

**THE IMPACT OF INTERNATIONAL OUTSOURCING ON EMPLOYMENT:
EMPIRICAL EVIDENCE FROM EU COUNTRIES**

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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 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 imports from low-wage countries may account for about a 0.25 percentage points employment reduction per year between 1995-2000. Imported materials from industrialised countries have no effect on employment. Furthermore, we find 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. Using quantile regressions we also find that the effect of imported materials from low-wage countries is not significant at the upper quartile of the conditional distribution of employment change.

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1. Introduction¹

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, all European countries experienced an increase in import penetration in manufacturing. Own calculations suggest that one half of the increase in imports can be attributed to the imports from low-wage countries. The literature agrees that imports from low income Central and East European and 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 moving their low-skill intensive parts of production. These goods are then imported back 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. Furthermore, we combine the trade statistics for goods imports and information from Input-Output tables. This allows us to identify 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 (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 might be

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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 to non-normality but also for the presence of outliers. Furthermore, quantile regressions allow us to concentrate the attention 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 the UK find a negative correlation between employment growth and either imports (Sachs and Shatz, 1994; Greenaway et al., 1999) or the 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 and they 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 1982-1988, but this effect disappears in the 1990s. Furthermore, the authors find that this effect seems to have been stronger in the high-skill intensive industries than in the 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, derived from a standard labour demand framework. The standard labour demand augmented by import penetration indicators may be specified by the following regression equation:

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

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 and λ_t are a sector and time specific effect and ε_{it} is the error term. Taking first differences gives the following labour demand equation in the first-differenced logarithmic form.

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

where Δ refers to the average annual change of the variables between 1995 and 2000. First differencing also eliminates the 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 the 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 29-35 summarising medium-skill to low-skill intensive sectors, and the remaining industries (NACE 15-28; 36). We also investigate 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 and 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 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 have to 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 (MI_{ij}), obtained from the Input-Output tables, by the respective country's (regional) import shares for total imports (M_{jc}/M_j), 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:

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

Note, that we have to assume that the breakdown by country of origin of intermediate imports of type j is the same across all 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, Hongkong, South Korea, Malaysia, Singapore, Taiwan, Thailand) and other East Asian countries (Indonesia, India, Philippines, Brunei, Myanmar, Vietnam, Laos, Cambodia). High-wage countries include EU15 countries and other industrialised OECD countries (e.g. USA, Japan, Australia etc. but excluding Mexico, South Korea and the four large new 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 over all seven EU countries in the sample. International outsourcing in 2000 has been 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 too much across the rest of the countries reaching levels of around 8 percent of production.

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

	Total inputs	Imported inputs from			Imported inputs from		
		world	high-wage countries	low-wage countries	world	high-wage countries	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.

From the mid-nineties to the year 2000, growth in intermediate imports has been most pronounced for Austria and Germany as well as 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 total EU7 imported materials come from other industrialised countries. However, imports of intermediates from low-wage countries have developed very dynamically in all the reporting countries. They have accounted for the main share in the overall increase in outsourcing activities in Finland, the Netherlands as well as Sweden. For other countries, like Denmark, Austria, Italy as well as Germany the observed overall increase in international outsourcing is due mainly to the 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.

Comparing the development of the share of total material inputs in gross production and the share of imported inputs, we find that for countries like 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 1995 to 2000 for those countries, while the share of imported inputs in total material inputs has been rising. Austria and Germany on the other hand are examples of countries which have intensified outsourcing of production processes so that part of the increase in international sourcing is accounted for by that. The increase in total material inputs in the Netherlands have led to increased international sourcing from low-wage countries only.

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, the basic metals industry, the 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.

Table 2: Development of International Outsourcing by Seven European Countries¹⁾ by Industry, 1995 - 2000

	2000			1995/2000			1995/2000		
	Shares in gross output as percent			Average annual percentage change			Difference in percentage points		
	world	high-wage countries	low-wage countries	world	high-wage countries	low-wage countries	world	high-wage countries	low-wage countries
15	5.73	4.60	1.13	1.97	1.57	3.70	0.53	0.34	0.19
16	0.66	0.56	0.10	23.53	21.31	42.82	0.43	0.35	0.09
17	11.11	6.91	4.21	0.83	-1.57	5.72	0.45	-0.57	1.02
18	6.43	2.28	4.14	6.39	3.62	8.13	1.71	0.37	1.34
19	12.65	4.79	7.86	4.62	1.63	6.74	2.56	0.37	2.19
20	5.66	3.58	2.08	-0.01	-2.06	4.24	0.00	-0.39	0.39
21	8.12	7.49	0.63	-0.43	-0.77	4.20	-0.18	-0.29	0.12
22	0.78	0.69	0.08	-5.66	-6.11	-1.21	-0.26	-0.26	-0.01
23	3.60	2.48	1.12	-1.35	-1.11	-1.87	-0.25	-0.14	-0.11
24	16.96	15.37	1.59	2.92	2.84	3.67	2.27	2.01	0.26
25	3.09	2.66	0.43	2.55	1.59	10.19	0.37	0.20	0.16
26	2.39	1.91	0.48	-0.09	-1.24	5.49	-0.01	-0.12	0.11
27	19.21	15.16	4.05	2.29	1.27	6.78	2.06	0.93	1.13
28	1.93	1.49	0.44	2.94	1.25	10.42	0.26	0.09	0.17
29	8.08	7.09	0.99	2.67	1.58	13.42	1.00	0.54	0.46
30	20.92	14.56	6.35	7.77	5.25	15.32	6.53	3.29	3.24
31	7.83	5.88	1.95	5.57	3.74	12.60	1.86	0.99	0.87
32	18.45	14.13	4.32	1.50	-0.56	10.78	1.33	-0.40	1.73
33	7.17	6.41	0.76	3.73	2.97	11.92	1.20	0.87	0.33
34	10.51	9.12	1.39	-1.67	-3.76	29.06	-0.93	-1.93	1.00
35	17.14	15.02	2.12	6.31	5.62	12.12	4.52	3.59	0.92
36	3.57	1.97	1.60	7.14	4.27	11.46	1.04	0.37	0.67
	8.83	7.20	1.63	2.61	1.44	8.95	1.07	0.50	0.57

¹⁾ Weighted average across countries.

Growth in imported materials from low-wage countries has been strongest in the office machinery sector, the leather industry and in the 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.

Table 3: Outsourcing and Employment

	total employment	Median of log change of employment in high-/medium-skill intensive industries (NACE 29-35)	employment in low-skill intensive industries
<i>Total outsourcing</i>			
Degree of outsourcing			
low-below ind. average	-0.312	-	-0.312
high-above ind. average	-0.486	0.334	-1.629
Total	-0.415	0.334	-0.632
Difference between high and low outsourcing industries			
Kruskal-Wallis test, p-value	0.544	-	0.002
<i>Outsourcing to low-wage countries</i>			
Degree of outsourcing			
low-below ind. average	-0.330	0.198	-0.337
high-above ind. average	-0.583	0.354	-1.587
Total	-0.415	0.334	-0.632
Difference between high and low outsourcing industries			
Kruskal-Wallis test, p-value	0.157	0.917	0.007
<i>Outsourcing to high-wage countries</i>			
Degree of outsourcing			
low-below ind. average	-0.375	-	-0.375
high-above ind. average	-0.450	0.334	-0.947
Total	-0.415	0.334	-0.632
Difference between high and low outsourcing industries			
Kruskal-Wallis test, p-value	0.579	-	0.068

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 to see whether there has been a systematically different development across these industry groups in employment. The results 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 4 presents basic descriptive statistics for the variables used in the regression. Employment declined by 0.8 percent per year during the period 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. The sample of EU countries experienced an increase in total imported materials over the period 1995-2000. The increase in the ratio of imported intermediates inputs to gross production is about 0.25 percentage points per year on average. As evident from the differences between the mean and median values, changes in imported materials seems to be not normally distributed. Furthermore, it seems to be the case that the average change of imported materials is strongly influenced by extreme observations (see also Figure 1 in appendix).

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 provides the regression results using various estimation techniques and specifications. In order to get 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 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 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 and negative impact on total employment. The coefficient is strongly significant and negatively signed regardless whether or not imports from high-wage countries are included. Using weighted least squares we find a smaller but still significant impact of outsourcing to low-wage countries.² 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 rather complements 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.

² 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
	<i>OLS estimates (panel 1)^a</i>									
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	
	<i>Robust regression estimates (panel 2)</i>									
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
	<i>Median regression estimates (t-values based on bootstrap standard errors) (panel 3)</i>									
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	
	<i>Weighted OLS estimates (panel 4)^a</i>									
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		
country 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 significant at 1%, 5% and 10% level. The dependent variable is 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 average annual change in percentage points. The sample contains 144 observations measured as long differences from 1995-2000. ^at-values are based on heteroscedasticity consistent standard errors.

Furthermore, in order to get insights 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.

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

	Less skill intensive manufacturing industries				Machinery, Electrical, optical & transport equip.	
	OLS		OLS weighted		OLS	
	coeff.	t-value	coeff.	t-value	coeff.	t-value
	(1a)		(1b)		(1c)	
$\Delta \ln$ value added const. prices	0.21 **	2.41	0.38 ***	5.18	0.11 ***	3.15
$\Delta \ln$ real wages	-0.31 ***	-3.27	-0.31 ***	-4.10	-0.36 ***	-6.90
Δ 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)	
$\Delta \ln$ value added const. prices	0.16	1.69	0.35 ***	4.46	0.10 ***	3.37
$\Delta \ln$ real wages	-0.27 **	-2.59	-0.30 ***	-3.78	-0.34 ***	-10.81
Δ 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)	
$\Delta \ln$ value added const. prices	0.22 ***	2.58	0.39 ***	5.36	0.11 ***	3.18
$\Delta \ln$ real wages	-0.32 ***	-3.46	-0.33 ***	-4.26	-0.38 ***	-6.76
Δ 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)	
$\Delta \ln$ value added const. p.	0.15 ***	1.64	0.34 ***	4.39	0.12 ***	3.27
$\Delta \ln$ real wages	-0.27 ***	-2.58	-0.30 ***	-3.79	-0.39 ***	-6.59
Δ IMQ low-wage countries	-8.93 ***	-3.82	-5.49 ***	-3.84	-1.90	-0.78
Δ 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: 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 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)			
$\Delta \ln$ value added const. p.	0.12 *	1.73	0.18 *	1.82
$\Delta \ln$ 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)			
$\Delta \ln$ value added const. p.	0.13 *	1.85	0.16	1.58
$\Delta \ln$ real wages	-0.32 ***	-3.27	-0.34 ***	-4.06
Δ IMQ 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)			
$\Delta \ln$ value added const. p.	0.16 **	2.31	0.19 **	2.01
$\Delta \ln$ real wages	-0.36 ***	-3.42	-0.38 ***	-4.69
Δ IMQ 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)			
$\Delta \ln$ value added const. p.	0.16	2.50	0.19 **	2.04
$\Delta \ln$ real wages	-0.41 ***	-3.57	-0.39 ***	-4.33
Δ IMQ from low-wage countries	-5.31 ***	-2.63	-3.09	-1.02
Δ IMQ 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: See Table 5.

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 country origin. After totally differentiating the labour demand equation and the following transformation into growth rates, the percentage change of total employment can be written as:

$$\Delta \ln L \cong \beta_1 \cdot \overline{\Delta \ln Y} + \beta_2 \cdot \overline{\Delta \ln WP} + \beta_3 \overline{\Delta IMQ} + \text{constant},$$

where the bar denotes 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 upon 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. The increase in imported materials from low-wage countries has decreased employment by 0.26 percentage points per year over the period 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 quite 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 between 1995 and 2000. However, output growth is not sufficient to compensate 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 between 0.09 percentage points of the decline in employment in less skill intensive industries over the period 1995-2000.

5. Conclusions

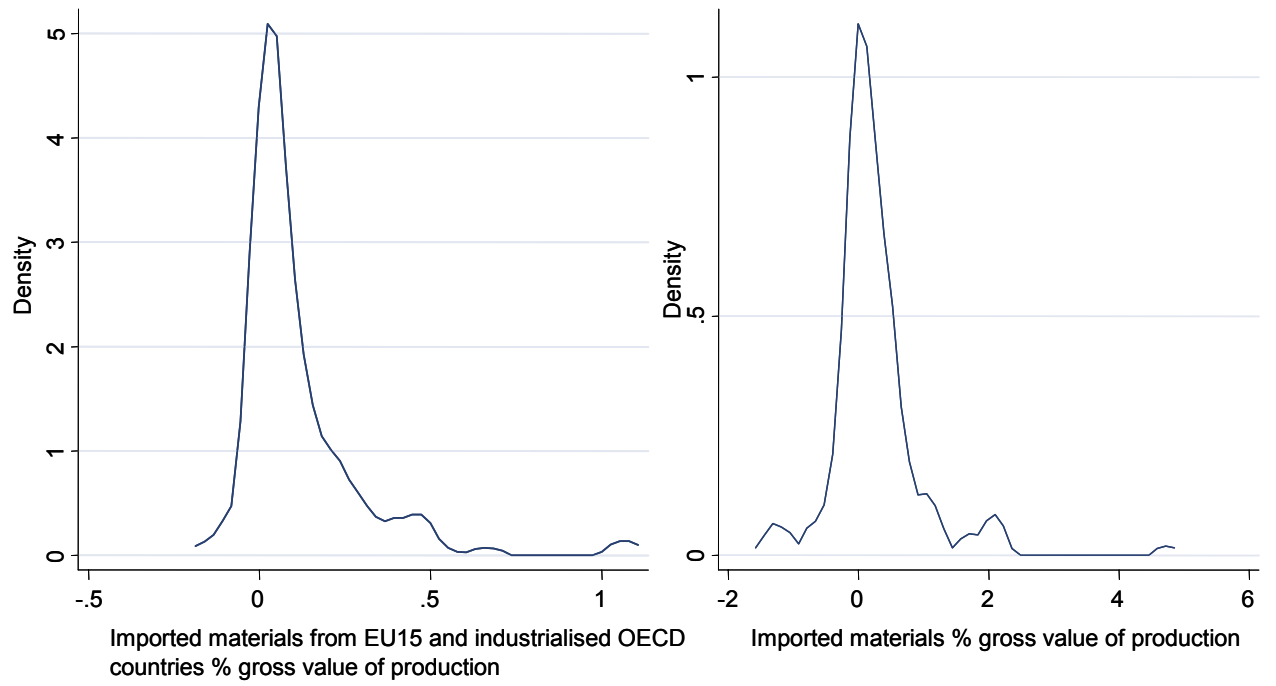
This paper presents further insights into the employment effects of international outsourcing. We estimate a labour demand equation for a sample of manufacturing two-digit industries for EU countries over the period 1995-2000. Our results for seven EU countries show that imports from low-wage countries 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 gross production in seven EU countries amounted to 0.11 percentage points per year. According to our calculations, the observed change in EU outsourcing 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 systematic 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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Appendix*Figure 1: Univariate Kernel Density.*

Source: EUROSTAT Input-Output-Tables, UN Foreign Trade Statistics, own calculations.