THE IMPACT OF INTERNATIONAL OUTSOURCING ON EMPLOYMENT: EMPIRICAL EVIDENCE FROM EU COUNTRIES[1]

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Abstract:

This paper investigates the impact of international outsourcing on total employment using two-digit manufacturing data for seven EU countries for the period of 1995-2000. Estimates using OLS first differences show that imported materials from the same industry originating from low-wage countries have a significant and negative impact on total employment. The estimates suggest that rising intermediate imports from low-wage countries may account for an approximate reduction of 0.25 percentage points in employment per year. Sample split regressions show that the impact of imported materials from low-wage countries is statistically significant in industries with low skill intensity but not in skill intensive industries such as machinery, electrical, optical and transport equipment.

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1. Introduction

Poor employment performance in manufacturing in the EU15 countries has generated an ongoing debate on the impact of trade with low-wage countries. Increased international outsourcing and import competition are often blamed for the deteriorating labour demand in European manufacturing. Indeed, every European country has experienced an increase in import penetration in manufacturing. Our own calculations suggest that one half of the increase in imports can be attributed to the imports from low-wage countries. The literature is in agreement with the fact that imports from low income Central and Eastern European as well as East Asian countries were the fastest growing components of trade (Bernard et al., 2003; Boston Consulting Group, 2004; Greenaway et al., 1999). This increase in imports is also due to the enlargement of international outsourcing activities in European manufacturing. Between 1995 and 2000 the ratio of imported materials from the same industry to gross output increased from 7.7 percent to 8.8 percent on average (weighted mean across industries and seven EU countries), with sourcing activities from low-wage countries growing by an average rate of 9 percent p.a. over the same time span. The increase in international outsourcing activities may reflect the fact that firms take advantage of low labour costs by way of moving their low-skill intensive areas of production. These goods are then reimported as intermediate inputs. Since less-skill intensive activities still represent a significant part of industrial activities, outsourcing may decrease domestic employment. The poor employment performance could also be due to the adoption of labour saving new technologies. Since the impact of technological change is difficult to measure at the sectoral level, the contribution of international outsourcing from low-wage countries is a question of empirical assessment.

In this paper, we investigate the impact of international outsourcing. In particular, we construct a conceptually narrow measure of outsourcing (i.e. intermediate goods imports from the same industry) in order to investigate the employment effects of international outsourcing.[2] Furthermore, we combine the trade statistics for goods imports and information from input-output tables. This allows us to identify the imported intermediates by their country of origin. Specifically, we distinguish between imported materials from low-wage countries (i.e. new EU member states and developing and newly industrializing countries (NICS)) and high-wage countries (i.e. former EU15 member states and the remaining OECD countries). The labour demand model is estimated by OLS on long differences. Since low-skill intensive industries

[2] Other measures of international outsourcing include outward processing trade data and trade in intermediate goods (see Egger and Egger, 2001) .

might be more prone to outsourcing than skill intensive industries we also investigate whether the degree of outsourcing differs across industries. Finally, we use quantile regression estimators that provide robust estimates, particularly for misspecification errors related not only to non-normality, but also for the presence of outliers. Furthermore, quantile regressions enable us to concentrate on specific parts of the distribution of interest (top and low end of the distribution of employment changes).

There are several empirical contributions on the impact of either import competition or intermediate imports on labour demand. Studies for the US and UK find a negative correlation between employment growth and change in import volumes (Sachs and Shatz, 1994; Greenaway et al., 1999) or a change in import prices (Revenga, 1992). Using a panel of 167 manufacturing industries over the period 1979 to 1991 in the UK, Greenaway, Hine and Wright (1999) find that import penetration has a negative impact on industrial employment. However, the authors find that North-North trade has greater effects on employment than North-South trade. By contrast, based on US manufacturing data, Sachs and Shatz (1994) conclude that industry employment levels fall due to imports from developing rather than developed countries. Revenga (1992) argues that increased import competition has been a major factor in declining employment in US manufacturing. Freeman and Revenga (1999) find for the OECD countries some moderate effects of import competition on employment. Moreover, the authors find evidence that the impact on employment of intra-OECD trade is more important than the impact of non-OECD trade. Neven and Wyplosz (1996) use import prices instead of trade flows as an indicator of international competitive pressure, in which they also find that European industries are affected by competition with developing and developed countries to the same extent. Based on a panel of OECD countries, Landesmann, Stehrer and Leitner (2001) find that import penetration from emerging countries (i.e. Southern Europe and the Asian "tigers") had a significant negative effect on employment growth in the period of 1982-1988, but this effect in turn disappears in the 1990s. Furthermore, the authors find that the effect of outsourcing seems to have been stronger in high-skill intensive industries rather than in low-skill intensive industries. Again, however, this effect disappears in the 1990s.

2. Empirical model and hypotheses

One approach to estimate the effect of international trade on employment is to regress employment against a number of explanatory variables that are derived from a standard labour

demand framework. The standard labour demand augmented by import penetration indicators may be specified by the following regression equation:[3]

$$\ln L_{it} = \beta_0 + \beta_1 \ln Y_{it} + \beta_2 \ln WP_{it} + \beta_3 IMQ_{it} + \beta_4 T + \mu_i + \varepsilon_{it}.$$

Where the left-hand side variable, L_{it} is total employment. Y_{it} denotes value added in constant prices and WP_{it} real wages. The parameters β_1 and β_2 can be interpreted as the wage and output elasticities of labour demand. To capture the impact of international outsourcing various measures are employed. To start with we use total imported materials from the same industry as a percentage of gross output IMQ_{it}. μ_i is a sector effect, T is the time trend and ε_{it} is the error term. Taking first differences gives the following labour demand equation in the first-differenced logarithmic form.

$$\Delta \ln L_i = \alpha_0 + \alpha_1 \Delta \ln Y_i + \alpha_2 \Delta \ln WP_i + \alpha_3 \Delta IMQ_i + \nu_i,$$

where the new error term, $\nu_i \equiv \varepsilon_{it} - \varepsilon_{i,t-1}$, has zero mean and constant variance. Δ refers to the average annual change of the variables between 1995 and 2000. Time differencing of the time trend generates the constant α_0. First differencing also eliminates industry effects and so we can estimate this model using OLS. The coefficient on real wage should be negative, whereas the coefficient on output should be positive. In addition to including the share of total intermediate imports, we also disaggregate imports by country of origin. In particular, we construct import-output ratios for two different groups of countries (i.e. high-wage and low–wage countries).

The main research question to be examined is whether imported materials are a complement or a substitute for domestic employment. A second aim of this paper is to investigate the impact of imported materials from low-wage and high-wage countries. Again, our prime interest refers to the question of whether imported materials from the new EU members and South East Asian countries are a substitute or a complement for domestic employment. Feenstra and Hanson (1999) suggest that the negative employment effects should be higher in industries characterised by a high share of low-skill intensive intermediates. Therefore, we conduct separate regressions for two broad industry groups, one comprising NACE 15-28; 36 summarising medium-skill to low-skill intensive sectors, and the remaining industries (NACE 29-35). We also investigate

[3] In order to compare our results to other studies we do not take the logarithm of the share of imported materials.

whether the degree of international outsourcing is different between declining and expanding industries.

3. Data and descriptive statistics

The data used in the empirical application come from a number of sources. We use data from the OECD STAN database on total employment, real and nominal value added, total wage and compensation as well as gross production. Real wages are calculated as total wage costs divided by the number of employees and deflated by the value added deflator. Employment includes both part and full-time employees. We use EU input-output tables in order to construct the narrow measure of international outsourcing. The narrow measure of international outsourcing is calculated as imported materials from the same two-digit industry and probably best captures the idea of outsourcing, especially because we must rely on the relatively high aggregation level of two-digit industries.

Specifically, we use input-output tables for seven EU countries (Austria, Denmark, Finland, Germany, Italy, the Netherlands and Sweden), which in contrast to other countries' input-output tables, provide direct information on imported intermediates. These data are made available by Eurostat for the years 1995 and 2000. However, the imported intermediate inputs of an industry are usually not disaggregated by country of origin. Therefore, it is not possible to directly distinguish between intermediate imports from advanced and less advanced countries. To derive a regional breakdown of intermediate imports we combine data on intermediate materials with the trade statistics derived from the UN Foreign Trade Database. We multiply each type of imported input (MIij), obtained from the input-output tables, by the respective country's (regional) import shares for total imports (Mjc/Mj), which are obtained from trade statistics. That is, imported intermediates purchased by industry j and purchased by industry i from country (country group) c are given by:

$$IM_{ic} = \sum_{j=1}^{N} MI_{ij} \frac{M_{jc}}{M_j}.$$

Note, that we have to assume that the breakdown by country of origin of intermediate imports of type j is the same across all of the input purchasing sectors i.

We construct separate outsourcing measures for two different groups of countries, namely high- and low-wage countries. Low-wage countries include the new EU member states and the NICs

(China, Hong Kong, South Korea, Malaysia, Singapore, Taiwan, and Thailand) and other East Asian countries (Indonesia, India, Philippines, Brunei, Myanmar, Vietnam, Laos, and Cambodia). High-wage countries include the EU15 countries and other industrialised OECD countries (e.g. the USA, Japan, Australia et cetera, but excluding Mexico, South Korea and the four large new EU member states).

Table 1 summarises the level and development of imported inputs as a share of gross production for the individual countries considered in the analysis as well as for the average of all seven EU countries in the sample. International outsourcing in 2000 was most intensive for Austria and the Netherlands with imported intermediates accounting for 14 percent and 11 percent of gross production, respectively. The magnitude of international outsourcing does not vary excessively across the rest of the countries reaching levels of around 8 percent of their production.

From the mid-1990s to the year 2000, growth in intermediate imports was the most pronounced for Austria, Germany, and Finland. Taking the average of all seven countries in the sample, we find international outsourcing to have risen by an average rate of 2.6 percent p.a. Note that outsourcing to high-wage countries (including intra-EU trade) is still dominant, reaching far higher levels than outsourcing to low-wage countries. Roughly 80 percent of the total EU7 imported materials come from other industrialised countries. However, imports of intermediates from low-wage countries have developed very dynamically in all of the reporting countries. They have accounted for the main share in the overall increase in outsourcing activities in Finland, the Netherlands and Sweden. For other countries, such as Denmark, Austria, Italy and Germany the observed overall increase in international outsourcing is mainly due to an increase in outsourcing to other high-wage countries. Outsourcing to the new EU members among the CEEC is most intense and most dynamic for Austria, followed by Germany and Finland.

Table 1: Manufactured Intermediate Inputs and International Outsourcing in Selected European Countries 1995 - 2000

	Total inputs	Imported inputs from world	Imported inputs from high-wage countries	Imported inputs from low-wage countries	Imported inputs from world	Imported inputs from high-wage countries	Imported inputs from low-wage countries
	Shares in gross output as percent 2000				Shares in total inputs as percent 2000		
Austria	20.06	14.03	11.70	2.33	69.95	58.33	11.63
Denmark	16.15	8.20	6.99	1.21	50.75	43.29	7.47
Finland	22.35	8.27	6.07	2.20	36.98	27.14	9.84
Germany	21.20	8.44	6.35	2.09	39.80	29.93	9.87
Italy	16.74	8.28	6.40	1.88	49.48	38.22	11.26
Netherlands	23.06	11.04	8.77	2.27	47.90	38.03	9.87
Sweden	16.91	9.02	7.98	1.04	53.35	47.21	6.14
EU7[1])	18.54	8.83	7.20	1.63	47.63	38.85	8.78
		Average annual percentage change 1995/2000					
Austria	2.50	6.12	5.07	12.58	3.53	2.51	9.83
Denmark	-0.56	1.88	1.49	4.35	2.46	2.06	4.93
Finland	-0.56	2.68	0.18	12.35	3.26	0.74	12.98
Germany	1.80	5.34	3.74	11.32	3.49	1.91	9.36
Italy	-1.71	2.09	1.55	4.07	3.86	3.31	5.87
Netherlands	1.09	0.86	-0.28	6.10	-0.23	-1.35	4.95
Sweden	-1.83	0.81	-0.39	14.63	2.69	1.46	16.76
EU7[1])	-0.21	2.61	1.44	8.95	2.82	1.65	9.17
		Difference in percentage points					
Austria	2.33	3.61	2.56	1.04	11.14	6.79	4.35
Denmark	-0.46	0.73	0.50	0.23	5.80	4.20	1.60
Finland	-0.63	1.03	0.05	0.97	5.48	0.98	4.49
Germany	1.80	1.93	1.07	0.87	6.27	2.71	3.56
Italy	-1.50	0.81	0.47	0.34	8.54	5.74	2.80
Netherlands	1.22	0.46	-0.12	0.58	-0.56	-2.68	2.12
Sweden	-1.64	0.35	-0.16	0.51	6.62	3.31	3.31
EU7[1])	-0.19	1.07	0.50	0.57	6.18	3.06	3.12

[1]) Weighted average across countries and industries.

In comparing the development of the share of total material inputs in gross production and the share of imported inputs, we find that for countries such as Denmark, Finland, Italy and Sweden the growing importance of internationally sourced inputs is mainly the result of a substitution between formerly domestically sourced inputs and international purchased inputs rather than increased outsourcing per se. As indicated in Table 1, the share of total material inputs in gross production has been decreasing over the period of 1995 to 2000 for those countries, while the share of imported inputs in total material inputs has been increasing. Austria and Germany on the other hand are examples of countries that have intensified the outsourcing of production processes to where part of the increase in international sourcing is accounted for by that. The increase in total material inputs in the Netherlands has led to increased international sourcing only from low-wage countries.

Outsourcing of the seven EU countries to low-wage countries is highest in the leather industry, office machinery and computers, in communications equipment, textiles, apparel, and basic metals (Table 2). With the exception of communications equipment and office machinery, these industries are low-skill intensive sectors. Outsourcing to high-wage countries on the other hand is more strongly concentrated in sectors exhibiting an above-average ratio of high-skilled to low-skilled labour. It is highest in the chemical sector, basic metals industry, and transport equipment industry, as well as in office machinery, communication equipment and the motor vehicle industry. A Kruskal-Wallis test confirms a systematic difference in the outsourcing pattern of EU countries between low-wage and high-wage countries.

Growth in imported materials from low-wage countries has been strongest in the office machinery sector, leather industry and in communication equipment industry. Unfortunately, the skill intensity of the outsourced fragments is not directly observable. However, casual evidence points to a comparative advantage of low-wage countries in low-skill intensive production lines. Hence, the outsourced fragments probably use foreign low-skilled labour more intensively. The increase in imported materials from high-wage countries is most pronounced in transport equipment, office machinery and the chemical industry.

As a first glance at the possible impact of international outsourcing, we split the data into industries with above average outsourcing activities and industries with below average outsourcing activities and perform a Kruskal-Wallis test in order to see whether there has been a systematically different development across these industry groups in employment. The results shown in Table 3 indicate that high outsourcing industries have been subject to significantly higher negative total employment responses than low outsourcing industries in low-skill intensive sectors only. Furthermore, employment losses in these sectors are significantly higher only if inputs are sourced from low-wage countries. On the other hand, outsourcing to high-wage countries does not seem to have a differential impact on employment.

Table 2: Development of International Outsourcing by Seven European Countries [1]) by Industry, 1995 - 2000

		2000			1995/2000			1995/2000		
		International Outsourcing to								
		world	high-wage countries	low-wage countries	world	high-wage countries	low-wage countries	world	high-wage countries	low-wage countries
		Shares in gross output as percent			Average annual percentage change			Difference in percentage points		
15	Food products, beverages	5.73	4.60	1.13	1.97	1.57	3.70	0.53	0.34	0.19
16	Tobacco products	0.66	0.56	0.10	23.53	21.31	42.82	0.43	0.35	0.09
17	Textiles	11.11	6.91	4.21	0.83	-1.57	5.72	0.45	-0.57	1.02
18	Wearing apparel	6.43	2.28	4.14	6.39	3.62	8.13	1.71	0.37	1.34
19	Tanning and dressing of leather	12.65	4.79	7.86	4.62	1.63	6.74	2.56	0.37	2.19
20	Wood, products of wood and cork	5.66	3.58	2.08	-0.01	-2.06	4.24	0.00	-0.39	0.39
21	Pulp, paper and paper products	8.12	7.49	0.63	-0.43	-0.77	4.20	-0.18	-0.29	0.12
22	Publishing, printing and reproduction	0.78	0.69	0.08	-5.66	-6.11	-1.21	-0.26	-0.26	-0.01
23	Coke, refined petroleum and nuclear fuel	3.60	2.48	1.12	-1.35	-1.11	-1.87	-0.25	-0.14	-0.11
24	Chemical and chemical products	16.96	15.37	1.59	2.92	2.84	3.67	2.27	2.01	0.26
25	Rubber and plastic priducts	3.09	2.66	0.43	2.55	1.59	10.19	0.37	0.20	0.16
26	Other non-metallic mineral products	2.39	1.91	0.48	-0.09	-1.24	5.49	-0.01	-0.12	0.11
27	Basic metals	19.21	15.16	4.05	2.29	1.27	6.78	2.06	0.93	1.13
28	Fabricated metal products	1.93	1.49	0.44	2.94	1.25	10.42	0.26	0.09	0.17
29	Machinery and equipment n.e.c.	8.08	7.09	0.99	2.67	1.58	13.42	1.00	0.54	0.46
30	Office machinery and computers	20.92	14.56	6.35	7.77	5.25	15.32	6.53	3.29	3.24
31	Electrical machinery and apparatus n.e.c.	7.83	5.88	1.95	5.57	3.74	12.60	1.86	0.99	0.87
32	Radio, TV and communication equipment	18.45	14.13	4.32	1.50	-0.56	10.78	1.33	-0.40	1.73
33	Medical, precision and optical instruments, watches	7.17	6.41	0.76	3.73	2.97	11.92	1.20	0.87	0.33
34	Motor vehicles, trailers and semi-trailers	10.51	9.12	1.39	-1.67	-3.76	29.06	-0.93	-1.93	1.00
35	Other transport equipment	17.14	15.02	2.12	6.31	5.62	12.12	4.52	3.59	0.92
36	Furniture; manufacturing n.e.c.	3.57	1.97	1.60	7.14	4.27	11.46	1.04	0.37	0.67
	Total manufacturing	8.83	7.20	1.63	2.61	1.44	8.95	1.07	0.50	0.57

[1]) Weighted average across countries.

Table 3: Outsourcing and Employment

	total employment	Mean of log change of emloyment in high/medium skill intensive industries (NACE 29-35)	emloyment in low skill intensive industries
Total outsourcing	100		
Degree of outsourcing			
low-below ind. average	-0.673	0.864	-0.985
high-above ind. average	-0.900	0.063	-1.922
Total	-0.780	0.280	-1.304
Difference between high and low outsourcing industries			
Kruskal-Wallis test, p-value	0.984	0.917	0.166
Outsourcing to low wage countries			
Degree of outsourcing			
low-below ind. average	-0.068	0.868	-0.424
high-above ind. average	-2.264	-0.476	-3.708
Total	-0.780	0.280	-1.304
Difference between high and low outsourcing industries			
Kruskal-Wallis test, p-value	0.007	0.779	0.000
Outsourcing to high wage countries			
Degree of outsourcing			
low-below ind. average	-0.825	0.882	-0.985
high-above ind. average	-0.737	0.194	-1.922
Total	-0.780	0.280	-1.304
Difference between high and low outsourcing industries			
Kruskal-Wallis test, p-value	0.499	0.779	0.166

Table 4 presents the basic descriptive statistics for the variables used in the regression. Employment declined by 0.8 percent per year during the period of 1995-2000 (unweighted means across industries and countries). Output measured by value added in constant prices increased by 3.3 percent per year on average. The average annual growth rate of real wages is 1.6 percent percent. The sample of EU countries experienced an increase in total imported materials over the period of 1995-2000. The increase in the ratio of imported intermediates inputs to gross production is approximately 0.25 percentage points per year on average. As is evident from the differences between the mean and median values, changes in imported materials seem to be abnormally distributed. In particular, it seems to be the case that the average change of imported materials is strongly influenced by extreme observations.

Table 4: Summary Statistics

	Mean	Q50	Q25	Q75	Std. Dev	Min	Max
	all manufacturing industries (# of obs: 144)						
Average annual growth rate between 1995 and 2000 (%):							
Value added in const. prices per employee	4.0	2.7	0.7	5.0	7.5	-11.7	51.7
Value added in constant prices	3.3	2.3	0.0	5.0	8.4	-28.9	55.6
Total employment	-0.8	-0.4	-2.2	1.3	3.9	-22.2	11.3
Real wages	1.6	1.4	-0.7	3.5	7.0	-27.3	55.6
Absolute average annual change between 1995 and 2000 (percentage points):							
Imported materials (IM) % gross value of production	0.25	0.11	-0.06	0.43	0.70	-1.46	4.73
IM from low-wage countries % production	0.10	0.04	-0.15	0.23	0.64	-1.96	4.84
IM from high-wage countries % production	0.11	0.05	0.01	0.15	0.18	-0.15	1.07
	manufacturing industries NACE 15-28 and 36 (# of obs: 96)						
Average annual growth rate between 1995 and 2000 (%):							
Value added const. prices per employee	3.3	2.6	0.7	4.4	5.2	-11.7	39.6
Value added constant prices	2.0	1.6	-0.2	3.7	5.2	-12.5	34.3
Total employment	-1.3	-0.6	-2.6	0.5	3.4	-15.0	7.6
Real wage	1.4	1.4	-0.6	3.6	5.1	-19.4	22.6
Absolute average annual change between 1995 and 2000 (percentage points):							
Imported materials % gross value of production	0.17	0.09	-0.07	0.39	0.46	-0.94	2.15
IM from low-wage countries % production	0.05	0.02	-0.13	0.20	0.34	-0.94	1.22
IM from high-wage countries % production	0.08	0.03	0.01	0.11	0.15	-0.15	1.07
	manufacturing industries NACE 29-35 (# of obs: 48)						
Average annual growth rate between 1995 and 2000 (%):							
Value added const. prices per employee	5.6	3.6	0.3	5.8	10.6	-6.7	51.7
Value added constant prices	5.9	4.1	1.5	7.3	12.2	-28.9	55.6
Total employment	0.3	0.3	-0.7	2.2	4.7	-22.2	11.3
Real wage	1.8	1.4	-1.0	3.2	9.9	-27.3	55.6
Absolute average annual change between 1995 and 2000 (percentage points):							
Imported materials % gross value of production	0.39	0.28	-0.05	0.51	1.01	-1.46	4.73
IM from low-wage countries % production	0.21	0.10	-0.19	0.30	0.99	-1.96	4.84
IM from high-wage countries % production	0.16	0.10	0.04	0.23	0.21	-0.13	1.06

Source: EUROSTAT Input-Output tables, UN Foreign Trade Statistics, OECD STAN, own calculations.

4. Estimation results

Table 5 shows regression results using various estimation techniques and specifications. In order to obtain sufficient observations we pool the data across the seven EU countries and sectors. For each EU country we have between 18 and 22 industries resulting in a total of 144 observations. Panel 1 contains standard OLS estimates using first differences. As was seen in section 3, the mean of imported materials is strongly influenced by some extreme observations. Therefore, we use the robust regression which is an iterative, weighted least squares procedure that controls for outliers (see panel 2). The third is a median regression where absolute rather

than squared deviations are minimized, and where the object is to predict the median of the dependent variable conditional on the values of the independent variables (see panel 3). Finally, we used weighted OLS where the weights are the industry share of total manufacturing employment for each country (panel 4). Specification 1 uses the total imported materials. Specification 2-5 investigate the role of imports from low-wage and high-wage countries. In specification 3 we include a complete set of country dummies in order to control for country effects.

Most of the estimated coefficients are consistent across specifications and estimation techniques. Our results show that EU imports of inputs from low-wage countries have a significant as well as negative impact on total employment. The coefficient is strongly significant and negatively signed regardless of whether or not imports from high-wage countries are included. Using weighted least squares we find a smaller, but still significant, impact when outsourcing to low-wage countries.[4] Taking the logarithm we also find a significantly negative impact of the share of imported materials. However, in contrast, total imported materials have no effect on employment. This indicates the importance of disaggregating imports into imports from low-wage and high-wage countries. The share of imported materials from high-wage countries has a positive impact on employment indicating that imports from high-wage countries and domestic employment are complements rather than substitutes. However, the coefficient is not significantly different from zero in most of the regressions. Value added in constant prices has a positive and highly significant impact on employment. However, the output elasticity is rather low. As expected, real wages have a significant negative impact on employment.

[4] Weights are the industry share in total manufacturing employment calculated for each country.

Table 5: Estimation Results of the Labour Demand Equation

	(i)			(ii)			(iii)			(iv)			(v)		
	coeff.		t-value	coeff.		t-value	coeff.		t-value	coeff.		t-value	coeff.		t-value
	OLS estimates (panel 1)[a]														
Δln value added const. p.	0.15	***	4.44	0.16	***	4.96	0.17	***	5.45	0.16	***	4.50	0.17	***	4.93
Δln real wages	-0.31	***	-6.17	-0.32	***	-7.86	-0.32	***	-7.40	-0.34	***	-6.18	-0.35	***	-5.87
Δ imported materials (IM) % production (Q)	-0.07		-0.13												
ΔIMQ low-wage countries				-4.50	***	-3.26	-4.10	***	-2.70				-4.79	***	-3.53
ΔIMQ high-wage countries										0.45		0.85	0.68		1.22
country dummies		no			no			yes			no			no	
constant	-0.01	***	-2.75	0.00		-1.07	-0.01		-1.71	-0.01		-2.87	0.00		-1.13
Adj. R^2		0.53			0.54			0.57			0.50			0.54	
	Robust regression estimates (panel 2)														
Δln value added const. p.	0.13	***	4.86	0.15	***	5.88	0.15	***	6.50	0.14	***	5.22	0.17	***	6.49
Δln real wages	-0.32	***	-8.71	-0.33	***	-11.08	-0.34	***	-12.17	-0.36	***	-9.49	-0.40	***	-11.71
Δ total imported materials (IM) % production	0.02		0.06												
ΔIMQ low-wage countries				-5.32	***	-4.52	-4.53	***	-4.02				-5.80	***	-4.98
ΔIMQ high-wage countries										0.60		1.41	0.97	**	2.48
country dummies		no			no			yes			no			no	
constant	0.00	*	-1.83	0.00		-0.11	-0.01		-1.72	0.00	*	-1.95	0.00		0.04
	Median regression estimates (t-values based on bootstrap standard errors) (panel 3)														
Δln value added const. p.	0.17	***	2.59	0.18	***	2.68	0.18	**	2.39	0.14	**	2.08	0.19	***	2.85
Δln real wages	-0.28	***	-4.01	-0.32	***	-5.31	-0.32	***	-4.16	-0.34	***	-4.19	-0.33	***	-3.91
Δ imported materials (IM) % production	-0.28		-0.62												
ΔIMQ low-wage countries				-5.28	***	-2.73	-4.58	**	-2.13				-6.44	***	-3.83
ΔIMQ high-wage countries										0.23		0.36	0.59		0.93
country dummies		no			no			yes			no			no	
constant	0.00		-1.01	0.00		-0.26	-0.01		-1.09	0.00		-0.99	0.00		-0.23
Pseudo R^2		0.19			0.23			0.29			0.19			0.24	
	Weighted OLS estimates (panel 4)[a]														
Δln value added const. p.	0.13	***	3.18	0.15	***	3.46	0.16	***	4.26	0.14	***	3.18	0.16	***	3.40
Δln real wages	-0.31	***	-5.93	-0.30	***	-7.13	-0.32	***	-6.83	-0.33	***	-6.21	-0.35	***	-6.43
Δ imported materials (IM) % production	0.18		0.37										-3.54	**	-2.21
ΔIMQ low-wage countries				-3.06	*	-1.84	-2.82	*	-1.67				0.87		1.53
ΔIMQ high-wage countries										0.66		1.27			
countrys dummies		no			no			yes			no			no	
constant	0.00		-1.18	0.00		-0.17	0.00		-0.50	0.00		-1.22	0.00		-0.22

Notes: ***, ** and * denote significance at the 1%, 5% and 10% levels. The dependent variable is the average annual growth rate of total employment between 1995-2000. All variables except the import variables are measured as average annual change in percent. Indicators on imported materials are measured as the average annual change in percentage points. The sample contains 144 observations measured as long differences from 1995-2000. [a]t-values are based on heteroscedasticity consistent standard errors.

Furthermore, in order to obtain insight into the outsourcing effects in skill intensive versus low-skill intensive industries we split the sample into NACE 29-35 and the remaining industries. The results of the sample split regressions are shown in Table 6. We find that the impact of imported materials from the new EU member states and NICs is significantly negative in low-

skill intensive industries. Interestingly, we find a significant impact of total imported materials. Furthermore, we do not find a negative effect of imports originating from industrialised countries. In machinery, electrical, optical and transport equipment none of the different measures of international outsourcing are statistically significant at the five and ten percent levels.

Table 6: Estimation Results of the Labour Demand Equation, Sample Split

	Less skill intensive manufacturing industries				Machinery, Electrial, optical & transport equip.	
	OLS		OLS weighted		OLS	
	coeff.	t-value	coeff.	t-value	coeff.	t-value
	(1a)		(1b)		(1c)	
∆ln value added const. prices	0.21 **	2.41	0.38 ***	5.18	0.11 ***	3.15
∆ln real wages	-0.31 ***	-3.27	-0.31 ***	-4.10	-0.36 ***	-6.90
∆ total imported materials(IM) % production (Q)	-1.45 **	-2.37	-0.65 *	-1.78	0.49	0.74
constant	-0.01 ***	-2.93	-0.01 ***	-3.38	0.00	0.26
Adj. R^2	0.38		0.42		0.71	
	(2a)		(2b)		(2c)	
∆ln value added const. prices	0.16	1.69	0.35 ***	4.46	0.10 ***	3.37
∆ln real wages	-0.27 **	-2.59	-0.30 ***	-3.78	-0.34 ***	-10.81
∆IMQ low-wage countries	-8.75 ***	-3.95	-5.24 ***	-4.14	-1.37	-0.55
constant	0.00	-1.23	-0.01	-2.11	0.01	0.94
Adj. R^2	0.48		0.48		0.71	
		(3a)		(3b)		(3c)
∆ln value added const. prices	0.22 ***	2.58	0.39 ***	5.36	0.11 ***	3.18
∆ln real wages	-0.32 ***	-3.46	-0.33 ***	-4.26	-0.38 ***	-6.76
∆IMQ high-wage countries	-1.06	-1.46	-0.46	-1.06	0.73	1.10
constant	-0.01	-3.49	-0.01 ***	-3.79	0.00	0.32
Adj. R^2	0.35		0.43		0.72	
		(4a)		(4b)		(4c)
∆ln value added const. p.	0.15 ***	1.64	0.34 ***	4.39	0.12 ***	3.27
∆ln real wages	-0.27 ***	-2.58	-0.30 ***	-3.79	-0.39 ***	-6.59
∆IMQ low-wage countries	-8.93 ***	-3.82	-5.49 ***	-3.84	-1.90	-0.78
∆IMQ high-wage countries	0.23	0.37	0.22	0.46	0.83	1.23
constant	0.00	-1.18	-0.01 **	-2.05	0.00	0.75
Adj. R^2	0.48		0.47		0.73	

Notes: ***, ** and * denote significance at the 1%, 5% and 10% levels. The dependent variable is the average annual growth rate of total employment between 1995-2000. All variables except the import variables are measured as average annual change in percent. Indicators on imported materials are measured as the average annual change in percentage points. The sample contains 48 observations for the sample including skill intensive industries (NACE 29-35) and 96 observations of all others. [a]t-values are based on heteroscedasticity consistent standard errors.

We also investigate whether the impact of international outsourcing differs across the conditional distribution by using quantile regressions for the quantiles 0.25 and 0.75. In this

way, we allow for different effects along the distribution. These estimates are shown in Table 7. The quantile regression shows that this effect is more pronounced at the low end of the conditional employment distribution.

Table 7: Estimation Results of the Labour Demand Equation: Quantile Regressions

	Q25			Q75		
	coeff.		t-value	coeff.		t-value
			(1)			
Δln value added const. p.	0.12	*	1.73	0.18	*	1.82
Δln real wages	-0.29	***	-2.87	-0.36	***	-4.34
Δ total imported materials(IM) % production	-0.77		-0.79	0.49		0.78
constant	-0.02	***	-4.62	0.01	*	1.74
Pseudo R^2		0.22			0.21	
			(2)			
Δln value added const. p.	0.13	*	1.85	0.16		1.58
Δln real wages	-0.32	***	-3.27	-0.34	***	-4.06
ΔIMQ from low-wage countries	-6.51	***	-3.06	-2.04		-0.61
constant	-0.01	***	-2.74	0.01	*	1.88
Pseudo R^2		0.29			0.21	
			(3)			
Δln value added const. p.	0.16	**	2.31	0.19	**	2.01
Δln real wages	-0.36	***	-3.42	-0.38	***	-4.69
ΔIMQ from high-wage countries	0.98		1.13	0.82		1.32
constant	-0.02	***	-5.63	0.01	*	1.67
Pseudo R^2		0.23			0.21	
			(4)			
Δln value added const. p.	0.16		2.50	0.19	**	2.04
Δln real wages	-0.41	***	-3.57	-0.39	***	-4.33
ΔIMQ from low-wage countries	-5.31	***	-2.63	-3.09		-1.02
ΔIMQ from high-wage countries	1.27		1.53	0.80		1.23
constant	-0.01	***	-3.11	0.01	**	2.00
Pseudo R^2		0.30			0.23	

Notes: ***, ** and * denote significance at the 1%, 5% and 10% levels. The dependent variable is the average annual growth rate of total employment between 1995-2000. All variables except the import variables are measured as average annual change in percent. Indicators on imported materials are measured as the average annual change in percentage points. The sample contains 144 observations measured as long differences from 1995-2000. The equation is estimated by quantile regression technique. The cut-points are the first quartile (25%) and the third quartile (75%). Standard errors are bootstrapped (1000 replications).

Given the elasticities of labour demand, one can calculate how much of the observed change in total employment can be attributed to the effects of wages, output, total imported materials and imported materials disaggregated by the country of origin. After completely differentiating the labour demand equation in levels and the following transformation into growth rates, the percentage change of total employment can be written as:

$$\Delta \ln L \cong \alpha_1 \overline{\Delta \ln Y} + \alpha_2 \overline{\Delta \ln WP} + \alpha_3 \overline{\Delta IMQ} + \alpha_0,$$

where the horizontal bar denotes an average change in the right-hand-variables over the sample period. Alternatively, we replace total material imports by the share of imported materials from low-wage countries. $\Delta L / L$ denotes the actual employment growth rate which should be close to the predicted employment growth rate. The first term on the right-hand side measures the output effect. The second term on the right-hand side captures the price effects calculated as the product of change in real wages and the estimated wage elasticity. The third term on the right-hand side measures the effect of international outsourcing. The results of the decomposition analysis appear in Table 8 and Table 9.

Table 8: Contribution of Sources of Labour Demand in Percentage Points: Impact of Imports from Low-Wage Countries

	actual employ-ment	predicted employment	value added const. prices	real wages	imports from low-wage countries	constant
			all manufacturing industries, total sample			
OLS estimates	-0.77	-0.77	0.53	-0.50	-0.49	-0.31
Weighted OLS estimates	-0.07	-0.07	0.44	-0.21	-0.26	-0.04
Median regression estimates	-0.41	-0.38	0.42	-0.44	-0.28	-0.08
			less skill intensive industries			
OLS estimates	-1.30	-1.30	0.31	-0.40	-0.74	-0.47
Weighted OLS estimates	-0.53	-0.53	0.70	-0.35	-0.30	-0.58
Median regression estimates	-0.60	-0.59	0.32	-0.35	-0.25	-0.31

Notes: These calculations are based on the average annual change in the explanatory variables multiplied by the regression coefficients.

The calculations show that imports from low-wage countries have made a significant contribution to the decline in manufacturing employment. According to the most conservative estimate, the increase in imported materials from low-wage countries has decreased employment by 0.26 percentage points per year over the period of 1995-2000. If the sample is restricted to less skill intensive industries, we find that 0.30 percentage points can be attributed to international outsourcing to low-wage countries. This effect is rather large given the low ratio of imported materials from low-wage countries to gross production. Wage and output effects also play an important role in explaining the employment change. Output is the most important source of labour demand. Output growth has accounted for a 0.44 percentage points increase in employment from 1995 to 2000. However, output growth is not sufficient enough to compensate for the negative employment effects of international outsourcing and wages.

Table 9: Contribution of Sources of Labour Demand in Percentage Points: Impact of Total Imported Materials

	actual employ-ment	predicted employment	value added const. prices	real wages	total imported materials	constant
			less skill intensive industries			
OLS estimates	-1.30	-1.30	0.41	-0.44	-0.25	-1.02
Weighted OLS estimates	-0.53	-0.53	0.77	-0.37	-0.09	-0.84
Median regression estimates	-0.60	-0.67	0.58	-0.48	-0.05	-0.71

Notes: See Table 8.

Table 9 shows that the increase in total intermediate materials explains 0.09 percentage points of the decline in employment in less skill intensive industries over the period of 1995-2000.

5. Conclusions

This paper presents further insights into the employment effects of international outsourcing. We estimate a labour demand equation for a sample of manufacturing two-digit industries for EU countries over the period 1995-2000. Our results for seven EU countries show that imports from low-wage countries have a statistically significant impact on employment. Imports from industrialised countries have no effect on employment. Therefore, future studies in outsourcing should focus on imported materials from low-wage countries.

The average annual change in the ratio of imported materials from low-wage countries to the gross production in seven EU countries amounted to 0.11 percentage points per year. According to the most conservative calculations, the observed change in EU outsourcing to low-wage countries between 1995 and 2000 alone accounts for an employment reduction of 0.26 percentage points per year. We also find that output growth is still the major determinant in explaining employment performance.

Furthermore, we discover that the magnitude of the effect differs across industries. Sample split regressions show that the impact of imported materials from low-wage countries is not significantly different from zero in some industries such as machinery, electrical, optical and transport equipment. Quantile regression results show that there are no systematically significant effects of international outsourcing on employment in the upper quartile of the distribution of employment change (i.e. in expanding industries).

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