Trade Integration, Production Disintegration and Equalisation of Factor Prices

Laura Márquez-Ramos*

Abstract

This paper aims to formalise a conceptual framework based on Vernon's product cycle theory and the Heckscher–Ohlin model, which allows trade in intermediate goods to explain the impact of trade integration on high-skilled and low-skilled wages. An empirical analysis is carried out to analyse if increased trade integration in the European Union, and thereafter increased outsourcing from well-established EU countries to new developing and transition members, is leading to an equalisation of factor prices.

Total word count: 5,645

* Assistant Professor, PhD. Department of Economics and Institute of International Economics, Universitat Jaume I, Campus del Riu Sec, 12071 Castellón, Spain. Tel: +34 964387166, Fax: +34 964728591, Email: lmarquez@eco.uji.es

Abstract

This paper aims to formalise a conceptual framework based on Vernon's product cycle theory and the Heckscher–Ohlin model, which allows trade in intermediate goods to explain the impact of trade integration on high-skilled and low-skilled wages. An empirical analysis is carried out to analyse if increased trade integration in the European Union, and thereafter increased outsourcing from well-established EU countries to new developing and transition members, is leading to an equalisation of factor prices.

Keywords: production networks, intermediate goods, low-skilled and high-skilled wages

JEL Classification: F11, F16

1. Introduction

Classical thinking, which stressed international differences in technology in conjunction with international differences in real wage levels as a source of comparative advantage, dominated trade theory until the appearance of the Heckscher–Ohlin (H–O) theory, which centred on resource endowments as the main factor explaining international trade patterns. Nevertheless, with the development of the product cycle theories (Vernon, 1966), technology came once again to the forefront of trade-related research. Along these lines, Jones and Bhagwati (1970) considered the way in which the H–O model could be applied to Vernon's product cycle theory by arguing that developed countries will tend to have a comparative advantage in producing new commodities at early stages of production.

More recently, Jones and Kierzkowski (2004) suggest that the theory of international trade should put more emphasis on trade in intermediate goods and goods in process. A production process can be separated into different fragments, and production of a fragment may be located in the same country or in a different one. Of course, a particular final

commodity could be produced in a vertically integrated process, with all the activity taking place locally. Nonetheless, the total cost of production output might be lowered by outsourcing[1] some fragments of the integrated activity. Since, according to Vernon (1966), less developed countries take over labour-intensive production, Jones and Kierzkowski (2004) state that "In Vernon's hands [reinterpretation for production] explains a sequence whereby there is a continual outsourcing of production towards less developed areas as techniques simplify, accompanied by ever-emerging new products and technologies being developed in advanced areas".[2]

Feenstra (1998) has already argued that by allowing for trade in intermediate goods, outsourcing has a qualitatively similar effect on reducing the demand for low-skilled relative to high-skilled labour[3] within an industry as does technology, through innovation and communication improvements. Furthermore, empirical research shows that increased fragmentation of production will not only lead to a reduction in wages for low-skilled workers, but also to higher wages for high-skilled workers in developed countries (Feenstra and Hanson, 1999; Hijzen, Görg and Hine, 2005; Geishecker and Görg, 2005).

Feenstra and Taylor (2008) develop a two-country model of outsourcing, which predicts an increase of the relative demand for high-skilled labour in both countries, along with an increase in the relative wage of high-skilled labour because of increased outsourcing. As these authors point out, "this result is one of the most important predictions from [their] model of outsourcing and would not occur from [their] earlier models of trade, such as the

[1] As in Feenstra and Taylor (2008), we use the term outsourcing whenever the components or parts of a good are produced in several countries, regardless of the ownership of the plants that provide the components or parts.
[2] Jones and Kierzkowski (2004), page 10.
[3] Workers who have relatively little education or training are considered to be low-skilled labour, whereas those workers who have greater skills are considered to be high-skilled labour.

Heckscher-Ohlin model."[4] To arrive at this result, these authors ordered a continuum of activities in the value chain, from low-skilled (assembly and component production) to high-skilled (marketing and sales, R&D), and assumed that the home (developed) country outsources its lowest skill-intensive activities, which will be the highest skill-intensive activities in the destination country. This assumption is not very realistic, as developed countries might carry out assembly operations and component production.[5] In fact, the authors fail to provide evidence in the case of the United States and Mexico; in the case of the non-*maquiladora* (cross-border assembly) plants in Mexico, the evidence is that the relative wages of high-skilled workers fell after the formation of the North American Free Trade Agreement (NAFTA).

Grossman and Rossi-Hansberg (2008) propose a theory based on "task trade" to decompose the effects of a fall in outsourcing costs, based on productivity, labour-supply and relative-price effects. The productivity effect works to the benefit of the factor whose tasks are being moved abroad (low-skilled labour). Outsourcing frees up domestic low-skilled workers, who have to be reabsorbed into the labour market. In turn, the labour-supply effect might harm low-skilled workers and benefit domestic high-skilled workers, as their marginal product increases because trade increases relative low-skill-intensity. Finally, when analysing the relative-price effect, these authors have to assume different production technologies in countries to show that an increase in fragmentation in a large developed economy will decrease the relative price of the low-skill-intensive good, harming the relative price of the low-skilled labour and rewarding high-skilled labour (in line with

[4] Feenstra and Taylor (2008), page 238.
[5] For example, Dedrick, Kraemer and Linden (2010) find that Toshiba, a Japanese component supplier, captures the highest value in iPod supply chain in 2005. Then, iPods are assembled in China, which value added from final assembly is 3.86$, and exported to the United States with an estimated factory cost of 144.56$.

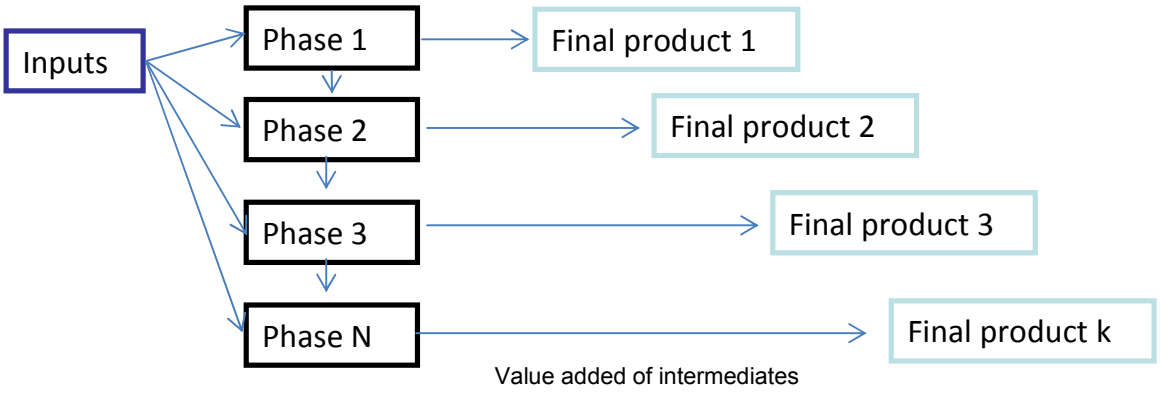
Stolper and Samuelson, 1941). Nonetheless, trade in goods studies have not yet formalised a theory that allows trade in intermediate goods to explain the impact of trade integration on wages.

To cover the lack of economic literature, this paper motivates a conceptual framework based on H-O and Vernon's (1966) product-life cycle, which relates fragmentation, trade in goods and consequences on the labour markets. In an empirical application, the particular case of the advanced European Union (EU) regional integration process is analysed. The rest of the paper is organised as follows: Section 2 presents the conceptual framework. Section 3 describes data and variables. Section 4 presents the empirical analysis. Finally, Section 5 concludes.

2. Conceptual framework

We base our conceptual framework on Vernon's product cycle theory as well as on the H-O model. In order to do so, we distinguish between final and intermediate goods. Figure 1 summarises a vertically integrated production network where different inputs can be used in different phases of the productive process and, additionally, intermediate goods obtained in the different phases can be used in the production of both final and intermediate goods for consumers in national or foreign markets. It is worth noting that the longer the vertical production network, the higher the number of phases or fragments (N) in the production process of a final product (k) and hence, we assume that the added value of intermediate goods over the final product k increases. Furthermore, the longer the vertical production network, the more likely it is that a firm disintegrates production and outsources some fragments of the integrated activity.

Figure 1. Vertically integrated production network



Source: Own elaboration

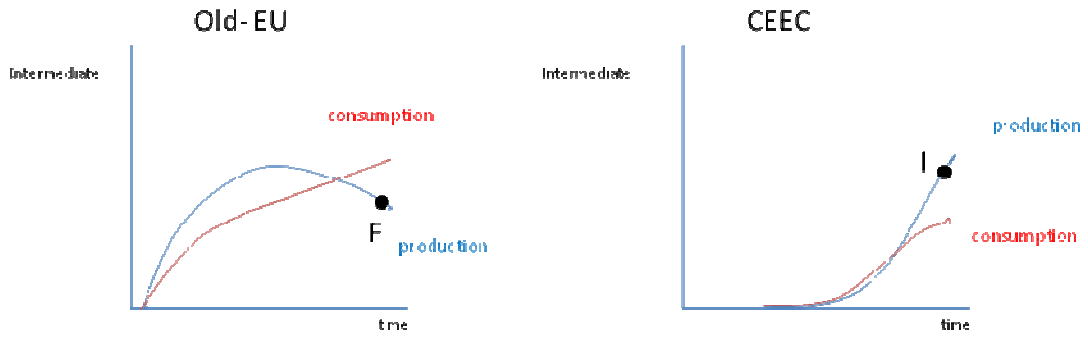
Vernon (1966) considers different stages in the life of a product. In the early stages of the introduction of a new product, price elasticity of demand for the output is comparatively low due to the high degree of product differentiation or the existence of imperfect competition, and hence the cost of inputs is not as relevant as it is in more advanced stages of the life cycle, in which production costs begin to become significant with regard to product characteristics. If labour cost differences are large enough to offset trade, then international fragmentation of production processes could make sense. Consequently, developed countries might export goods in process to developing countries, developing countries might process these goods and then export these intermediate goods to developed countries, which assemble and sell the final good.

When demand for a particular product increases, and a certain degree of standardisation takes place, increases in the consumption of the final product could lead to an increase in the consumption of the intermediate inputs associated with the final good. Additionally, at an advanced stage in the standardisation of the final product, other countries might offer competitive advantages as production locations, and hence the production of the

intermediate good could decrease in developed countries and increase in developing countries.[6]

In the case of the EU, European agreements established bilateral free trade between the EU members and each individual Central Eastern European Country (CEEC) in most industrial products by the end of 1994. Furthermore, the majority of CEECs have gained full accession into the EU common market since 2004 (2007 for the case of Bulgaria and Romania). Accession of the CEECs to the EU might have fostered the integration of production networks between old-EU members and CEEC countries as follows: in the initial stages, old-EU developed countries are net exporters of a particular intermediate good required for the production of a final good, whereas in the advanced stages, old-EU countries are net importers. Otherwise, in the initial stages, CEEC developing and transition countries are net importers of a particular intermediate good required for the production of a final good (which they can then use in the production of other goods), whereas in the advanced stages CEEC countries are net exporters.

Figure 2. Product-life cycle of an intermediate good



Source: Own elaboration

[6] Therefore, trade in goods of similar factor intensities, or intra-industry trade, is possible under an H-O-Vernon framework, as an intermediate might use the same technology in both countries, although a particular intermediate might present a product-life cycle that induces specialisation in developed countries in the initial stages and specialisation in developing countries in the advanced stages of the life cycle.

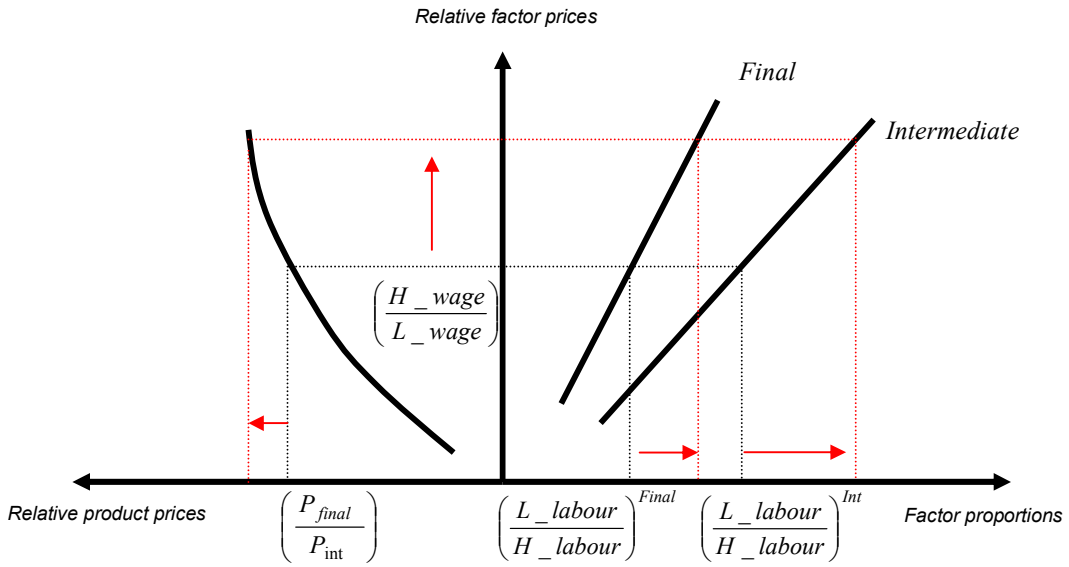
H-O theory leads to the theorem of the equalisation of factor prices, thus relative factor prices converge with trade openness as do relative product prices (Samuelson, 1948). When allowing trade in intermediate goods, efficiency gains might bring costs in terms of income distribution, and hence the decision of companies to spread production across countries has distributional consequences that cannot be ignored.

In order to test if outsourcing makes factor-price equalisation more or less likely in the EU integration process, we assume that intermediate goods are low-skill-labour intensive in an advanced stage of product-life cycle, where perfect competition can be assumed, whereas the corresponding final goods are high-skill-labour intensive. Therefore, those countries abundant in high-skilled labour specialise in the production of final goods (point F in Figure 2) and those countries abundant in low-skilled labour specialise and export intermediate goods (point I in Figure 2). The well-known Stolper-Samuelson theorem will lead to lower relative wages for low-skilled workers and higher relative wages for high-skilled workers in the high-skill abundant country, as the relative price of the final (high-skill-intensive) good increases and marginal product of high-skilled workers increases because trade increases relative low-skill-intensities. Analogously, as the relative price of intermediates (low-skill-intensive) increases in the low-skill abundant country, relative wages for low-skilled workers will increase and relative wages for high-skilled workers will decrease. This process is summarised in Figure 3, where * denotes international relative prices, *P* and *wage* denote product and factor prices, *H (L)* denotes high (low) – skill, *final* refers to a final good and *int* to a intermediate good.

Figure 3. Stolper-Samuelson theorem and equalisation of factor-prices with intermediate goods in the high-skill abundant country

$$\left(\frac{P_{final}}{P_{\text{int}}}\right)^{H\_abundant} \leq \left(\frac{P_{final}}{P_{\text{int}}}\right)^{*} \leq \left(\frac{P_{final}}{P_{\text{int}}}\right)^{L\_abundant}$$

$$\left(\frac{H\_wage}{L\_wage}\right)^{H\_abundant} \leq \left(\frac{H\_wage}{L\_wage}\right)^{*} \leq \left(\frac{H\_wage}{L\_wage}\right)^{L\_abundant}$$



Source: Own elaboration[7]

3. Data and variables

To choose one representative old-EU country and one CEEC, we start by considering the differences in factor endowments within EU countries. The two factors to be considered are high-skill and low-skill labour. We then use data relating to the educational attainment of the total population aged 15 and over from Barro and Lee (2000). On the one hand, countries such as Germany and Sweden are among the countries whose population has a higher number of average years of schooling, and the highest endowment of high-skilled workers. On the other hand, in southern member states such as Italy, Slovenia and Spain,

[7] Modified figure utilised by Krugman and Obstfeld (2006) for the case of two final goods, page 61.

there is a comparably larger proportion of low-skilled population. Therefore, the empirical analysis is based on two countries: Germany (old-EU) and Slovenia (CEEC).

We obtain trade data from Eurostat from the year 1995 to 2007 by NACE revision 1[8] to analyse comparative advantages over time and EU KLEMS database on output, input and productivity (O'Mahony and Timmer, 2009) to construct a data series that reflects the content on intermediates within manufacturing industries and labour compensation per hour (NACE sectors 15–37).[9] We construct two variables, *Intermediate Content* and labour *Compensation per hour*, which are calculated as the ratio of the value of intermediate inputs (in millions of Euros) and the value of gross output (in millions of Euros), and as the ratio of the compensation of employees (in millions of Euros) and the total hours worked by employees (millions) as denoted in equation (1) and (2), respectively:

$$Intermediate\_content_{jt} = \frac{INT_{jt}}{Y_{jt}} \quad (1)$$

$$Compensation\_hour_{jt} = \frac{COMP_{jt}}{HOUR_{jt}} \quad (2)$$

where j denotes the respective two-digit NACE manufacturing industry, INT the value of intermediate inputs, Y the industry's output value, COMP denotes labour compensation and HOUR denotes hours worked by employees in a particular industry.

Geishecker and Görg (2005) classify industries as low-skill and high-skill-intensive on the basis of German household information. We then follow this classification to distinguish between high-skill and low-skill-intensive industries. As in the H-O model, we assume that those industries that are intensive in one factor in Germany are also intensive in the same factor in Slovenia.

[8] EU-27 Trade since 1995 by CPA 2002.
[9] See Table A.1 in Appendix.

The first part of Table 1 presents the evolution from 1995 to 2007 of the content in intermediates of manufactures in Germany, and the second part of Table 1 presents the evolution of labour compensation per hour. The last column reports "high" when the value of that particular industry in the last year for which we have data is higher than the average, "low" otherwise. Table 2 presents the evolution from 1995 to 2006 of the indicators obtained in equations (1) and (2) for Slovenia.

These figures indicate that wood, chemical and transport industries have experienced the highest increase in intermediate content in Germany. Otherwise, these industries have experienced a decrease in intermediate content in Slovenia. This result reveals the creation of a strong and complex integration relationship through various stages of production in Germany, which might be outsourcing a number of fragments to CEECs to benefit from lower production costs. Furthermore, this result also reveals an increasing specialisation and, probably, cost reductions attributable to production volume increases in particular fragments in Slovenia, which can then be used in the production of both final and intermediate goods for domestic consumers or foreign markets, such as Germany. Finally, Tables 1 and 2 show that wages have increased over time in both Germany and Slovenia, and that this increase is higher in Slovenia, therefore reducing the existing wage gap.

Table 1. Intermediate Content and Labour Compensation per hour in Germany

Intermediate Content																	
Industry description	**NACE**	**Skill-intensity**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**% increase**	**Comparison to average**
FOOD , BEVERAGES AND TOBACCO	15 to 16	Low	0.72	0.73	0.73	0.72	0.71	0.72	0.73	0.72	0.72	0.73	0.74	0.75	0.76	4.35	high
TEXTILES, TEXTILE , LEATHER AND FOOTWEAR	17 to 19	Low	0.67	0.67	0.67	0.67	0.68	0.68	0.69	0.67	0.67	0.67	0.67	0.68	0.69	3.51	low
WOOD AND OF WOOD AND CORK	20	Low	0.63	0.62	0.62	0.62	0.63	0.62	0.64	0.66	0.66	0.65	0.68	0.69	0.70	12.42	high
PULP, PAPER, PAPER , PRINTING AND PUBLISHING	21 to 22	21: Low 22: High	0.59	0.58	0.59	0.58	0.59	0.60	0.61	0.61	0.61	0.61	0.61	0.62	0.63	6.77	low
CHEMICAL, RUBBER, PLASTICS AND FUEL	23 to 25		0.65	0.65	0.65	0.65	0.67	0.69	0.68	0.67	0.68	0.69	0.70	0.71	0.72	10.13	high
Coke, refined petroleum and nuclear fuel	23	Low	0.91	0.88	0.86	0.81	0.92	0.87	0.82	0.87	0.90	0.90	0.92	0.90	0.93	2.24	high
Chemicals and chemical	24	High	0.62	0.62	0.63	0.64	0.65	0.66	0.66	0.64	0.65	0.64	0.64	0.66	0.66	7.13	low
Rubber and plastics	25	Low	0.60	0.58	0.59	0.59	0.59	0.61	0.61	0.60	0.61	0.61	0.62	0.64	0.65	9.07	low
OTHER NON-METALLIC MINERAL	26	Low	0.57	0.57	0.58	0.58	0.58	0.59	0.60	0.60	0.60	0.61	0.62	0.62	0.63	9.70	low
BASIC METALS AND FABRICATED METAL	27 to 28	27: High 28: Low	0.62	0.62	0.63	0.62	0.61	0.63	0.63	0.62	0.62	0.64	0.65	0.66	0.69	9.73	low
MACHINERY, NEC	29	High	0.59	0.59	0.59	0.59	0.60	0.61	0.61	0.59	0.60	0.60	0.61	0.63	0.64	8.19	low
ELECTRICAL AND OPTICAL EQUIPMENT	30 to 33	High	0.59	0.59	0.60	0.61	0.61	0.61	0.65	0.62	0.61	0.61	0.62	0.62	0.63	6.30	low
TRANSPORT EQUIPMENT	34 to 35	High	0.67	0.69	0.69	0.71	0.73	0.76	0.74	0.73	0.73	0.74	0.75	0.74	0.75	12.14	high
MANUFACTURING NEC; RECYCLING	36 to 37	Low	0.61	0.60	0.61	0.61	0.62	0.63	0.62	0.63	0.63	0.64	0.65	0.65	0.66	9.56	low
Labour compensation per hour																	
Industry description	**NACE**	**Skill-intensity**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**% increase**	**Comparison to average**
FOOD , BEVERAGES AND TOBACCO	15 to 16	Low	14.76	15.06	15.47	16.10	16.51	16.78	17.50	17.82	18.53	18.26	18.66	18.64	18.91	28.16	low
TEXTILES, TEXTILE , LEATHER AND FOOTWEAR	17 to 19	Low	16.98	17.97	18.26	18.51	18.65	19.66	19.83	20.24	21.22	20.99	22.17	22.17	22.72	33.79	low
WOOD AND OF WOOD AND CORK	20	Low	18.09	18.89	18.15	17.72	18.10	18.29	18.71	20.37	21.07	20.71	20.49	21.01	21.17	17.06	low
PULP, PAPER, PAPER , PRINTING AND PUBLISHING	21 to 22	21: Low 22: High	21.34	22.17	23.36	23.88	20.18	21.09	20.94	21.30	21.87	21.76	21.37	21.18	21.82	2.23	low
CHEMICAL, RUBBER, PLASTICS AND FUEL	23 to 25		27.96	28.82	28.77	29.25	29.68	31.65	32.44	31.95	33.18	33.32	34.28	34.94	36.08	29.05	high

Coke, refined petroleum and nuclear fuel	23	Low	27.87	34.42	36.25	38.16	43.51	45.00	48.92	52.97	48.57	51.21	53.87	51.61	53.55	92.12	high
Chemicals and Chemicals	24	High	32.19	32.87	32.49	33.60	34.33	37.55	38.29	37.38	39.25	39.71	41.38	42.62	44.24	37.44	high
Rubber and plastics	25	Low	21.86	22.60	23.06	22.96	22.87	23.59	24.43	24.05	24.70	24.97	25.06	25.25	25.92	18.59	low
OTHER NON-METALLIC MINERAL	26	Low	21.01	22.05	22.10	22.66	23.43	24.27	24.94	25.46	26.04	25.31	26.69	26.68	26.34	25.37	low
BASIC METALS AND FABRICATED METAL	27 to 28	27: High 28: Low	25.40	26.37	26.09	25.72	26.42	26.83	27.78	27.13	27.23	26.89	27.84	28.76	28.96	14.02	low
MACHINERY, NEC	29	High	26.15	27.46	27.74	28.50	29.64	30.86	32.53	33.01	32.84	33.40	33.04	34.25	34.86	33.29	high
ELECTRICAL AND OPTICAL EQUIPMENT	30 to 33	High	25.70	26.56	27.79	27.64	28.73	31.10	30.70	33.73	34.77	35.04	34.76	36.64	36.67	42.71	high
TRANSPORT EQUIPMENT	34 to 35	High	28.68	31.77	32.51	32.60	35.31	38.06	40.28	41.91	42.46	43.29	43.99	48.38	47.76	66.51	high
MANUFACTURING NEC; RECYCLING	36 to 37	Low	20.06	20.86	21.71	22.22	22.49	23.09	23.11	23.34	23.42	23.41	23.52	23.66	23.67	17.98	low

Source: Own elaboration with EU KLEMS data

Table 2. Intermediate Content and Labour Compensation per hour in Slovenia

Intermediate Content																
Industry description	**NACE**	**Skill-intensity**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**% increase**	**Comparison to average**
FOOD , BEVERAGES AND TOBACCO	15 to 16	Low	0.71	0.70	0.69	0.70	0.69	0.71	0.71	0.71	0.69	0.72	0.72	0.74	4.14	high
TEXTILES, TEXTILE , LEATHER AND FOOTWEAR	17 to 19	Low	0.68	0.68	0.68	0.69	0.69	0.71	0.72	0.72	0.74	0.75	0.75	0.74	7.65	high
WOOD AND OF WOOD AND CORK	20	Low	0.72	0.71	0.68	0.68	0.65	0.67	0.66	0.66	0.65	0.66	0.66	0.66	-7.88	low
PULP, PAPER, PAPER , PRINTING AND PUBLISHING	21 to 22	21: Low 22: High	0.70	0.65	0.65	0.65	0.63	0.67	0.65	0.66	0.67	0.68	0.68	0.70	0.00	low
CHEMICAL, RUBBER, PLASTICS AND FUEL	23 to 25		0.67	0.67	0.66	0.65	0.63	0.66	0.65	0.64	0.62	0.63	0.66	0.65	-3.59	low
Coke, refined petroleum and nuclear fuel	23	Low	0.88	0.98	0.92	0.85	0.90	0.96	0.94	0.86	0.81	0.87	0.79	0.68	-23.27	low
Chemicals and Chemicals	24	High	0.66	0.64	0.63	0.64	0.60	0.63	0.62	0.62	0.59	0.61	0.63	0.62	-6.09	low
Rubber and plastics	25	Low	0.66	0.65	0.64	0.65	0.65	0.69	0.68	0.67	0.67	0.68	0.71	0.71	7.36	high
OTHER NON-METALLIC MINERAL	26	Low	0.61	0.62	0.61	0.62	0.59	0.63	0.63	0.64	0.61	0.62	0.63	0.65	6.45	low
BASIC METALS AND FABRICATED METAL	27 to 28	27: High 28: Low	0.70	0.68	0.69	0.67	0.66	0.69	0.69	0.68	0.68	0.71	0.71	0.74	5.44	high
MACHINERY, NEC	29	High	0.72	0.69	0.69	0.69	0.68	0.70	0.70	0.69	0.69	0.70	0.70	0.71	-0.94	high
ELECTRICAL AND OPTICAL EQUIPMENT	30 to 33	High	0.64	0.65	0.63	0.63	0.63	0.67	0.68	0.68	0.67	0.68	0.70	0.72	11.91	high
TRANSPORT EQUIPMENT	34 to 35	High	0.86	0.87	0.89	0.88	0.86	0.87	0.86	0.86	0.84	0.84	0.85	0.83	-3.01	high
MANUFACTURING NEC; RECYCLING	36 to 37	Low	0.63	0.63	0.63	0.62	0.61	0.63	0.63	0.63	0.64	0.64	0.64	0.65	3.40	low
Labour compensation per hour																
Industry description	**NACE**	**Skill-intensity**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**% increase**	**Comparison to average**
FOOD , BEVERAGES AND TOBACCO	15 to 16	Low	4.70	5.35	5.47	5.86	5.83	6.58	7.27	8.15	8.58	9.26	9.14	9.90	110.74	low
TEXTILES, TEXTILE , LEATHER AND FOOTWEAR	17 to 19	Low	3.14	3.41	3.65	3.97	4.30	4.81	5.36	5.78	6.20	6.76	7.02	7.32	133.27	low
WOOD AND OF WOOD AND CORK	20	Low	3.18	3.48	3.88	4.12	4.66	5.16	5.63	5.94	6.56	7.07	7.64	7.96	150.64	low
PULP, PAPER, PAPER , PRINTING AND PUBLISHING	21 to 22	21: Low 22: High	4.97	5.39	6.25	6.92	7.44	8.14	9.04	9.14	9.55	10.41	11.02	11.57	133.01	high
CHEMICAL, RUBBER, PLASTICS AND FUEL	23 to 25		5.16	5.86	6.42	6.98	7.37	8.36	9.61	10.40	11.50	12.28	13.08	13.72	165.76	high

Coke, refined petroleum and nuclear fuel	23	Low	6.06	6.57	6.94	7.09	6.60	7.57	8.41	9.12	8.03	11.11	12.24	11.86	95.68	high
Chemicals and Chemicals	24	High	6.22	6.97	7.68	8.34	8.73	9.84	11.55	12.92	14.56	15.57	16.41	17.33	178.84	high
Rubber and plastics	25	Low	3.94	4.44	4.83	5.40	5.85	6.68	7.46	7.63	8.19	8.70	9.56	10.00	153.51	low
OTHER NON-METALLIC MINERAL	26	Low	3.89	4.33	4.68	5.14	5.76	6.25	6.77	7.20	7.80	8.62	9.00	10.16	161.46	low
BASIC METALS AND FABRICATED METAL	27 to 28	27: High 28: Low	3.78	4.28	4.73	5.24	5.66	6.31	6.92	7.52	8.08	8.71	9.12	9.74	157.67	low
MACHINERY, NEC	29	High	3.05	4.00	4.60	5.08	5.48	6.15	6.69	7.51	8.17	8.94	9.65	10.06	230.04	low
ELECTRICAL AND OPTICAL EQUIPMENT	30 to 33	High	4.13	4.65	5.13	5.55	6.04	6.88	7.64	8.44	9.03	9.41	9.97	10.43	152.51	low
TRANSPORT EQUIPMENT	34 to 35	High	3.78	4.29	4.81	5.46	6.01	6.69	7.42	8.46	8.70	9.44	10.04	10.42	175.47	low
MANUFACTURING NEC; RECYCLING	36 to 37	Low	3.33	3.58	4.11	4.53	4.70	5.54	5.89	6.44	6.91	7.49	7.77	8.12	143.79	low

Source: Own elaboration with EU KLEMS data

4. Empirical analysis

The information provided in Tables 1 and 2 is used to construct a classification matrix of manufacturing industries in Germany (Table 3) and Slovenia (Table 4). Skill-intensity is shown on the horizontal axis, and intermediate content on the vertical axis. The tables are divided into four quadrants, with respect to the different possible combinations of skill-intensity and intermediate content in industries. On the horizontal axis, Quadrants III and IV represent those industries classified as high-skill-intensity, whereas Quadrants I and II represent those industries classified as low-skill-intensity. On the vertical axis, Quadrants I and III represent industries with high intermediate content, whereas Quadrants II and IV represent those industries less susceptible to international fragmentation of production by the presence of a relatively lower content of intermediates. Following these tables, two possible combinations on factor prices can be hypothesised for the industries more likely to disintegrate production (Quadrants I and III). On the one hand, Table 3 represents the old-EU developed country (Germany), abundant in high-skilled labour. Quadrants I and III include both low-skilled and high-skilled workers[10] that work in industries with low-skill intensity and high-skill intensity, respectively. Outsourcing some fragments of the integrated activity in Germany will lead to lower relative wages for low-skilled workers in Quadrant I and higher relative wages for high-skilled workers in Quadrant III. On the other hand, Table 4 represents the new-EU developing country (Slovenia), abundant in low-skilled labour. Outsourcing towards Slovenia will lead to a higher relative price of intermediate goods in Slovenia, which increases intermediate content. We would then expect higher relative wages for low-skilled workers in Quadrant I and lower relative wages for high-skilled workers in Quadrant III.

[10] In line with the assumption of perfect factor mobility within a country.

Table 3. Classification matrix: Expected evolution of wages in Germany (high-skill abundant)

Intermediate content			
High	Quadrant I Lower relative wages of low-skilled workers **15**, **16**, **20**, 23	Quadrant III Higher relative wages of high-skilled workers **34**, **35**
Low	Quadrant II 17, 18, 19, 21, 25, 26, 28, 36, 37	Quadrant IV 22, 24, 27, 29, 30, 31, 32, 33
	Low	*High* *Skill-intensity*

Source: Own elaboration with EU KLEMS data and Geishecker and Görg (2005) classification

Table 4. Classification matrix: Expected evolution of wages in Slovenia (low-skill abundant)

Intermediate content			
High	Quadrant I Higher relative wages of low-skilled workers 15, 16, 17, 18, 19, 25, 28	Quadrant III Lower relative wages of high-skilled workers **27**, **29**, **30**, **31**, **32**, **33**, **34**, **35**
Low	Quadrant II 20, 21, 23, 26, 36, 37	Quadrant IV 22, 24
	Low	*High* *Skill-intensity*

Source: Own elaboration with EU KLEMS data and Geishecker and Görg (2005) classification

Tables 3 and 4 include those industries for which relative wages follow the expected trend (in bold). Thus, there exist lower relative wages of low-skilled workers - as they are below the average in the last year considered - in low-skill-intensive industries. There also exist higher relative wages of high-skilled workers in high-skill-intensive industries in Germany (old-EU member, high-skill abundant), and lower relative wages of high-skilled workers in high-skill-intensive industries in Slovenia (new-EU member, low-skill abundant).

Nonetheless, the data fail to provide evidence of higher relative wages of low-skilled workers in low-skill-intensive industries in Slovenia.

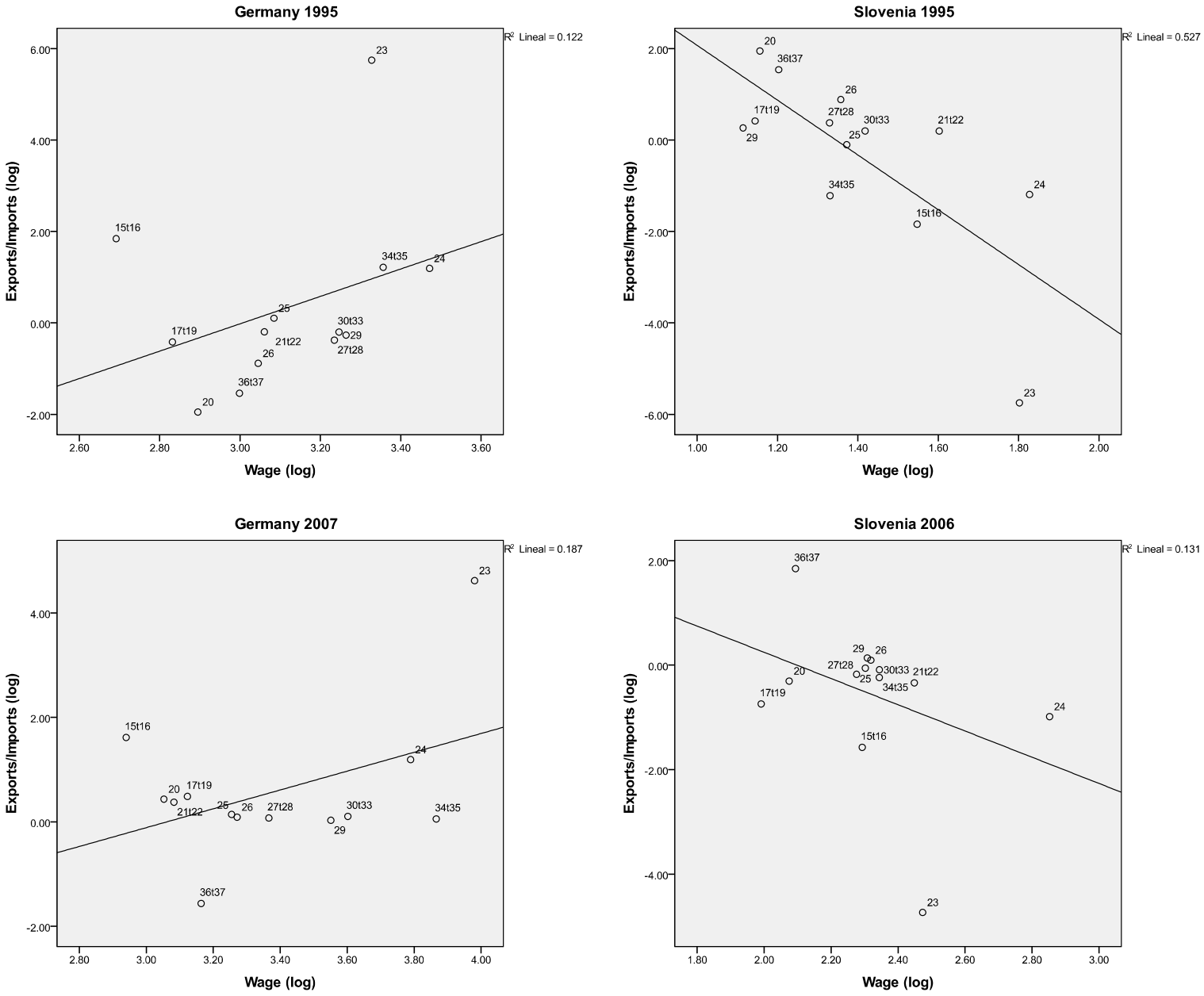
Figure 4 (left part) shows that those industries in Germany with comparative advantages (higher ratio of exports from Germany to Slovenia to exports from Slovenia to Germany) also present a higher level of wages, excluding industries 15 and 16 (Food, beverages and tobacco), which include sensitive products.[11] Industries 34 and 35 (Transport equipment) present the highest wage rates in the year 2007, although the exports/imports ratio has decreased over time. This result might be due to the increase of intermediate imports coming from Slovenia and to higher relative wages for high-skilled workers in these sectors.

Figure 4 (right part) shows an opposite pattern in the year 1995, as those industries with comparative advantages in Slovenia (higher ratio of exports from Slovenia to Germany to exports from Germany to Slovenia) present a lower level of wages. In the year 2006, wage dispersion decreased, and the results are more consistent with the theory, as there is a less steep decreasing slope between comparative advantages and wages. Therefore, recent EU adhesion is not only having consequences on specialisation and trade patterns but also on income distribution. Finally, two outliers[12] can be identified within industries 36 and 37 (Manufacturing and recycling) and 24 (Chemicals). The former presents a comparative advantage and a lower wage level than expected, while the latter presents a comparative disadvantage and a higher wage level than expected. Slovenian labour market rigidity might be behind these figures.

[11] We refer to sensitive products as those products which are susceptible to competition from imports from other country suppliers.

[12] Sector 23 (Coke, refined petroleum and nuclear fuel) remains an outlier in Germany and Slovenia. Similar conclusions are derived when we exclude this sector.

Figure 4. Comparative advantage and wage (in logs) in Germany and Slovenia



Source: Own elaboration with EU KLEMS and Eurostat data

5. Conclusions

This paper aims to formalise a conceptual framework, which allows trade in intermediate goods to explain the impact of trade integration on wages. We empirically analyse if the

free movement of goods equalises factor prices by analysing whether or not high-skilled and low-skilled labour prices in EU countries are converging within the EU regional integration process. Our results provide evidence about the magnitude of potential losses for low-skilled workers in low-skilled industries in developed economies, and potential losses for high-skilled workers in high-skilled industries in developing countries, thereby supporting H-O predictions.

Important policy implications can be derived from this study. First, as trade in intermediate goods is increasing in importance with trade liberalisation; trends towards a more efficient distribution of resources lead to firms in developed countries allocating low-skilled production activities to developing countries, as they face a higher relative wage for low-skilled workers than that found in developing countries. Second, outsourcing will not only reduce the relative wage of low-skilled workers in developed countries, but may also reduce the relative wage of high-skilled workers in developing countries. Therefore, regional trade integration has income distribution consequences that cannot be ignored. Finally, the effect on income distribution might be magnified in advanced regional integration processes which present higher levels of integration between pairs of countries, as is the case in the European single market, where restrictions of the free movement of workers within member states are higher than existing restrictions to capital allocation, and where a number of countries present strong rigidities in labour markets which prevent an adequate response to market fluctuations.

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APPENDIX

Table A.1. List of manufacturing industries

Code	Description
15	Food products and beverages
16	Tobacco products
17	Textiles
18	Wearing apparel; furs
19	Leather and leather products
20	Wood and products of wood and cork (except furniture), articles of straw and plaiting materials
21	Pulp, paper and paper products
22	Printed matter and recorded media
23	Coke, refined petroleum products and nuclear fuel
24	Chemicals, chemical products and man-made fibres
25	Rubber and plastic products
26	Other non-metallic mineral products
27	Basic metals
28	Fabricated metal products, except machinery and equipment
29	Machinery and equipment n.e.c.
30	Office machinery and computers
31	Electrical machinery and apparatus n.e.c.

32	Radio, television and communication equipment and apparatus
33	Medical, precision and optical instruments, watches and clocks
34	Motor vehicles, trailers and semi-trailers
35	Other transport equipment
36	Furniture; other manufactured goods n.e.c.
37	Recovered secondary raw materials