The European Journal of Comparative Economics
Vol. 10, n. 1, pp. 81-107
ISSN 1824-2979

Skill Content of Intra-European Trade Flows

Goetz Zeddies[1]

Abstract

In recent decades, the international division of labor has expanded rapidly in the wake of European integration. In this context, especially Western European high-wage countries should have specialized on (human-)capital intensively manufactured goods and should have increasingly sourced labor-intensively manufactured goods, especially parts and components, from Eastern European low wage countries. Since this should be beneficial for the high-skilled and harmful to the lower-qualified workforce in high-wage countries, the opening up of Eastern Europe is often considered as a vital reason for increasing unemployment of the lower-qualified in Western Europe. This paper addresses this issue by analyzing the skill content of Western European countries' bilateral trade using input-output techniques in order to evaluate possible effects of international trade on labor demand. Thereby, differences in factor inputs and production technologies have been considered, allowing for vertical product differentiation. In this case, skill content of bilateral exports and imports partially differs substantially, especially in bilateral trade between Western and Eastern European countries. According to the results, East-West trade should be harmful particularly to the medium-skilled in Western European countries.

JEL-Classification: C 67, F 11, F 15, F 16

Keywords: European Integration, International Trade, Labor Demand, Input-Output Analysis

1. Introduction

In the course of globalization, highly-developed countries should have increasingly specialized in human capital-intensive manufactured goods and, in return, should have sourced labor-intensive manufactured products from low-wage countries. For this reason, especially the opening up of Eastern Europe, but also the international integration of the Newly Industrializing East Asian Economies is often considered a significant cause of labor demand shifts detrimental for the lower-qualified in Western European countries, since international trade should favor the high-skilled in these countries (e.g. Freeman 1995, Wood 1995). This paper addresses this question by analyzing the skill content of bilateral intra-European trade flows of selected EU Member States, allowing inferences to be made about the impact of these trade relations on factor demand patterns in those countries. Previous studies on the factor content of trade have shown that, even in trade between highly developed countries, the results depend largely on whether or not international differences in technology are considered. Unlike previous studies, this paper takes up this issue by analyzing the high-, medium- and low-skill content of bilateral trade between Western European and, for comparison, also between Western and Eastern European countries. The skill content of trade is analyzed for identical, but also for different technologies by using country specific

[1] Halle Institute for Economic Research (IWH), Germany. E-Mail: goetz.zeddies@iwh-halle.de

input-output and factor input data. According to theory, different factor intensities in production are a prerequisite for vertical product differentiation, which has become more and more important in recent decades (Falvey and Kierzkowski 1987, Helpman 1981). As the analyses show, the results do indeed depend largely on whether vertical product differentiation is allowed for or not.

The paper is structured as follows: The following section contains a review of the literature, while section 3 describes the theoretical background and the model used in calculating the skill content of trade. In section 4, the skill content of the bilateral trade flows of six Western European countries is calculated by applying input-output techniques. Finally, section 5 closes with some concluding remarks.

2. Review of the Literature

One of the main theoretical foundations for explaining international trade patterns and their consequences for factor demand and income distribution in trading partner countries is the neo-classical Heckscher-Ohlin (HO) model of trade. According to this model, each country will specialize in and export commodities utilizing its abundant and thus comparatively cheap factors of production and will import goods using its scarce factors of production. An empirical test of the HO-theorem for the United States performed by Leontief (1953) seemed to disprove the hypothesis that countries' patterns of specialization are determined by factor proportions. In a model with two production factors (capital and labor), Leontief disaggregated the US economy into 50 industries, 38 of which produced tradable goods. He showed that in 1947, US imports were 30% more capital-intensive than US exports, although at the time the US was considered to be one of the most capital-abundant countries in the world. Today it is widely accepted that, besides trade barriers, differences in labor force qualifications is the main reason for this Leontief paradox (Baldwin 1971, Kravis 1956, Trefler 1993).

So far, analyses investigating the factor content of trade for different countries exist (e.g. Dasgupta et al. (2009) for India, Engelbrecht (1996) for Germany, Webster (1993) for the UK and Widell (2005) for Sweden), as well as studies testing traditional trade theories (e.g. Bowen et al. 1987, Davis and Weinstein 2001, Maskus 1985, Staiger 1988, Trefler 1995). However, in many of these last mentioned studies the empirical results of these tests are quite inconclusive. A critical concern is that the bulk of these studies assume identical production technologies and factor inputs across countries for calculating the factor content of countries' trade. As a consequence, the factor content of exports and imports hardly deviates one from the other. However, according to New Trade Theories, identical production technologies would imply only horizontal product differentiation, resulting in horizontal intra-industry trade. In this case, imports would differ from domestically manufactured export goods only with respect to product characteristics, but would be of the same quality. But these days, product differentiation is largely vertical, which means that goods are manufactured with different factor proportions or technologies and differ with respect to quality and prices (Falvey and Kierzkowski 1987, Flam and Helpman 1987). By implication, this means that producing

a perfect import substitute would require exactly the same factor inputs and production technology that are applied when producing the considered product abroad. If not, the domestically manufactured import substitute and the imported product would not be homogeneous. Against this background, quantifying domestic job losses induced by imports for different skill groups requires calculating the factor content of imports by using technology as well as factor input matrices of trading partner countries.

Although empirical analyses investigating the factor content of trade on a bilateral level have more recently used technology matrices of both the exporting and the importing country (e.g. Choi and Krishna 2004, Davis and Weinstein 2003, Harrigan 1997, Lundberg and Wiker 1997, Nishioka 2006 and Torstensson 1992), many of these analyses are restricted to highly developed OECD countries, which probably share quite similar production technologies and factor endowments. Although Hakura (1999) found that theoretical hypotheses are empirically supported for EU Member States if different technology matrices are used for the countries considered, only bilateral trade relations between the high income Western European countries of Belgium, Germany, France, Italy and the Netherlands were considered. For EU member states, only Cabral et al. (2006 and 2009) focused on trade between high-income countries (the UK and others, respectively) and middle-income countries. However, for the former, only the United Kingdom's, and for the latter, only the Portuguese technology matrix was used and considered as representative.

Against this background, in this study trade flows between not only selected Western, but also between Western and new Eastern European EU member states will be taken into account. The countries considered are Austria, Denmark, France, Germany, the Netherlands and Sweden and, as Eastern European trading partners, the Czech Republic, Hungary, Poland and Slovakia. Thereby, those Western European countries with the most intensive trade relations with Eastern Europe, measured by the share of the four Eastern European countries in total exports and imports, are considered. With respect to Eastern European countries, the country selection was limited by data availability. Detailed data on labor input by industry are only available for the four countries mentioned above. However, these four countries are the most important Eastern European trading partners of the Western European countries considered in this study. Since data on capital input are only available for the Czech Republic and Hungary, capital was not taken into account.[2] Unlike many other studies dealing with factor content in bilateral trade (e.g. Davis and Weinstein 2001, Harrigan 1997, Lai and Zhu 2007), in this study the total labor force will be subdivided into human capital and lower-qualified labor in order to deduce factor demand patterns arising from international trade between EU Member States. This will be done by

[2] Data on capital input is provided by EU KLEMS as well as by the OECD STAN database. However, data on capital input by industry are not available for Poland and Slovakia. But the neglect of other production factors than labor does not pose a technical problem for the empirical analyses, but could increase the mismatch between factor content of trade and endowment differences (Davis and Weinstein 2001).

identifying the high-, medium- and low-skill content of intra-European trade flows. In this way, the calculations will be performed in the case of identical as well as of different technologies across countries by using *national* factor input and input-output matrices. This allows for a consideration of country specific factor inputs resulting from endowment differences.

3. Theoretical Background and Specification of the Model

3.1 The HOV-Model of Trade

According to the Heckscher-Ohlin model of trade, international trade results from differences in countries' factor endowments. A modification of the traditional HO model suggests that, under the assumption of balanced trade, identical production technologies, identical and homothetic preferences across countries, no factor intensity reversals and free trade, international trade will accomplish the task of exchanging the services of production factors embodied in tradable goods and services (Vanek 1968). This Heckscher-Ohlin-Vanek (HOV) version of the classical HO model therefore implies that countries should have a net export of relatively abundant factor services and a net import of relatively scarce factor services (Melvin 1968). In the following paragraphs, the HOV model will be formally derived.[3]

Besides direct factor inputs, the production in industry *i* normally requires intermediate inputs from other industries in order to produce country *m's* gross output (Y^m_{gross}). These are captured by the (*i* x *i*) input-output matrix of country *m*, which can be easily transformed into a technical coefficients matrix, denoted by A^m. Each element in A^m shows the units of input from different industries necessary for producing one unit of output in industry *i*. Under the presence of intermediate inputs, the interrelationship between gross and net output (Y^m_{net}) of country *m* is expressed by,

$$Y^m_{net} = (I - A^m)Y^m_{gross} \tag{1}$$

where *I* represents the (*i* x *i*) identity matrix. Assuming that ($I - A^m$) is invertible, a (*f* x *i*) matrix of total (direct and indirect) factor input requirements, indicating the required amount of different production factors *f* for producing one unit of output in each industry *i* of country *m* (B^m_{total}), can be defined as:

$$B^m_{total} = B^m\left(I - A^m\right)^{-1} \tag{2}$$

[3] For the following derivation of the model see Feenstra (2004).

In equation (2), B^m denotes the (f x i) direct factor input matrix and B^m_{total} the (f x i) total factor input (direct plus indirect factor inputs due to inter-industrial linkages) for industry i. In order to calculate the factor content of net exports, assume that Y^m_{net} stands for the (i x 1) net output vector of industries i in country m and D^m denotes country m's (i x 1) domestic demand vector for goods of each industry i. The difference between domestic production and domestic demand yields the (i x 1) net trade vector of country m (T^m_{net}):

$$T^m_{net} = Y^m_{net} - D^m \tag{3}$$

The factor content of country m's net exports F^m is thus determined by the (direct and indirect) factor input matrix in production multiplied by the vector of net exports:

$$F^m = B^m_{total} T^m_{net} = B^m (I - A^m)^{-1} T^m_{net} \tag{4}$$

On the basis of equation (4), the (net) employment effects of international trade can be determined for different factors of production. It is thus assumed that exports are associated with job creation, while imports are accompanied by domestic job losses, since with increasing imports domestic production will *ceteris paribus* be reduced.

According to the HOV model, the factor content of trade should be determined by countries' factor endowments. If all countries shared a common technology matrix B_{total}, under the assumption of full employment, the factor endowment of country m (V^m) would equal factor input in production (left hand side of equation (5)):

$$B_{total} Y^m_{net} = B\left(I - A\right)^{-1} Y^m_{net} = V^m \tag{5}$$

Accordingly, world factor endowment (V^W) must equal factor input in world production, as denoted in equation (6):

$$B_{total} Y^W_{net} = B\left(I - A\right)^{-1} Y^W_{net} = V^W \tag{6}$$

If preferences are homothetic across countries, country m's vector of final goods demand (D^m), under market equilibrium, equals the world output vector (Y^W_{net}) multiplied by country m's share in total world expenditure (s^m):

$$D^m = s^m Y^W_{net} \tag{7}$$

By multiplying equation (7) by the common technology matrix B_{total}, it follows that:

$$B_{total} D^m = s^m V^W \tag{8}$$

Given equation (3) and subtracting equation (8) from equation (5) yields the following equation (9) of the standard HOV model:

$$B_{total}\left(Y_{net}^m - D^m\right) = B_{total} T_{net}^m = F^m = V^m - s^m V^W \tag{9}$$

The left hand side of equation (9) depicts the so called measured factor content of trade (F^m), which consists of a total (direct and indirect) coefficients matrix of factor inputs and a net trade vector of country *m*. The right hand side of equation (9) represents the predicted factor content of trade of country *m*, resulting from endowment differences between country *m* and the rest of the world (Leamer 1980). According to the HOV model, then, endowment differences should result in (net) exports of factor services.

3.2 Model Specification for the Present Analysis

In the following, the skill content of country *m's* bilateral trade relations will be determined. Therefore, equation (4) will be slightly modified in the way suggested by Deardorff (1982) and Helpman (1984):

$$F^{mn} = B_{total}^m T_{net}^{mn} = B^m (I - A^m)^{-1} T_{net}^{mn} \tag{10}$$

In equation (10), F^{mn} represents bilateral skill content of trade, respectively, between countries *m* and *n*, and T_{net}^{mn} stands for net exports of country *m* to country *n*. As stated in section 3.1, one assumption of the HOV model is balanced trade. In the case of trade imbalances, net exports of factor services calculated by equation (10) would be biased and not comparable across countries. Thus, skill content of exports of country *m* to country *n* as well as of imports of country *m* from country *n* will be calculated separately. The skill content of country *m*'s exports to country *n* (F_{Ex}^{mn}) is calculated by the following formula (11):

$$F_{Ex}^{mn} = B_{total}^m Ex^{mn} = B^m \left(I - A^m\right)^{-1} Ex^{mn} \tag{11}$$

In equation (11), Ex^{mn} represents country *m's* (*i* x 1) export vector to country *n*. Likewise, the skill content of imports (F_{Im}^{mn}) will be calculated by multiplying the total factor input matrix B_{total}^{m} by country *m*'s import vector from country *n* (Im^{mn}):

$$F_{\mathrm{Im}}^{mn} = B_{total}^{m}\,\mathrm{Im}^{mn} = B^{m}\left(I - A^{m}\right)^{-1}\mathrm{Im}^{mn} \tag{12}$$

Clearly, the methodology described above rests on the assumption that imported commodities are manufactured abroad with the same technology and factor inputs as domestic import substitutes. In this case, imports would be perfectly homogeneous with domestically manufactured goods. In the presence of vertical product differentiation, the assumption of similar production technologies across countries should be abandoned and the skill content of country *m*'s imports from country *n* should be calculated as follows:

$$F_{\mathrm{Im}}^{mn} = B_{total}^{n}\,\mathrm{Im}^{mn} = B^{n}\left(I - A^{n}\right)^{-1}\mathrm{Im}^{mn} \tag{13}$$

According to equation (13), the skill content of country *m's* imports from country *n* (F_{Im}^{mn}) is now determined by country *m*'s (*i* x 1) import vector from country *n* (Im^{mn}) multiplied by country *n*'s total factor input matrix B_{total}^{n}. The latter is calculated from the direct factor input matrix (B^n) and the technology matrix (A^n) of country *n*.[4]

3.3 Addressing the Problem of Re-Exports

In the model described above, it is assumed that international trade might be associated with shifts in factor demand. This assumption becomes obsolete if previously imported goods are exported without entering the domestic production process of a country (so called *re-exports*). This kind of trade flow has no effect on domestic factor demand at all. In the case of the Western European countries considered in this study, the *re-export ratio*, defined as the share of goods re-exported without entering into domestic production in total exports, ranges from 4% (Sweden) to 15% (Germany). Only in the case of the Netherlands is the re-export ratio considerably higher, amounting to 33%, probably due to the Rotterdam-effect. Whereas for countries' total trade, re-exports can be identified in the import tables provided together with the Eurostat input-output tables, this is presumably not always the case in bilateral trade

[4] Similar to the traditional model in equation (4), this approach, although allowing for vertical product differentiation, rests on the assumption that exports are manufactured entirely domestically and imports are manufactured entirely abroad. In the presence of international fragmentation of production, this may not necessarily be the case, since exports might contain foreign factor services and imports probably do not contain only factor services of trading partner country *n*.

data. According to Eurostat, the Community's statistics are compiled by the special trade system, where re-exports are excluded as far as extra-EU trade is concerned. Since intra-EU trade statistics, which are used in these analyses, do not have a direct link to customs procedures, they are not in general compiled on a special trade basis and should thus also contain re-exports (Eurostat 2009). Of course, an imported product which is re-exported without being processed domestically leaves the country with the same factor content with which it entered. In such a case, using different technology and factor input matrices for calculating the factor content of imports and exports would be misleading. Against this background, the results obtained for different technologies must be qualified. The following section describes the data used to calculate the skill content of the above mentioned EU Member States' trade.

4. Empirical Analysis

4.1 Description of the Data

In the following empirical analysis, equations (11) to (13) will be used to calculate the skill content of the bilateral trade of the six Western European countries of Austria, Denmark, France, Germany, the Netherlands and Sweden. In this way, the reciprocal trade of these countries and, for comparison, their trade with the Eastern European countries of Hungary, Poland, Slovakia and the Czech Republic will be analyzed. Strictly speaking, investigating such a few bilateral trade flows does not allow to draw back on overall labor market outcomes in the Western European countries, since the four Eastern European countries considered do only account for a small fraction in Western European countries total trade. However, the analyses provide insight into the skill content of trade between the similarly developed Western European countries and, for comparison, between Western and Eastern European countries with lower per capita incomes. This allows to conclude on factor demand shifts resulting from East-West trade.

According to equations (11) to (13), identifying the factor content of exports and imports requires the following data: firstly, the (f x i) direct factor input matrices of countries m (B^m) and n (B^n), containing the inputs of production factors, in this case labor input by qualifications, in each industry i. Secondly, in order to capture intermediate inputs, it is necessary to calculate input coefficients between industries i from the input-output tables of countries A^m and A^n, respectively. Finally, bilateral export and import vectors about industries i are necessary to determine the factor content of export production and imports. These are drawn from the OECD STAN database[5], which offers bilateral trade data classified by the International Standard Industrial Classification of All Economic Activities (ISIC Rev. 3). The input-output tables for countries m and n required for calculating intermediate factor input coefficient

[5] OECD, STAN Bilateral Trade Database, http://www.oecd.org/sti/btd

matrices were drawn from Eurostat. These are classified by NACE Rev. 2/CPA, which is the EU specialization of ISIC, and provide data for 59 industries.

Direct factor input matrices for different EU Member States are provided by EU KLEMS, offering data on total hours worked (per year) for the total economy and, differing from country to country, a minimum of 25 industries (manufacturing *and* services classified by NACE), as well as a subdivision of working hours into high-, medium- and low-skilled employees.[6] These data allow a calculation of total working hours for all three skill groups by industry. However, according to EU KLEMS, the cross-country comparability of data on employment by skill-level cannot be guaranteed (Kangasniemi et al. 2007). For instance, for some countries, data are taken from labor force surveys, whereas in other cases, use has been made of establishment surveys or a social-security database or a mix of sources (O'Mahony et al. 2007). For the present study, this is of course a serious problem. In order to overcome these shortcomings, Eurostat Labor Force Surveys were taken into account, whose international comparability is, according to Eurostat, "….*considerably higher than that of any other existing set of statistics on employment and unemployment for EU Member States*" (European Commission 2003, p.11).[7] However, Eurostat Labor Force Surveys only provide data on the number of employees by qualification for the economy as a whole. Against this background, in the case of Eurostat Labor Force Surveys, the shares of the high-, medium- and low-skilled in total employment were calculated and compared to the shares of these skill groups in total working hours displayed by EU KLEMS (for total economy). Following this, for each skill group, the relation of the share in total employment obtained from Eurostat data to that obtained from EU KLEMS was determined. Finally, these quotients were taken as a multiplier to adjust the proportion of skill groups (in total working hours) in each industry in the EU KLEMS tables.[8] With these "adjusted" shares, total working hours for the high-, the medium- and the low-skilled were calculated for each industry.[9]

[6] The fact that Eurostat input-output tables are disaggregated into 59 industries, but EU KLEMS employment data into only 25 industries does not pose a problem, since both Eurostat and EU KLEMS data follow the NACE/CPA classification system (2-digit). Input-output data can therefore easily be aggregated to the 25 industries for which employment data are provided by EU KLEMS.

[7] This is due to the recording of the same set of characteristics in each country, a close correspondence between the EU list of questions and the national questionnaires, the use of the same definitions for all countries, the use of common classifications and the data being centrally processed by Eurostat.

[8] The fact that Eurostat reports the number of employees and EU KLEMS working hours for each skill group would only cause problems if working hours of the high-, medium and low-skilled differed radically from country to country. In such cases, the original data in the EU KLEMS tables in working hours by level of qualification could be distorted by this adjustment procedure. But this is seemingly not the case.

[9] Thereby, it is assumed that Eurostat data on employment by qualification deviate systematically, i.e. not only on an aggregate level, but also in single industries, from employment data provided by EU KLEMS due to divergent types of survey. While Eurostat data are entirely based on labor force surveys, EU KLEMS data are only partially taken from labor force surveys, but for some countries also from establishment surveys and from social-security databases for others. All calculations were also

Table A-1 in the appendix offers an overview of the data sources and industries considered. In the following section, empirical results of the analyses for 2005 are presented. This is the last year for which input-output tables and factor input matrices are available for all the countries considered.

4.2 Measuring the Skill Content of Trade

Skill content of intra-European trade flows calculated with identical technologies

In this sub-section, the high-, medium and low-skill content of Western European countries` exports and imports will be calculated on a bilateral basis. In the first step, it will be assumed that imports and exports are only horizontally differentiated, if at all, which means that production technologies and factor inputs in trading partner countries *n* are the same as in the respective reporting country *m*.

Calculating the high-, medium- and low-skill content in bilateral trade requires bilateral trade vectors, i.e. bilateral trade by industries data provided by OECD. As can be seen from table A-1, such data are only available for goods, not for services. This shortcoming will be addressed in two ways. In a first mode of calculation, it is assumed that the composition of *bilateral* trade in goods and services is similar to the composition of countries' *total* goods and services exports and imports. For the latter, data are available from input-output tables. Hence, the relation of single services exports and imports to country *m*'s *total* manufacturing exports and imports, respectively, is calculated from input-output tables. These coefficients are then used for estimating notional *bilateral* trade volumes in the services sectors. In a second mode of calculation, it will be assumed that bilateral trade in services does not take place at all. This means that in the bilateral export and import vectors, trade flows are set to zero in the services sectors. In fact, services are of minor importance in international trade. For five of the countries considered, in 2005, the year underlying the calculations, the share of services ranges from only 14% (in German exports) to 26% (in Austrian exports). Services trade is only of relevance to Denmark, since the share of services amounts to 34% of total exports and to 33% of total imports (according to balance of payments statistics for 2005).

The results for the first mode of calculation (including notional services trade) are reflected in table 1 (the results for the second mode of calculation, without services trade, can be found in table A-2 in the appendix). Since in the case of trade imbalances net exports of factor services calculated by equation (10) would be biased and not comparable across countries, high-, medium- and low-skill content of trade is displayed separately for exports and imports. Since the international comparability of skill content of exports and imports is also impeded by the differences in size of the countries concerned, skill content is expressed by working hours of high-, medium- and low-

performed with the original EU KLEMS data. The results of these calculations do not substantially differ and are provided on request.

skilled employees per 1000 Euro of bilateral exports and imports. Thus, the values in columns 3 to 5 in table 1 indicate the number of working hours of high-, medium- and low-skilled workers necessary for producing 1000 Euro of output in country *m*, which is exported to country *n*. In contrast, the values displayed in columns 6 to 8 of the table show the working hours of high-, medium- and low-skilled workers required for producing 1000 Euro of output in country *n*, which is then imported by country *m*. If, for instance, the input of low-skilled workers for the production of goods imported from country *n* exceeds the input of low-skilled workers for export production in country *m*, bilateral trade between countries *m* and *n* should be beneficial for the low-skilled in country *n* but unfavorable for the low-skilled in country *m*.[10]

According to the results presented in table 1, the high-, medium- and low-skill content of exports and imports in bilateral trade of the six Western European countries is quite similar if identical production technologies are assumed for trading partner countries (i.e. if the skill content of imports is computed by using input-output tables and factor input matrices of country *m*). This does not only hold for reciprocal trade of the Western European countries, but also for East-West trade. While in the case of bilateral trade between the Western European countries this result could have been expected, one would theoretically expect that exports from Western to Eastern Europe should be especially less low-skill intensively manufactured than imports. But this is only the case for Austria, whose imports from Eastern Europe are slightly more low-skill intensive than the corresponding exports. In contrast, the French, the Dutch, the German and the Swedish exports to Eastern Europe are, with the exception of German and Swedish exports to Slovakia, less high-skill intensively manufactured than imports from those countries. The same holds for trade between Austria and the Czech Republic as well as for trade between Denmark and Hungary, Poland and Slovakia.[11] If trade in services is excluded, by tendency, high-, medium- as well as low-skill content of trade decreases marginally (table A-2 in the appendix). It would appear that this result owes something to the fact that employees of all skill levels in the services sector are less productive than their counterparts in manufacturing. This is quite plausible, since production in manufacturing is much more capital intensive than production in the services sector.

[10] Strictly speaking, this is of course also only the case if trade between countries *m* and *n* is balanced.

[11] Theoretically, high-, medium- and low-skilled factor services embodied in exports from country *m* to country *n* should of course equal the high-, medium- and low-skilled factor services embodied in the imports of country *n* from country *m*. This is not always the case since total export values declared from country *m* to country *n* in industries *i* are not identical to the imports of country *n* from country *m* in industries *i* declared in trade statistics. This might arise from the fact that imports are generally reported on the basis of cost, insurance and freight, while exports are reported on a free on board basis.

Table 1: Factor Content of Trade of Western European Countries in 2005 (identical technologies)

Working hours of high-, medium- and low-skilled per 1000 Euro of exports and imports -

Country m	Trading Partner n	Factor content of country m's exports			Factor content of country m's imports		
		High-Skilled	Medium-Skilled	Low-Skilled	High-Skilled	Medium-Skilled	Low-Skilled
Austria	Denmark	3.16	18.64	5.13	3.2	19.68	5.82
	France	3.17	18.57	5.1	3.15	18.2	5.02
	Germany	3.18	18.63	5.13	3.15	18.53	5.21
	Netherlands	3.17	18.85	5.32	3.1	21.19	6.96
	Sweden	3.18	18.76	5.24	3.2	17.68	4.69
	Czech Republic	3.13	18.37	5.03	3.15	19.93	6.04
	Hungary	3.15	18.35	5.01	3.12	20.38	6.38
	Poland	3.18	18.32	4.97	2.98	18.86	5.6
	Slovakia	3.14	18.03	4.83	3.08	19.73	6.03
Denmark	Austria	3.15	6.46	3.49	3.39	6.51	3.27
	France	2.92	5.93	3.24	3.36	6.26	3.25
	Germany	3.0	6.48	3.67	3.33	6.41	3.27
	Netherlands	2.67	5.46	3.07	3.53	6.35	3.53
	Sweden	2.84	5.61	3.07	3.44	6.33	3.2
	Czech Republic	3.27	6.35	3.31	3.15	6.43	3.15
	Hungary	3.17	6.51	3.33	3.37	6.26	3.08
	Poland	3.16	6.48	3.56	3.24	6.51	3.58
	Slovakia	3.25	6.36	3.23	3.52	6.73	3.38
France	Austria	3.86	7.33	4.66	4.04	7.52	4.92
	Denmark	3.84	7.64	4.97	3.78	7.89	5.05
	Germany	3.86	7.43	4.78	3.83	6.81	4.27
	Netherlands	3.83	7.93	5.25	3.67	8.13	5.68
	Sweden	3.83	7.03	4.39	3.89	6.81	4.32
	Czech Republic	3.87	7.12	4.46	4.13	7.12	4.4
	Hungary	3.83	6.98	4.34	4.12	7.28	4.55
	Poland	3.83	7.06	4.43	4.0	7.76	5.12
	Slovakia	3.88	7.09	4.41	4.22	7.5	4.75
Germany	Austria	3.8	10.27	2.97	3.97	10.01	2.79
	Denmark	3.88	10.61	3.11	4.19	11.68	3.53
	France	3.89	9.85	2.75	3.85	9.61	2.73
	Netherlands	3.78	10.49	3.11	3.74	10.57	3.31
	Sweden	3.93	10.01	2.81	3.9	9.98	2.8
	Czech Republic	3.88	10.05	2.83	4.05	9.84	2.69
	Hungary	4.0	9.83	2.69	4.37	9,75	2.56
	Poland	3.76	9.98	2.84	4.01	10.66	3.05
	Slovakia	4.0	9.89	2.71	3.98	9.3	2.48

Sources: Eurostat, EU KLEMS, OECD, own calculations

Table 1 (continued): Factor Content of Trade of Western European Countries in 2005 (identical technologies)

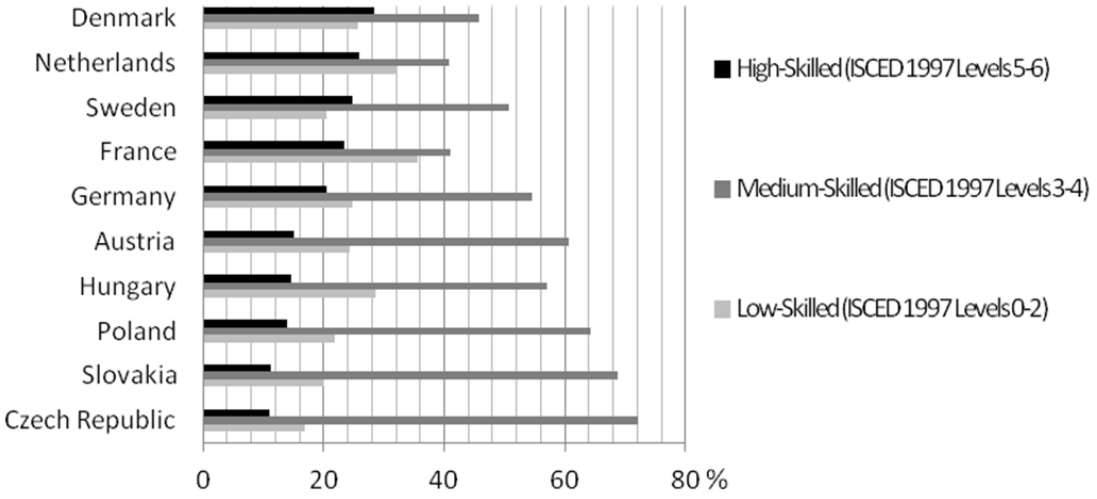
Working hours of high-skilled and lower-qualified per 1000 Euro of exports and imports -

Country m	Trading Partner n	Factor content of country m's exports			Factor content of country m's imports		
		High-Skilled	Medium-Skilled	Low-Skilled	High-Skilled	Medium-Skilled	Low-Skilled
Netherlands	Austria	3.38	6.35	4.43	3.82	6.6	4.82
	Denmark	3.53	6.64	4.58	3.34	5.82	4.06
	France	3.24	6.07	4.28	3.57	6.1	4.12
	Germany	3.22	6.07	4.28	3.44	5.86	4.07
	Sweden	3.53	6.56	4.44	3.73	6.35	4.45
	Czech Republic	3.59	6.48	4.19	3.9	6.46	4.06
	Hungary	3.58	6.51	4.25	4.02	6.74	4.11
	Poland	3.44	6.46	4.49	3.79	6.7	4.71
	Slovakia	3.43	6.37	4.35	3.97	6.51	3.95
Sweden	Austria	3.86	9.21	2.75	3.57	8.49	2.92
	Denmark	3.37	8.74	2.94	3.08	8.24	2.96
	France	3.36	8.43	2.71	3.33	7.48	2.29
	Germany	3.34	8.43	2.7	3.43	7.99	2.45
	Netherlands	3.39	8.62	2.75	3.31	8.62	2.8
	Czech Republic	3.29	8.68	2.81	3.54	7.95	2.35
	Hungary	3.56	8.22	2.5	3.87	7.48	2.11
	Poland	3.39	9.25	3.17	3.43	8.36	2.74
	Slovakia	3.5	8.61	2.67	3.36	9.18	3.06

Sources: Eurostat, EU KLEMS, OECD, own calculations

While the closely balanced skill content of trade between the Western European countries is quite logical, different results might have been expected for trade between Western and Eastern European countries. Figure 1 depicts the shares of the high-skilled (persons with tertiary education), the medium-skilled (persons with upper- and post-secondary education) and the low-skilled (persons with pre-primary, primary and lower-secondary education) in the total population of the countries considered in 2005. As could be expected, the share of human capital in the total population is higher in Western than in Eastern European countries. But interestingly, this does not mean that in Eastern Europe, the share of the low-skilled in total population is higher than in the West. Instead, in the Czech Republic and Slovakia, the share of the low-skilled in total population is even lower than in all of the Western European countries considered. In contrast, in Eastern Europe, except Hungary, the group of the medium-skilled is by far larger than in Western Europe. This might suggest that international trade between Western and Eastern European countries is harmful especially for the medium-skilled in Western European countries. Against this background, in the following sub-section, the high-, medium- and low-skill content in bilateral trade relations will be identified by using national input-output and factor input data for each country.

Figure 1: Share of High-, Medium- and Low-Skilled Persons in Total Population in 2005



Source: Eurostat, own calculations

Skill content of intra-European trade flows calculated with technology differences

In the following, for each country *m*, the high-, medium- and low-skill content of imports will be calculated on the basis of the factor input matrices and input-output tables of trading partner countries *n* (equation (13)). In this way, international technology differences and vertical product differentiation are taken into account. Table 2 reflects the computational results for high-, medium- and low-skill content of imports and exports.[12] The results without notional services trade can be found in table A-3 in the appendix.

As indicated in table 2, skill content of bilateral exports and imports differs much more if trading partner countries' technology and factor input matrices are used for calculating the factor content of imports, even in bilateral trade between the Western European countries. With respect to the latter, high-skill content of exports and imports is quite similar. While the low-skill content of bilateral exports and imports differs only a little, the medium-skill content of Western European countries' bilateral exports and imports is rather imbalanced. As far as bilateral trade between the Western and the Eastern European countries is concerned, imports from Eastern Europe, especially from Poland, require a higher input of all skill groups than exports from the West to the East. In particular, high-, but especially the medium-skill content of exports from Western to Eastern Europe is *lower* than high- and medium-skill content of imports.

[12] Although the latter are identical with the values in table 1, they are nevertheless again presented in this table in order to facilitate the comparison of skill content of exports and imports.

Table 2: Factor Content of Trade of Western European Countries in 2005 (different technologies)

Working hours of high-skilled and lower-qualified per 1000 Euro of exports and imports –

Country m	Trading Partner n	Factor content of country m's exports			Factor content of country m's imports		
		High-Skilled	Medium-Skilled	Low-Skilled	High-Skilled	Medium-Skilled	Low-Skilled
Austria	Denmark	3.16	18.64	5.13	3.5	6.55	3.41
	France	3.17	18.57	5.1	3.84	7.14	4.57
	Germany	3.18	18.63	5.13	3.86	10.19	2.93
	Netherlands	3.17	18.85	5.32	3.43	6.41	4.56
	Sweden	3.18	18.76	5.24	3.34	8.55	2.72
	Czech Republic	3.13	18.37	5.03	5.88	47.84	3.95
	Hungary	3.15	18.35	5.01	7.63	36.19	9.42
	Poland	3.18	18.32	4.97	10.88	54.01	7.32
	Slovakia	3.14	18.03	4.83	4.13	31.67	2.1
Denmark	Austria	3.15	6.46	3.49	3.23	19.27	5.25
	France	2.92	5.93	3.24	4.02	7.86	5.1
	Germany	3.0	6.48	3.67	3.94	10.95	3.3
	Netherlands	2.67	5.46	3.07	3.74	7.03	5.15
	Sweden	2.84	5.61	3.07	3.47	8.86	2.95
	Czech Republic	3.27	6.35	3.31	6.07	46.27	3.5
	Hungary	3.17	6.51	3.33	7.09	31.75	7.0
	Poland	3.16	6.48	3.56	11.92	61.35	8.54
	Slovakia	3.25	6.36	3.23	5.12	42.71	2.61
France	Austria	3.86	7.33	4.66	3.18	18.21	5.02
	Denmark	3.84	7.64	4.97	3.1	5.44	2.91
	Germany	3.86	7.43	4.78	3.87	9.41	2.61
	Netherlands	3.83	7.93	5.25	3.3	6.03	4.44
	Sweden	3.83	7.03	4.39	3.18	7.99	2.54
	Czech Republic	3.87	7.12	4.46	5.05	39.55	2.98
	Hungary	3.83	6.98	4.34	5.4	25.3	6.28
	Poland	3.83	7.06	4.43	10.56	51.85	5.96
	Slovakia	3.88	7.09	4.41	4.0	30.87	1.79
Germany	Austria	3.8	10.27	2.97	3.17	18.08	4.95
	Denmark	3.88	10.61	3.11	3.08	6.16	3.46
	France	3.89	9.85	2.75	3.75	6.94	4.45
	Netherlands	3.78	10.49	3.11	3.2	5.8	4.17
	Sweden	3.93	10.01	2.81	3.18	8.23	2.66
	Czech Republic	3.88	10.05	2.83	5.35	42.59	3.37
	Hungary	4.0	9.83	2.69	5.43	24.96	6.05
	Poland	3.76	9.98	2.84	10.85	54.38	6.75
	Slovakia	4.0	9.89	2.71	3.35	25.42	1.46

Sources: Eurostat, EU KLEMS, OECD, own calculations

Table 2 (continued): Factor Content of Trade of Western European Countries in 2005 (different technologies)

Working hours of high-skilled and lower-qualified per 1000 Euro of exports and imports -

Country m	Trading Partner n	Factor content of country m's exports			Factor content of country m's imports		
		High-Skilled	Medium-Skilled	Low-Skilled	High-Skilled	Medium-Skilled	Low-Skilled
Netherlands	Austria	3.38	6.35	4.43	3.27	18.24	5.13
	Denmark	3.53	6.64	4.58	3.1	5.57	3.06
	France	3.24	6.07	4.28	3.98	7.67	4.97
	Germany	3.22	6.07	4.28	3.96	10.43	3.02
	Sweden	3.53	6.56	4.44	4.37	10.49	3.27
	Czech Republic	3.59	6.48	4.19	5.92	41.07	2.93
	Hungary	3.58	6.51	4.25	6.34	26.01	6.33
	Poland	3.44	6.46	4.49	11.84	59.26	8.88
	Slovakia	3.43	6.37	4.35	4.6	29.8	1.62
Sweden	Austria	3.86	9.21	2.75	3.3	17.82	4.83
	Denmark	3.37	8.74	2.94	3.17	5.14	2.71
	France	3.36	8.43	2.71	3.95	6.58	4.1
	Germany	3.34	8.43	2.7	4.01	9.41	2.66
	Netherlands	3.39	8.62	2.75	3.89	6.33	4.32
	Czech Republic	3.29	8.68	2.81	5.98	40.74	2.98
	Hungary	3.56	8.22	2.5	5.79	24.29	5.7
	Poland	3.39	9.25	3.17	11.0	47.82	4.83
	Slovakia	3.5	8.61	2.67	4.79	32.28	1.89

Sources: Eurostat, EU KLEMS, OECD, own calculations

But with respect to the low-skill content of trade, only the exports of Western European countries to Hungary and Poland, in case of Germany and Sweden also to the Czech Republic, are manufactured with a lower input of low-skilled workers than the corresponding imports.[13] This is quite interesting, since one would probably have expected that exports from Western to Eastern Europe are especially less low-skill intensively manufactured than the corresponding imports. Overall, this suggests that bilateral trade between the selected Western and Eastern European countries should be harmful especially to the medium-skilled workers in Western countries. By implication, East-West trade should be beneficial especially to the medium-, but less for the low-skilled in Eastern Europe. This corresponds to the finding that employment prospects of persons having attained less than upper secondary education are unfavorable not only in Western, but also in Eastern European countries (Varga 2007, Juergens and Krzywdzinski 2007). Beside others, this might be due to the fact that skill-levels in

[13] As before, the results for the second mode of calculation depicted in table A-3 in the appendix reveal that, by tendency, high-, medium- and low-skill content of trade is a little bit lower if services are excluded. But overall, the results are similar to those of the first mode of calculation including notional trade in services.

Eastern Europe, especially in Hungary, the Czech Republic and Slovakia, are an important determinant for foreign direct investment in those countries, since foreign investors do not primarily seek for low-skilled employees (Lankes and Venables 1997, Pye 1998, Elteto and Sass 1998). The results would also support the hypothesis that pressure on the low-skilled in Western countries is based less on international trade than on skill-biased technological progress (Krugman 1994). Moreover, these results are largely in line with differences in factor endowments, since Eastern European countries are, according to figure 1, especially much more medium-skill abundant than most of the Western European countries considered. Overall, the calculations demonstrate that the high-, medium- and low-skill content of exports and imports differs quite markedly in trade between countries with different factor endowments. This result is obtained by allowing for product differentiation, resulting from divergent factor inputs and/or technology matrices.

4.3 Assessment of the Empirical Findings

As the empirical analyses have shown, Western European countries' imports from Eastern Europe require a higher input of high-, partially low-, but especially medium-skilled labor than exports to that region. This is at least the case if vertical product differentiation is allowed for. Hence, the hypothesis that East-West trade is harmful only for the low-skilled in Western countries is not supported empirically. This is in accordance with findings of other analyses with respect to labor market outcomes of trade with Eastern European countries (e.g. Damijan et al. 2011, Commander and Kollo 2008, Woerz 2003).[14]

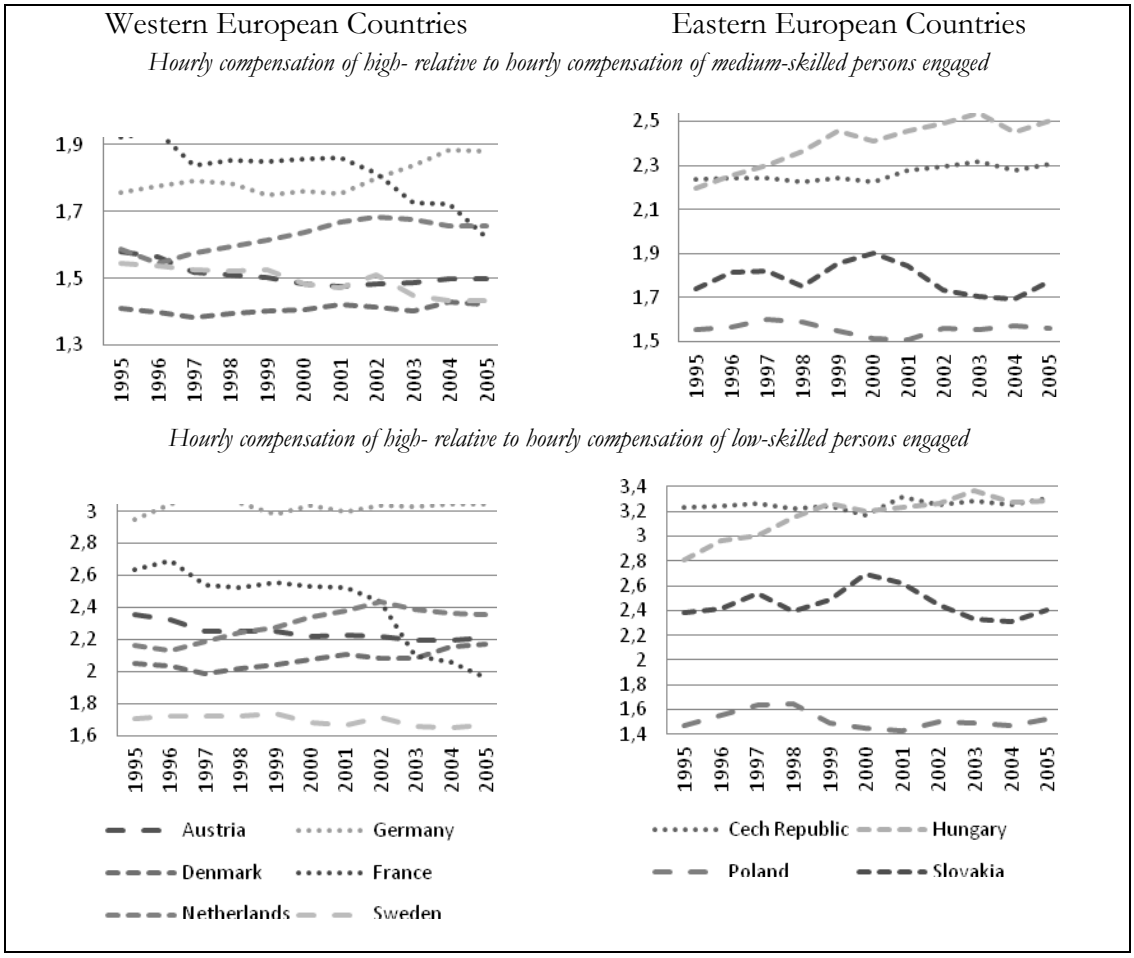
Interestingly, the empirical results obtained for the skill content of East-West trade do at least partially reflect in the development of relative wages. Figure 2 shows the relation of hourly earnings of the high-skilled to hourly earnings of the medium-skilled on the one hand and to hourly earnings of the low-skilled on the other.[15] If imports of the Western European countries from Eastern European trading partners were much more medium-skill intensively manufactured than the corresponding exports, ceteris paribus, wage spread between the high- and the medium-skilled should have increased in Western and should have decreased in Eastern European countries in the course of specialization. With respect to the Western European countries, from 1995 to 2005, the year underlying the empirical analyses, only in Germany, the Netherlands and, suggestively, in Denmark, the relation of hourly wages of the high-skilled to hourly wages of the medium-skilled increased. But for none of the Eastern European countries, a decrease in this ratio is observable. As far as wage spread between

[14] However, since it is generally accepted that transitions between the two groups of medium- and low-skilled are quite smooth (Kangasniemi et al. 2007), East-West trade might still be harmful also for the low-qualified in Western countries, if their level of qualification is similar to that of the medium-skilled in Eastern Europe.

[15] Hourly earnings in different skill groups were generated from data on total compensation and total working hours of employees from different skill groups offered by EU KLEMS.

the high- and the low-skilled is concerned, the latter did also only increase in Germany, Denmark and the Netherlands, which might be a result of higher demand for high-skilled relative to low-skilled labor. However, in the other three Western European countries, this ratio decreased. Moreover, in the Eastern European countries considered, wage spread does not indicate a demand shift towards low-skilled labor. In contrast, in Hungary, wages of the high-skilled increased much more than wages of the low-skilled. These observations would be in line with the empirical results obtained for the skill content of bilateral trade, implying that East-West trade is not *primarily* harmful for the low-skilled in Western countries.

Figure 2: Relative Wages in Western and Eastern European Countries



Sources: EU KLEMS, OECD, own calculations

Of course, drawing inferences from the empirical results for the skill content of trade on relative wages is difficult. First, the bilateral trade relations considered do only account for a small amount of countries' total trade. Hence, it is hardly possible to conclude on total factor price developments. Second, the latter are determined also by other factors, such as the power of trade unions or other institutional arrangements like social security benefits. Third, a critical assumption of the HO-model is flexible factor

prices. In reality, demand shifts for different skill groups must not necessarily lead to varying relative factor prices, but could also result in unemployment.

5. Conclusions

In the wake of globalization, Western European high-wage countries have experienced rising unemployment among the lower-qualified, which is often ascribed to the integration of the Central and Eastern European as well as the Newly Industrializing Asian Economies into the international division of labor. In this context, human capital-abundant countries are expected to specialize in capital- and high-skill-intensively manufactured goods. As the analyses have shown, imports of selected Western European countries from Eastern European trading partners require higher inputs of workers of all skill-levels than the corresponding exports, but especially of medium-skilled workers. Seemingly, East-West trade in Europe is not primarily harmful for the low-skilled in Western European high-wage countries. This suggests some policy implications. For instance, in Western European countries, selective policies towards different skill groups, not only limited to the low-qualified, are required. Moreover, the outcomes of European East-West trade do probably differ from industry to industry. Of course, in some industries, East-West trade might be harmful primarily to the low-skilled in Western European countries. Thus, one aim should focus on increasing inter-industrial worker mobility and/or a sufficient flexibility of wages. The empirical results comply with the fact that unemployment of the low-skilled is not only a problem in Western, but also in Eastern Europe. Since high unemployment of the low-skilled is probably largely due to skill-biased technological change, policy should also aim at increasing labor force qualification. This is especially the case for the Western European countries, where the share of the low-skilled in total population is, at least according to EUROSTAT data, even larger than in most of the Eastern European countries. Finally, in view of the fact that unemployment of the low-skilled in the context of European integration is not limited to Western European countries, the temporary arrangements introduced in order to impede the free movement of workers between new Eastern European and Western European EU member states should be scrutinized.

References

Baldwin R.E. (1971), 'Determinants of the Commodity Structure of U.S. Trade', *American Economic Review*, **61**, 126-146

Bowen H., Leamer E., Sveikauskas L. (1987), 'Multicountry, Multifactor Tests of the Factor Abundance Theory', *American Economic Review*, **77**, 791-809

Cabral M., Falvey R., Milner C. (2009), 'Does Skill Content Explain Total Trade and Intra-Industry Trade?', *Oxford Bulletin of Economics and Statistics,* **71 (5)**, 601-619

Cabral M., Falvey R., Milner C. (2006), 'The Skill Content of Inter- and Intra-Industry Trade: Evidence for the UK', *Review of World Economics,* **142**, 546-566

Choi Y.S., Krishna P. (2004) 'The Factor Content of Trade: An Empirical Test', *Journal of Political Economy*, **112 (4)**, 887-914

Commander S., Kollo, J. (2008), 'The Changing Demand for Skills: Evidence from Transition', *Economics of Transition*, **16 (2)**, 199-221

Damijan J.P., Rojec M., Ferjancic M. (2011), 'The growing Performance of Transition Economies: EU Market Access versus Supply Capacity Factors, *Panoeconomicus*, **58 (4)**, 489-509

Dasgupta P., Dhar A., Chakraborty D. (2009), 'Some Further Evidence on the Factor Content of India's Foreign Trade', *wired* at <http://www.iioa.org/pdf/17th%20Conf/Papers/1046452179_090529_093632_FULLPAPER-CONFERENCE2009.PDF/11-19-10>

Davis D.R., Weinstein D.E. (2003), 'The Factor Content of Trade', in Choi K. and Harrigan J. (eds.), *Handbook of International Trade*, Oxford.

Davis D.R., Weinstein D.E. (2001), 'An Account of Global Factor Trade', *American Economic Review,* **91 (5)**, 1423-1453

Deardorff A. (1982), 'The General Validity of the Heckscher-Ohlin Theorem', *American Economic Review,* **72 (4)**, 683-694

Elteto A., Sass M. (1998), 'Motivations and Behaviour of Foreign Investors in Hungary with Respect to their Export Activity', *IWE Working Paper*, Budapest

Engelbrecht H.J. (1996), 'The Composition of the Human Capital Stock and the Factor Content of Trade: Evidence for West(ern) Germany', *Economic Systems Research*, **8 (3)**, 271-297

European Commission (2003), *The European Union Labour Force Survey – Methods and Definitions 2001*, Luxemburg

Eurostat (2009), *Quality Report on External Trade Statistics*, Revised Edition 2009, Brussels

Falvey R., Kierzkowski H. (1987), 'Product Quality, Intra-Industry Trade and (Im)Perfect Competition', in Kierzkowski H. (ed.), *Protection and Competition in International Trade*, Oxford.

Feenstra R.C. (2004), *Advanced International Trade: Theory and Evidence*, Princeton, Princeton University Press.

Flam H., Helpman E. (1987), 'Vertical Product Differentiation and North-South Trade', *American Economic Review*, **77**, 810-822

Freeman, B. (1995), 'Are Your Wages Set in Beijing?', *The Journal of Economic Perspectives*, **9 (3)**, 15-32

Hakura D.S. (1999), 'A Test of the General Validity of the Heckscher-Ohlin Theorem for Trade in the European Community', *IMF Working Paper*, 9970

Harrigan J. (1997), 'Technology, Factor Supplies, and International Specialization: Estimating the Neoclassical Model', *American Economic Review,* **87 (4)**, 475-494

Helpman E. (1981), 'International Trade in the Presence of Product Differentiation, Economies of Scale and Monopolistic Competition – A Chamberlin/Heckscher-Ohlin Approach', *Journal of International Economics*, **11**, 305-340

Helpman E. (1984), 'The Factor Content of Foreign Trade', *Economic Journal,* **94**, 84-94

Juergens U., Krzywdzinski M. (2007), 'Zukunft der Arbeitsmodelle in Polen: Institutionelle Entwicklungen und Strategien transnationaler Unternehmen der Automobilindustrie', *Discussion Paper,* **SP III 2007-301**, Social Science Research Centre Berlin

Kangasniemi M. *et al.* (2007), *EU KLEMS Growth and Productivity Accounts*, Version 1.0, Part I – Methodology, wired at: <http://www.euklems.net/data/EUKLEMS_Growth_and_Productivity_Accounts_Part_I_Methodology.pdf/11-19-10>

Kravis I.B. (1956), 'Wages and Foreign Trade', *Review of Economics and Statistics,* **38**, 14-30

Krugman P (1994), 'Past and Prospective Causes of High Unemployment', *Economic Review of the Federal Reserve Bank of Kansas City,* **4**, 23-43

Lai H., Zhu S.C. (2007), 'Technology, Endowments, and the Factor Content of Bilateral Trade', *Journal of International Economics,* **71**, 389-409

Lankes H.P., Venables A:J: (1997), 'Foreign Direct Investment in Eastern Europe and the former Soviet Union: Results from a Survey of Investors', in Zecchini S. (ed), *Lessons from the Economic Transition: Central and Eastern Europe in the 1990s*, Dordrecht, Kluwer

Leamer E. (1980), 'The Leontief Paradox Reconsidered', *Journal of Political Economy*, **88 (3)**, 495-503

Leontief W. (1953), 'Domestic Production and Foreign Trade: The American Capital Position Re-Examined', *Proceedings of the American Philosophical Society,* **97**, 332-349

Lundberg L., Wiker P. (1997), 'Skilled Labor and International Specialization in OECD Countries', *International Review of Applied Economics,* **11 (3)**, 369-385

Maskus K.E. (1985), 'A Test of the Heckscher-Ohlin-Vanek Theorem: The Leontief Commonplace', *Journal of International Economics,* **19**, 201-212

Melvin J.R. (1968), 'Production and Trade with two Factors and three Goods', *American Economic Review,* **58**, 1249-1268

Nishioka S. (2006), 'An Explanation of OECD Factor Trade with Knowledge Capital and the HOV Model', *Discussion Papers in Economics, Working Paper*, **05-06** , University of Colorado at Boulder

O'Mahony M., van Ark B., Timmer M. (2007), 'EU KLEMS Growth and Productivity Accounts: An Overview' *International Productivity Monitor,* **14**, 71-85

Pye R.B.K. (1998), 'Foreign Direct Investment in Central Europe: The Experiences of Major Western Investors', *European Management Journal*, Special Issue 'Russia and Central and Eastern Europe'

Staiger R.W. (1988), 'A Specification Test of the Heckscher-Ohlin Theory', *Journal of International Economics,* **25 (1-2)**, 129-141

Torstensson J. (1992), 'Factor Endowments, Product Differentiation and International Trade', *Lund Economic Studies*, **47**, Lund

Trefler D. (1995), 'The Case of the Missing Trade and other Mysteries: Reply', *American Economic Review,* **93**, 1029-1046

Trefler D. (1993), 'International Factor Price Differences: Leontief was Right!', *Journal of Political Economy,* **101 (6)**, 961-987

Vanek J. (1968), 'The Factor Proportions Theory: The N-Factor Case', *Kyklos,* **21**, 749-756

Varga J. (2007), 'Labour Market Trends in Hungary 2007', in Fazekas K., Cseres-Gergely Z. and Scharle A. (eds), *The Hungarian Labour Market - Review and Analysis 2008*, Budapest, Institute of Economics, Hungarian Employment Foundation

Webster A. (1993), 'The Skill and Higher Educational Content of UK Net Exports', *Oxford Bulletin of Economics and Statistics,* **55 (2)**, 141-159

Widell L.M. (2005), 'On Measurements of the Factor Content of Trade: The Case of Sweden', *ESI Working Paper Series*, **2005:7**, Örebro

Woerz J. (2003), 'Skill Upgrading in Central and Eastern European Manufacturing Trade', *The Empirical Economic Letters*, **2 (6)**, 247-256

Wood A. (1995), 'How Trade hurt unskilled Workers', *Journal of Economic Perspectives,* **9 (3)**, 57-80

Appendix

Table A-1: Data Sources and Classifications

Industry	Employment by Qualification (EU KLEMS)	Input-Output Tables (Eurostat)	Bilateral Trade Data (OECD STAN Bilateral Trade Database)
	NACE Rev. 1, Code No.	CPA, Code No.	ISIC Rev. 3, Code No.
Agriculture, Hunting, Forestry and Fishing	01, 02, 05	01, 02, 05	01-02
Mining and Quarrying	10-12	10-14	10-14
Food, Beverages and Tobacco	15-16	15-16	15-16
Textiles, Leather and Footwear	17-19	17-19	17-19
Wood and Wood Products	20	20	20
Pulp, Paper and Paper Products; Publishing and Printing	21-22	21-22	21-22
Chemical Products, Rubber, Plastics, Fuel and other Non-Metallic Mineral Products	23-26	23-26	23-26
Basic Metals and Fabricated Metal Products	27-28	27-28	27-28
Machinery n.e.q.	29	29	29
Electrical and Optical Equipment	30-33	30-33	30-33
Transport Equipment	34-35	34-35	34-35
Manufacturing n.e.q.	36-37	36-37	36-37
Electricity, Gas and Water Supply	40-41	40-41	40-41
Construction	45	45	n.a.
Wholesale and Retail Trade	50-52	50-52	n.a.
Hotels and Restaurants	55	55	n.a.
Transport and Storage	60-63	60-63	n.a.
Post and Telecommunications	64	64	n.a.
Financial Intermediation	65-67	65-67	n.a.
Real Estate Activities, Renting of Machinery and Equipment and other Business Activities	70-74	70-74	n.a.
Public Admin. and Defense; Compulsory Social Security	75	75	n.a.
Education	80	80	n.a.
Health and Social Work	85	85	n.a.
Other Community, Social and Personal Services	90-93	90-93	n.a.
Activities of Households	95-97	95	n.a.

Table A-2: Factor Content of Trade of Western European Countries in 2005 (identical technologies), without notional trade in services

Working hours of high-skilled and lower-qualified per 1000 Euro of exports and imports -

Country m	Trading Partner n	Factor content of country m's exports			Factor content of country m's imports		
		High-Skilled	Medium-Skilled	Low-Skilled	High-Skilled	Medium-Skilled	Low-Skilled
Austria	Denmark	3.05	18.62	5.25	2.82	18.32	5.55
	France	3.06	18.53	5.21	3.0	18.12	5.08
	Germany	3.08	18.61	5.25	3.0	18.52	5.31
	Netherlands	3.06	18.9	5.5	2.95	21.71	7.4
	Sweden	3.07	18.79	5.39	3.06	17.51	4.68
	Czech Republic	3.0	18.27	5.11	3.25	21.85	6.82
	Hungary	3.03	18.24	5.08	2.97	20.74	6.71
	Poland	3.07	18.2	5.03	2.8	18.92	5.78
	Slovakia	3.01	17.82	4.85	2.92	19.96	6.29
Denmark	Austria	3.11	6.67	3.59	3.07	6.81	3.37
	France	2.73	5.77	3.16	3.02	6.43	3.34
	Germany	2.87	6.7	3.88	2.97	6.66	3.38
	Netherlands	2.3	4.97	2.87	3.26	6.57	3.76
	Sweden	2.59	5.23	2.87	3.14	6.54	3.28
	Czech Republic	3.33	6.49	3.28	2.71	6.69	3.21
	Hungary	3.16	6.74	3.32	3.04	6.43	3.1
	Poland	3.06	6.71	3.7	2.85	6.8	3.83
	Slovakia	3.29	6.5	3.14	3.25	7.13	3.54
France	Austria	3.54	6.94	4.59	3.82	7.5	5.01
	Denmark	3.51	7.33	4.98	3.51	7.92	5.16
	Germany	3.53	7.06	4.71	3.57	6.7	4.28
	Netherlands	3.49	7.69	5.33	3.39	8.2	5.88
	Sweden	3.5	6.56	4.26	3.64	6.7	4.33
	Czech Republic	3.55	6.68	4.33	3.91	7.05	4.42
	Hungary	3.5	6.51	4.19	3.9	7.23	4.6
	Poland	3.49	6.61	4.31	3.76	7.78	5.24
	Slovakia	3.55	6.64	4.27	4.0	7.48	4.83
Germany	Austria	3.74	9.03	2.47	3.89	9.82	2.68
	Denmark	3.83	10.19	2.91	3.15	8.91	2.68
	France	3.85	9.28	2.45	3.75	9.36	2.61
	Netherlands	3.71	10.05	2.91	3.63	10.46	3.28
	Sweden	3.89	9.47	2.55	3.81	9.78	2.69
	Czech Republic	3.84	9.52	2.58	3.54	8.54	2.27
	Hungary	3.98	9.27	2.41	4.36	9.51	2.41
	Poland	3.69	9.44	2.59	3.94	10.57	2.97
	Slovakia	3.98	9.33	2.44	3.9	9.0	2.32

Sources: Eurostat, EU KLEMS, OECD, own calculations

Table A-2 (continued): Factor Content of Trade of Western European Countries in 2005 (identical technologies), without notional trade in services

Working hours of high-skilled and lower-qualified per 1000 Euro of exports and imports -

Country m	Trading Partner n	Factor content of country m's exports			Factor content of country m's imports		
		High-Skilled	Medium-Skilled	Low-Skilled	High-Skilled	Medium-Skilled	Low-Skilled
Netherlands	Austria	2.97	5.81	4.05	3.26	6.36	4.88
	Denmark	3.16	6.18	4.24	2.65	5.38	3.92
	France	2.8	5.46	3.86	2.94	5.74	4.0
	Germany	2.78	5.45	3.86	2.77	5.44	3.94
	Sweden	3.16	6.07	4.06	3.14	6.04	4.42
	Czech Republic	3.25	5.98	3.74	3.36	6.19	3.92
	Hungary	3.23	6.01	3.81	3.51	6.55	3.99
	Poland	3.05	5.95	4.12	3.22	6.49	4.75
	Slovakia	3.04	5.84	3.94	3.46	6.25	3.79
Sweden	Austria	3.17	8.48	2.79	3.01	8.78	2.99
	Denmark	3.04	8.42	3.02	2.72	8.3	3.19
	France	3.02	7.98	2.7	3.03	7.35	2.35
	Germany	3.0	7.99	2.69	3.16	7.99	2.55
	Netherlands	3.08	8.25	2.76	3.34	8.62	3.14
	Czech Republic	2.93	8.33	2.84	3.31	7.94	2.42
	Hungary	3.31	7.69	2.41	3.71	7.35	2.12
	Poland	3.07	9.13	3.35	3.16	8.45	2.91
	Slovakia	3.22	8.23	2.64	3.07	9.49	3.32

Sources: Eurostat, EU KLEMS, OECD, own calculations

Table A-3: Factor Content of Trade of Western European Countries in 2005 (different technologies), without notional trade in services

Working hours of high-skilled and lower-qualified per 1000 Euro of exports and imports –

Country m	Trading Partner n	Factor content of country m's exports			Factor content of country m's imports		
		High-Skilled	Medium-Skilled	Low-Skilled	High-Skilled	Medium-Skilled	Low-Skilled
Austria	Denmark	3.05	18.62	5.25	3.0	6.02	3.11
	France	3.06	18.53	5.21	3.54	6.85	4.5
	Germany	3.08	18.61	5.25	3.72	9.64	2.7
	Netherlands	3.06	18.9	5.5	3.03	6.04	4.29
	Sweden	3.07	18.79	5.39	3.12	8.27	2.67
	Czech Republic	3.0	18.27	5.11	5.05	49.03	4.36
	Hungary	3.03	18.24	5.08	6.43	33.76	9.63
	Poland	3.07	18.2	5.03	9.85	54.96	8.02
	Slovakia	3.01	17.82	4.85	3.1	29.08	2.09
Denmark	Austria	3.11	6.67	3.59	3.11	18.92	5.32
	France	2.73	5.77	3.16	3.54	7.41	5.04
	Germany	2.87	6.7	3.88	3.83	10.19	2.92
	Netherlands	2.3	4.97	2.87	3.23	6.42	4.48
	Sweden	2.59	5.23	2.87	3.08	8.45	3.0
	Czech Republic	3.33	6.49	3.28	4.14	40.56	3.49
	Hungary	3.16	6.74	3.32	4.71	23.8	6.2
	Poland	3.06	6.71	3.7	10.73	66.39	10.89
	Slovakia	3.29	6.5	3.14	3.96	42.6	2.85
France	Austria	3.54	6.94	4.59	3.05	18.35	5.13
	Denmark	3.51	7.33	4.98	2.79	5.35	2.93
	Germany	3.53	7.06	4.71	3.8	9.26	2.49
	Netherlands	3.49	7.69	5.33	2.88	5.8	4.3
	Sweden	3.5	6.56	4.26	3.0	7.9	2.56
	Czech Republic	3.55	6.68	4.33	3.99	37.61	2.97
	Hungary	3.5	6.51	4.19	4.38	23.5	6.2
	Poland	3.49	6.61	4.31	9.84	53.02	6.36
	Slovakia	3.55	6.64	4.27	3.21	30.01	1.8
Germany	Austria	3.74	9.03	2.47	3.06	18.26	5.08
	Denmark	3.83	10.19	2.91	2.09	4.66	2.68
	France	3.85	9.28	2.45	3.48	6.81	4.49
	Netherlands	3.71	10.05	2.91	2.79	5.54	4.03
	Sweden	3.89	9.47	2.55	3.0	8.11	2.69
	Czech Republic	3.84	9.52	2.58	3.79	36.19	3.04
	Hungary	3.98	9.27	2.41	4.22	22.51	5.91
	Poland	3.69	9.44	2.59	10.0	56.06	7.3
	Slovakia	3.98	9.33	2.44	2.41	23.49	1.42

Sources: Eurostat, EU KLEMS, OECD, own calculations

Table A-3: (continued): Factor Content of Trade of Western European Countries in 2005 (different technologies), without notional trade in services

Working hours of high-skilled and lower-qualified per 1000 Euro of exports and imports -

Country m	Trading Partner n	Factor content of country m's exports			Factor content of country m's imports		
		High-Skilled	Medium-Skilled	Low-Skilled	High-Skilled	Medium-Skilled	Low-Skilled
Netherlands	Austria	2.97	5.81	4.05	3.05	18.74	5.43
	Denmark	3.16	6.18	4.24	2.47	5.21	3.03
	France	2.8	5.46	3.86	3.47	7.62	5.26
	Germany	2.78	5.45	3.86	3.77	10.09	2.92
	Sweden	3.16	6.07	4.06	3.2	8.12	2.63
	Czech Republic	3.25	5.98	3.74	3.91	36.95	2.91
	Hungary	3.23	6.01	3.81	4.28	22.35	6.35
	Poland	3.05	5.95	4.12	10.16	63.65	10.37
	Slovakia	3.04	5.84	3.94	3.05	27.19	1.6
Sweden	Austria	3.17	8.48	2.79	3.06	18.26	5.07
	Denmark	3.04	8.42	3.02	2.54	4.98	2.74
	France	3.02	7.98	2.7	3.46	6.45	4.17
	Germany	3.0	7.99	2.69	3.9	9.36	2.51
	Netherlands	3.08	8.25	2.76	3.12	6.06	4.1
	Czech Republic	2.93	8.33	2.84	4.08	38.12	3.03
	Hungary	3.31	7.69	2.41	3.97	21.55	5.52
	Poland	3.07	9.13	3.35	9.77	49.84	5.36
	Slovakia	3.22	8.23	2.64	3.39	32.07	1.99

Sources: Eurostat, EU KLEMS, OECD, own calculations