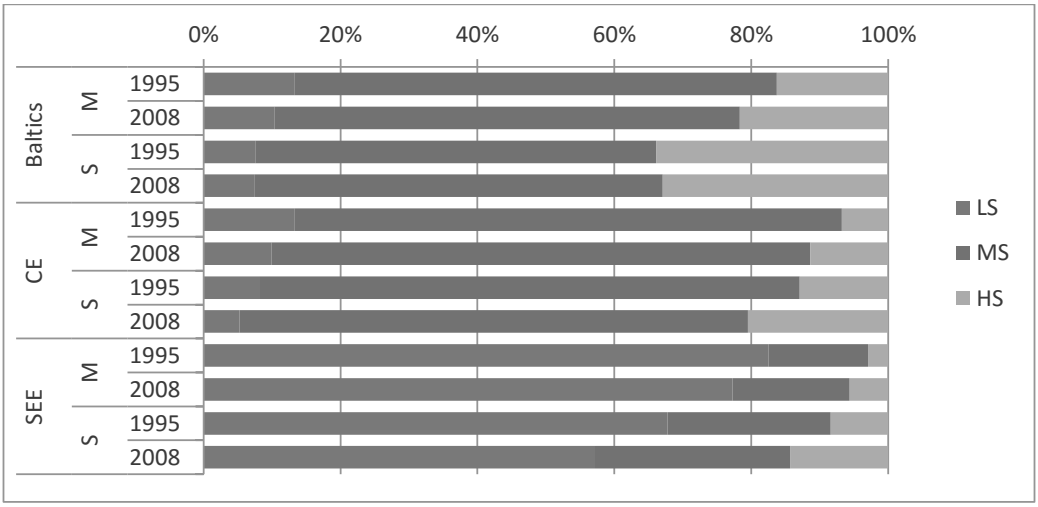
Figure 7 illustrates developments in structure of labour contribution in the Baltics, CE and SEE in 1995 and 2008[10]. As I aim to study the relationship between manufacturing and services workers in production of world final use of manufacturing goods, I depict the developments in two aggregate industries: manufacturing and services. The structure over time in labour hours is quite heterogeneous among country clusters while developments – similar. In 1995, low skilled (LS) labour contribution occupies the lowest share while the medium skilled (MS) occupies the largest share in the Baltics. But the high skilled (HS) account for a fair share of 20-30%. In CE, MS labour hours account for most of the labour contribution (70-80%). In SEE, 60-70% of labour hours come from the LS. While it might seem excessive, for example, Lozev, Vladova, Paskaleva (2011) survey of 504 Bulgarian

[10] In sections 4.1 and 4.2, I made a comparison between years 1995 and 2011. In this section I use year 2008 instead. It is so because data on labour inputs in Socio-Economic Accounts in WIOD, which are crucial for computing labour hours, is limited to year 2009. The year 2009, however, was the year of great trade collapse and is not a useful benchmark for comparison.

firms in 2009 shows that LS employee share in manufacturing is 71.5% while in services – 58%.

The developments up to 2008 show that the share of LS contribution in total CESEE worker hours has declined. While in all cases, except the Baltic service industries, HS labour contribution share in total labour hours has increased. Overall, MS share has also increased; it has happened at the expense of LS worker hours.

Figure 7. Structure of labour hours used in production of world final use of manufacturing goods (by skill types in manufacturing (M) and services (S))



Source: WIOD and author's calculations.

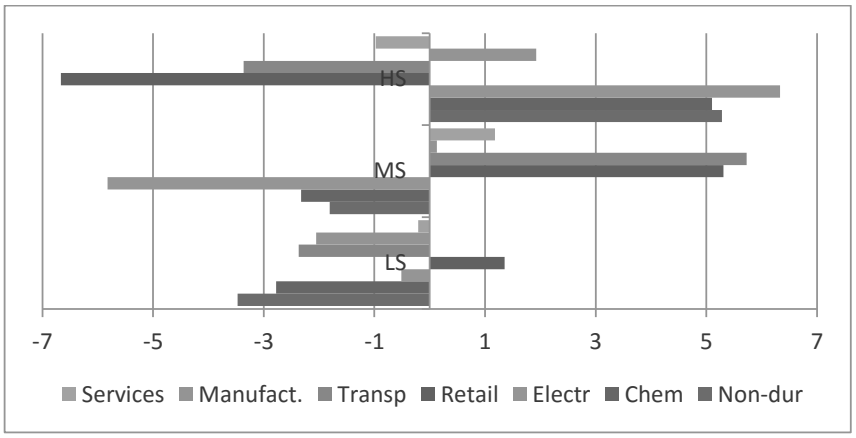
The obtained results demonstrate that labour hour distribution has not developed in favour of the LS workers. So taking into account unambiguous existence of production fragmentation I confirm the first part of the second hypothesis. Yet it still needs to be answered whether the movement from LS labour contribution to MS and HS labour contribution is comparable to Western Europe. In the following analysis emphasis is put on the Baltic countries while results of CE and SEE can be found in Appendix B.

I put forward the following analysis in order to find out which type of labour CESEE countries specialize in compared to the old EU countries. But before I move to that, I present changes in the Baltic labour contribution shares by skill types across five industries and two aggregate industries (manufacturing and services). They are calculated as labour contribution to world manufacturing share in 2008 minus labour contribution share in 1995 (e.g. % of LS 2008 – % of LS 1995).

Figure 8 shows that on aggregate level both manufacturing and services LS labour contribution shares have declined while MS and HS shares have increased. Industry-wise, while electrical and chemical industries reorient to MS and HS labour contribution, retail industry experiences the complete opposite. Skill upgrading in electrical and chemical industries could be linked to the fact that these industries are the most integrated in GVCs where overall skill upgrading is common (see section 4.1 and Berzina, 2013).

The situation in CE and SEE countries is much more homogenous across industries (Figures B.5 and B.6 in Appendix B). In CE, skill upgrading is very evident. LS and MS labour contribution shares decreased while HS labour hour VA share increased in all aggregate and individual industries. In SEE, LS labour contribution shares decreased while MS and HS shares increased. This again holds for all aggregate and individual industries. I interpret it as evident skill upgrading.

Figure 8. Changes in shares of the Baltic labour hours used in production of world final use of manufacturing goods (by skill types and industries in pp)



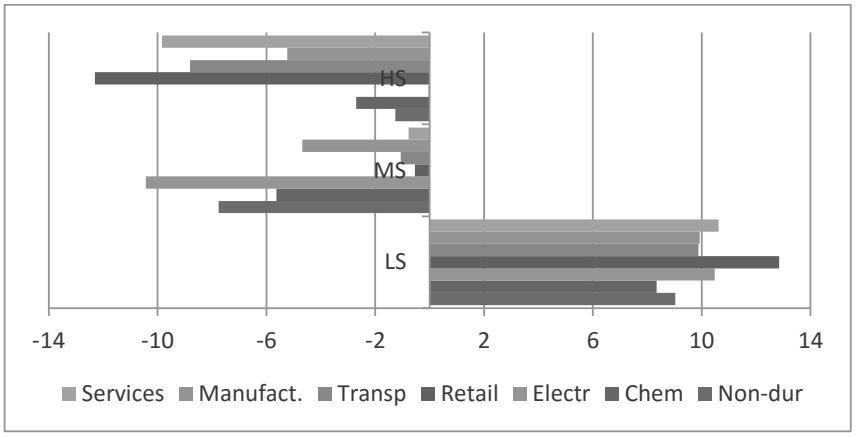
Source: WIOD and author's calculations.

Figure 9 presents changes in the Baltic labour contribution shares relative to the EU 17 countries[11]. It can be seen that, relative to processes in the EU, employment structure changes in the Baltics have been favourable to the LS rather than MS or HS labour. Essentially, Figure 9 means that LS labour contribution share in the Baltics has decreased in a much slower pace than in the old EU while the skills upgrading to MS and HS has occurred

[11] In this case, it would be calculated as e.g. (% of LS 2008 in Baltics – % of LS 1995 in Baltics) – (% of LS 2008 in EU – % of LS 1995 in EU). Thus, positive pp means that, relative to EU, LS share in Baltics has increased more or decreased less than in EU.

in a much faster manner in the old EU[12]. To sum up, Figures 8 and 9 combined show the following picture. The overall developments in the old and new EU (CESEE) are similar but what differs is the scale of skills upgrading process due to globalization of production. The elevated effects on the EU 17 countries could stem from the pressure on LS as China becomes an important provider of LS labour inputs in GVCs (Monfort, Vandenbussche and Forlani, 2008). Conclusions about CE and SEE are similar both with respect to the EU and OECD (Figures B.7 and B.8 Appendix B). Thus the conclusions can be generalized to developed countries.

Figure 9. Changes in shares of the Baltic labour hours used in production of world final use of manufacturing goods relative to changes in the EU 17 countries (by industries and skill types in pp)



Source: WIOD and author's calculations.

These observations partially correspond to previous findings. Gorg and Hanley (2005) in Ireland and Crino (2009) analysed a set of developed countries and concluded that offshoring in manufacturing industries affects LS workers of the home country negatively as usually LS tasks are offshored. Similar conclusion is made by Geishecker (2006) and Kandilov and Grennes (2010). This would indirectly imply that LS workers of the country where tasks are offshored to benefit. When looking at LS shares relative to the EU (Figure 9), my results show that CESEE LS workers are in a more beneficial position.

With respect to services, Crino (2009), Marin (2010) and Gal (2009) all argue that service offshoring should benefit HS workers of countries where tasks are offshored to. But

[12]I perform a robustness check by doing the same analysis for a larger set of developed countries whose proxy I choose as OECD countries. In case of comparison with OECD countries, a similar pattern holds. Distributional changes in labour hour shares favour LS but negative effect on MS and HS is not as definitive. However, to enhance paper's readability, I exclude extensive analysis from the paper.

Figure 9 illustrates that, relative to the EU, CESEE MS and HS workers lose to the EU MS and HS workers so my findings cannot confirm the ones of Crino (2009), Marin (2010) and Gal (2009) regarding services. On contrary, this is in line with Timmer et al. (2013a, 2014a) who claim that the old EU increasingly specializes in skill intensive activities.

The obtained results show that CESEE countries relatively specialize in LS labour. Thus, I can conclude that the negative distributional effect on LS workers in CESEE countries is much less pronounced compared to Western Europe. So the second part of first hypothesis is accepted.

5. Discussion of results

In this section I discuss the results obtained and present conclusions and implications that can be drawn from them. Later, I attempt to describe what future developments we can expect from ongoing globalization. Emphasis once again is on the Baltic countries.

Many authors have concluded that there is a process of fragmentation of world trade (e.g., Hummels et al. (2001), Johnson and Noguera (2012a, 2012b), Timmer et al. (2013b), etc.). However, a topic of interest is whether fragmentation is shifting in the direction of global or rather regional partnerships. But even with this discussion, one thing is clear – globalization of world trade increases and will increase in the future (Baldwin, 2006). Currently, the production fragmentation is much more pronounced in manufacturing industries, but it becomes increasingly present in services as well (Kommerskollegium, 2013). There are possible step-backs as to the degree of production fragmentation stemming from recessions as the great trade collapse in 2008-2009 or political instability which disrupts trade, such as tensions between Russia and the EU. But so far these have been only short term disturbances without long lasting effect on the trend of trade integration. Without doubt, Eastern European (CESEE) countries are an integral part of this process. My results show that CESEE countries participation in global value chains is well above the world's average both with respect to backward and forward trade.

The reason why it is so important to acknowledge globalization of world trade is because it already puts pressure on domestic labour markets and will continue to do so more. CESEE country case is particularly alarming, since production fragmentation in these countries is much more common than elsewhere. Disaggregation (or unbundling as Baldwin (2006) puts it) of production from solid goods to detailed tasks increases the strain to reallocate economic resources across countries, industries, companies and even individuals (Baldwin, 2006). That in turn means job availability and individual wages are determined by global markets, not local, which could affect certain participants in the labour market.

It is worth looking how integration of trade can be associated with labour demand for different skill types. Authors such as Timmer et al. (2013a) argue that skill upgrading takes place across Europe. My results also confirm that (Figure 7 and 8). The Baltic low skilled (LS) workers both in manufacturing industries and services contribute increasingly less labour hours used in production of world final use of manufacturing goods against all labour hours. The two reasons for such developments mentioned in the literature are technological

advancement and impact of trade patterns such as offshoring. The first one is defended by Berman et al. (1994), Bernard and Jensen (1997) and Timmer et al. (2014b) while the latter is advocated by Feenstra and Hanson (1995), Wood (1995) and Sachs et al. (1994). Technological advancement could explain skills upgrading in CESEE countries as LS jobs could be increasingly substituted by new technological solutions. However, offshoring could be harder to attribute as a plethora of authors discuss offshoring from the old EU countries, especially Germany and Austria, to CESEE countries (Sinn, 2006, Geishecker, 2006, Kandilov and Grennes, 2010 and Marin, 2010) which should do just the opposite – benefit the LS. So does technological advancement effect outweigh the offshoring effect?

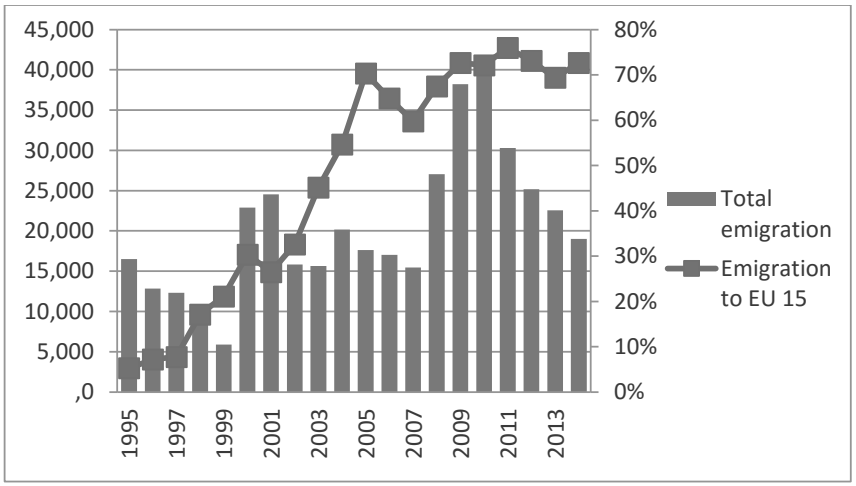
In order to further understand the effect on the LS, I use classical trade theory. However, in presence of global value chains, it cannot be straightforwardly applied as before. Taking into account unbundling of production from goods to tasks, analysis has to be applied not to production of goods but production stages. By doing so, I conclude the following. Relative to the world, CESEE countries are more abundant in medium skilled (MS) and high skilled (HS) labour, thus indicating that comparative advantage lies in MS and HS tasks. CESEE countries are a part of the EU which explains the common direction of development in comparative advantage.

The EU, on the other hand, is heterogeneous. Moreover, the EU represents a trading union, a large portion of CESEE trade source and destination and labour mobility is relatively high within the EU, so it is important to acknowledge the position of CESEE countries within the EU. Figure 9 of my results did that. It shows that, contrary to the world, CESEE countries are LS labour abundant in comparison to the old EU countries. That in turn indicates CESEE countries exhibit comparative advantage in LS tasks and activities (e.g. assembly, repair works, etc.) relative to the old EU and that has some potentially significant implications for the future.

Intuitively, comparative advantage in LS labour tasks compared to developed countries is unfavourable for MS and HS workforce that might push the more qualified labour to seek better labour market arrangements elsewhere but home countries. The Baltic States are particularly susceptible to these developments taking into account labour mobility. There is a reason to believe that labour mobility is higher in the Baltics and several other CESEE countries than in the EU on average. Hazans and Phillips (2009) argued that intra EU labour mobility in Latvia is one of the highest among new EU member states (2004

enlargement). From 2004 to 2008, 6.7% of Latvians moved to the UK and Ireland, thus making Latvia the second most mobile country among CESEE countries in terms of mobility to the UK and Ireland (Hazans, Phillips, 2009). The authors concluded that in comparison to other new EU member states Latvia is more vulnerable to labour outflow risk. Thus, taking into account comparative advantage in the LS. the Baltic countries could expect that increasingly more skilled (MS and HS) workers will emigrate to the old EU.

Figure 10. Total emigration in Latvia (thousands of people) (left hand axis) and share of emigration to the EU 15 as of total emigration (right hand axis)



Source: Central Statistical Bureau and author's calculations.

Yet, it is already happening (e.g. in Latvia). Since Latvia joined the EU, emigration has been higher than ten years before (Figure 10). In addition, emigration to the EU 15 countries spiked a year before accession to the EU and has been quite stable at around 70% since. With respect to emigration of skilled labour, Lithuania and Latvia, together with other CESEE countries, are among top 5 countries with the highest emigration rates of the highly educated (Romania – 9%, Lithuania – 7.2%, Slovakia – 6.5%, Latvia – 6.2% and Poland – 6.2%) (Canetta, Fries-Tersch, Mabilia-Milieu, 2014). In presence of comparative advantage in favour of LS labour and ongoing globalization of production, this trend is likely to persist and gain in strength. It is further amplified by the fact that HS labour is more mobile (e.g. they are more likely to overcome language barriers). Such scale of brain drain can have negative spillovers on the economy. Skilled workers are crucial for productivity, economic growth and innovation (Lowell and Findlay, 2001).

In order to tackle brain drain and prevent its negative effects, CESEE countries should work on shifting the comparative advantage in the direction of the MS and HS. While it

might seem that CESEE countries could shift the comparative advantage by increasing the number of MS and HS workers through incentivizing MS and HS emigrants to return to home countries, it seems nearly impossible given CESEE countries absolute disadvantage in wages compared to the EU 15. However, areas to tackle are as follows. Firstly, appropriate education policies targeted at increasing the overall skill level of the countries could foster the skill upgrading in CESEE countries relative to the EU 15. Secondly, upgrading of the export basket could restrict the supply of LS labour intensive tasks in manufacturing and services.

6. Conclusions

This paper sought to answer the following research question: How has the rise of global value chains affected low, medium an d high skilled labour in Eastern European countries? Using input-output tables from World Input-Output Database for 1995-2011, I apply framework developed by Timmer et al. (2013a) based on seminal work of Wassily Leontief (1936) to analyse value added and labour hours used in production of world final use of manufacturing goods in the Baltic, Central European and South Eastern European countries.

I first hypothesized that production fragmentation exists in Eastern European countries and that it is global rather than regional. I find that production fragmentation proxied by the share of intermediate inputs in total intermediate inputs exists in Eastern European countries and is at least twice as common as in the world on average. Moreover, Eastern European countries are rather regionally integrated in value chains than globally. Most of the imported and exported intermediates from Eastern European countries originate from and end up in other European Union countries. However, global integration, although less prevalent, is accelerating in a much faster manner than further regional integration. So the first part of the first hypothesis is accepted while the second – rejected.

My second hypothesis expected that production fragmentation would be associated with negative distributional effect on the low skilled employment in favour of medium and high skilled; yet, to a smaller extent compared to Western Europe. I find that indeed the share of low skilled labour hours used in production of world final use of manufacturing goods has decreased while medium and high skilled share in total labour hours have increased. However, I find that, compared to redistribution effects in Western Europe, the negative effect on the low skilled is negligible. Thus, I fully accept my second hypothesis.

Perhaps the most important contribution of my paper is examining the effect and possible implications of globalization and trade integration from the Eastern European country perspective. Previous papers have taken a stance of trade integration with Eastern Europe from the core European Union country perspective (e.g. Germany, Austria or the Netherlands). Eastern European country abundance and respective comparative advantage in low skilled labour tasks pushes out medium and high skilled labour. Combined with Eastern European absolute disadvantage in wages and higher labour mobility compared to the European Union average, it is likely that increasingly more medium and high skilled workers

will seek employment opportunities outside home countries and emigrate to the core European Union countries. Brain drain, in turn, will have negative spillover effects as skilled workers are necessary for productivity, economic growth and innovation. Thus, Eastern European countries should consider policies that would shift their comparative advantage in direction of more skilled workers.

However, one cannot disregard the potential effect of data in output-output form and omission of capital as production factor on the results. As for further research, capital as a production factor could be taken into account as well and the impact of production fragmentation and redistributional labour pressures on wage inequality could be studied.

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8. Appendices

8.1 Appendix A: Information on World Input-Output Database

Figure A.1. List of countries in World Input-Output Database

Country	Region	Country	Region
Austria	European Union	Portugal	European Union
Belgium	European Union	Romania	European Union
Bulgaria	European Union	Slovakia	European Union
Cyprus	European Union	Slovenia	European Union
Czech Republic	European Union	Spain	European Union
Denmark	European Union	Sweden	European Union
Estonia	European Union	United Kingdom	European Union
Finland	European Union	Canada	North America
France	European Union	United States	North America
Germany	European Union	Brazil	Latin America
Greece	European Union	Mexico	Latin America
Hungary	European Union	Australia	Asia and Pacific
Ireland	European Union	China	Asia and Pacific
Italy	European Union	India	Asia and Pacific
Latvia	European Union	Indonesia	Asia and Pacific
Lithuania	European Union	Japan	Asia and Pacific
Luxembourg	European Union	Russia	Asia and Pacific
Malta	European Union	South Korea	Asia and Pacific
Netherlands	European Union	Taiwan	Asia and Pacific
Poland	European Union	Turkey	Asia and Pacific

Source: WIOD.

Figure A.2. List of industries in World Input-Output Database matched with respective NACE revision 1.1 classification

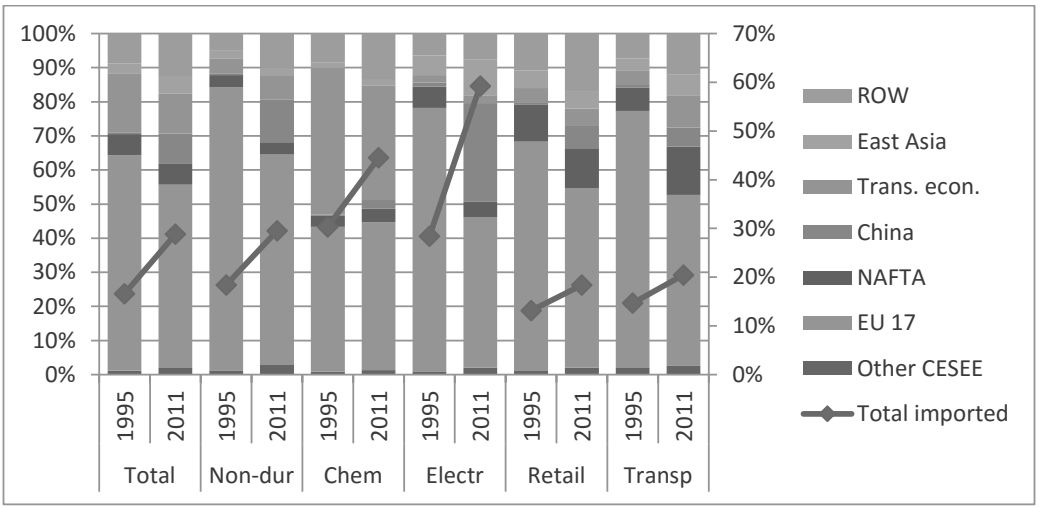
World Input-Output Database industry	Respective NACE rev. 1.1
Agriculture, Hunting, Forestry and Fishing	Section A-B
Mining and Quarrying	Section C
Food, Beverages and Tobacco	Sub-section DA
Textiles and Textile Products	Sub-section DB
Leather, Leather and Footwear	Sub-section DC
Wood and Products of Wood and Cork	Sub-section DD
Pulp, Paper, Paper, Printing and Publishing	Sub-section DE
Coke, Refined Petroleum and Nuclear Fuel	Sub-section DF

Chemicals and Chemical Products	Sub-section DG
Rubber and Plastics	Sub-section DH
Other Non-Metallic Mineral	Sub-section DI
Basic Metals and Fabricated Metal	Sub-section DJ
Machinery, Nec (not elsewhere classified)	Sub-section DK
Electrical and Optical Equipment	Sub-section DL
Transport Equipment	Sub-section DM
Manufacturing, Nec (not elsewhere classified); Recycling	Sub-section DN
Electricity, Gas and Water Supply	Section E
Construction	Section F
Sale, Maintenance and Repair of Motor Vehicles and Motorcycles; Retail Sale of Fuel	Section G 50
Wholesale Trade and Commission Trade, Except of Motor Vehicles and Motorcycles	Section G 51
Retail Trade, Except of Motor Vehicles and Motorcycles; Repair of Household Goods	Section G 52
Hotels and Restaurants	Section H
Inland Transport	Section I 60
Water Transport	Section I 61
Air Transport	Section I 62
Other Supporting and Auxiliary Transport Activities; Activities of Travel Agencies	Section I 63
Post and Telecommunications	Section I 64
Financial Intermediation	Section J
Real Estate Activities	Section K 70
Renting of Machinery & Equipment and Other Business Activities	Section K 71-74
Public Administration and Defence; Compulsory Social Security	Section L
Education	Section M
Health and Social Work	Section N
Other Community, Social and Personal Services	Section O
Private Households with Employed Persons	Section P

Source: WIOD and NACE rev. 1.1.

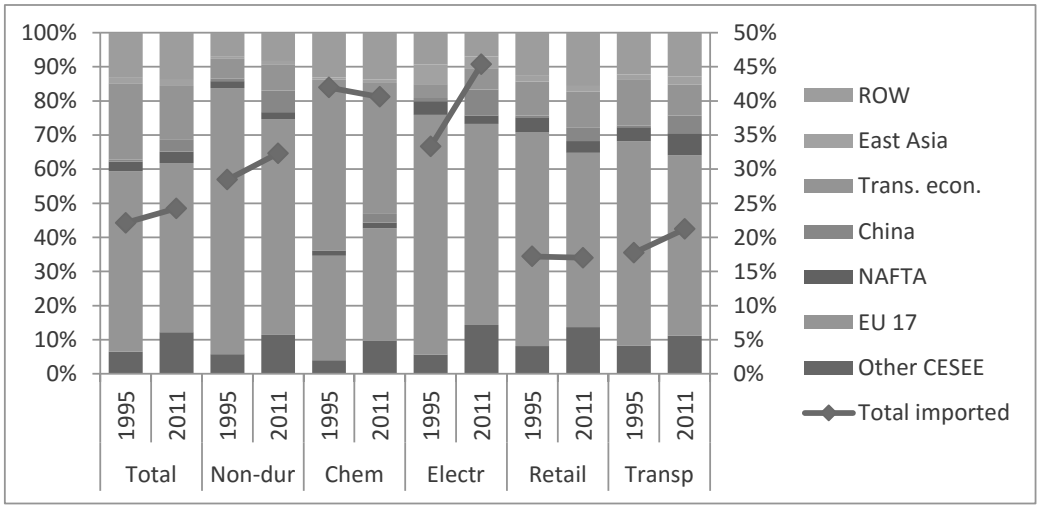
8.2 Appendix B: Analysis of results for Central and South Eastern European countries

Figure B.1. Use of imported intermediate inputs from regions (left hand axis) and share of imported intermediates to total intermediate inputs in Central Europe (right hand axis).



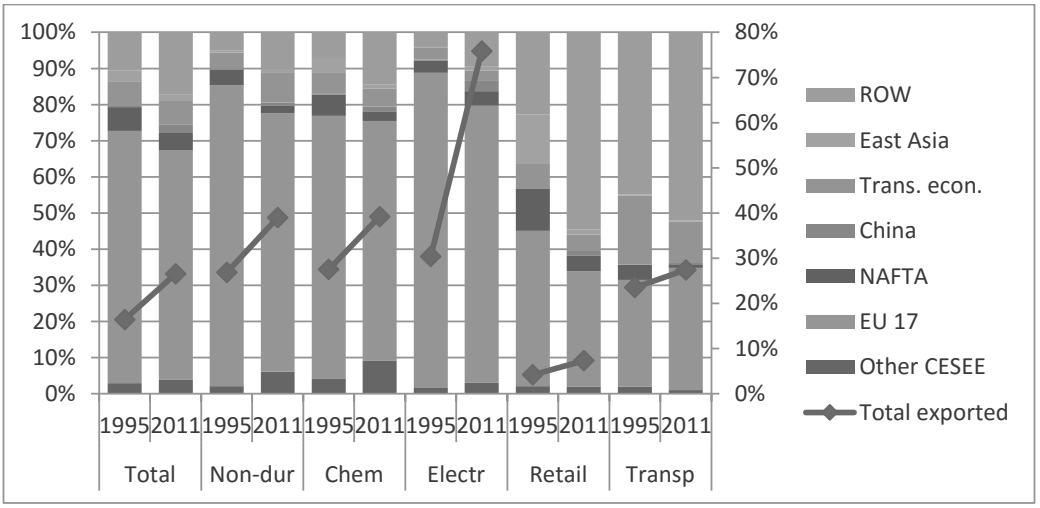
Source: WIOD and author's calculations.

Figure B.2. Use of imported intermediate inputs from regions (left hand axis) and share of imported intermediates to total intermediate inputs in South Eastern Europe (right hand axis).



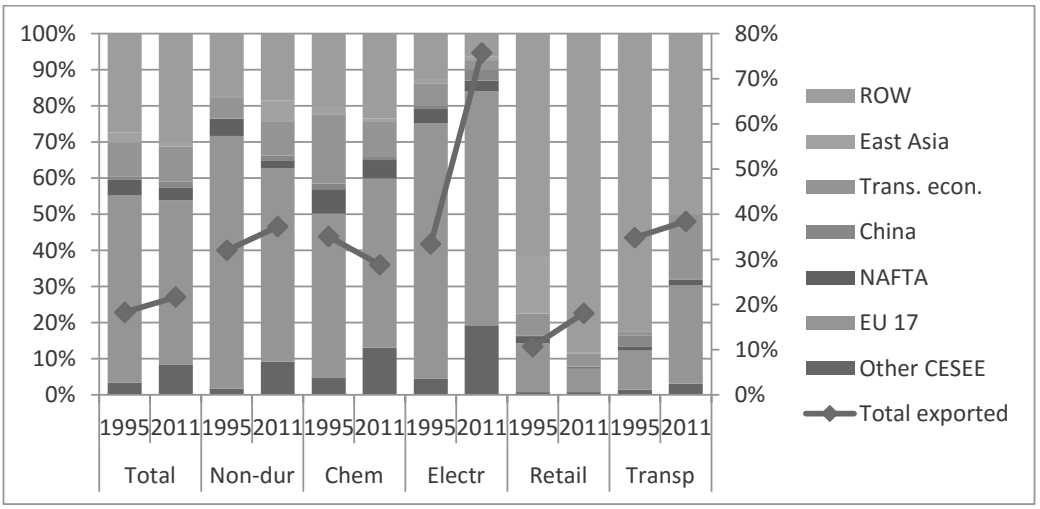
Source: WIOD and author's calculations.

Figure B.3. Supply of intermediate inputs to regions (left hand axis) and share of exported intermediates to total intermediate inputs supplied by Central Europe (right hand axis).



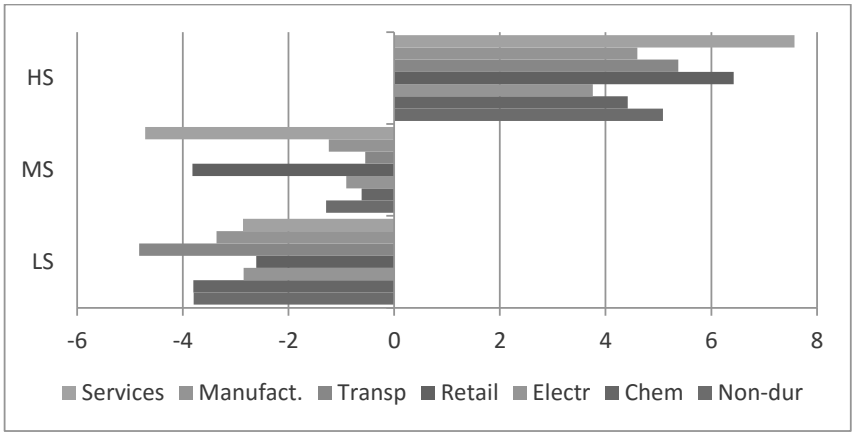
Source: WIOD and author's calculations.

Figure B.4. Supply of intermediate inputs to regions (left hand axis) and share of exported intermediates to total intermediate inputs supplied by South Eastern Europe (right hand axis).



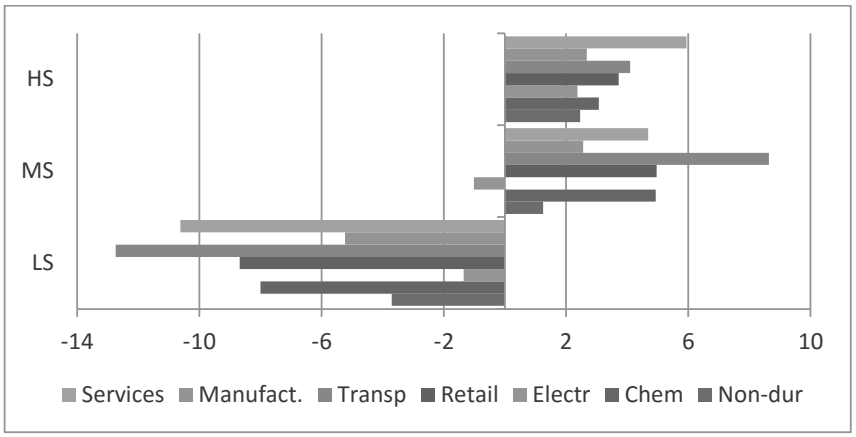
Source: WIOD and author's calculations.

Figure B.5. Changes in shares of Central Europe labour hours used in production of world final use of manufacturing goods (by skill types and industries in pp)



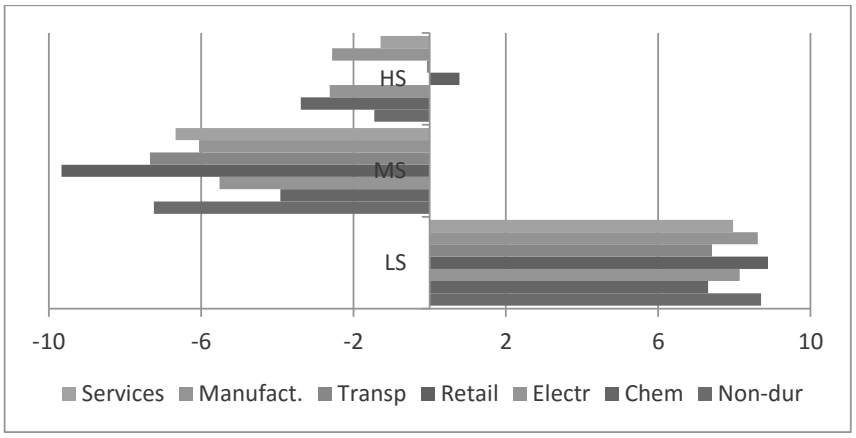
Source: WIOD and author's calculations.

Figure B.6. Changes in shares of South Eastern Europe labour hours used in production of world final use of manufacturing goods (by skill types and industries in pp)



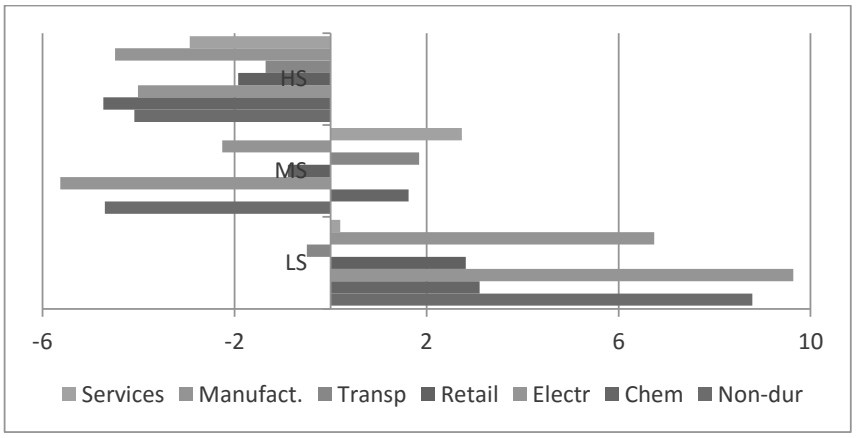
Source: WIOD and author's calculations.

Figure B.7. Changes in shares of Central Europe labour hours used in production of world final use of manufacturing goods relative to changes in the EU 17 countries (by industries and skill types in pp)



Source: WIOD and author's calculations.

Figure B.8. Changes in shares of South Eastern Europe labour hours used in production of world final use of manufacturing goods relative to changes in the EU 17 countries (by industries and skill types in pp)



Source: WIOD and author's calculations.