International outsourcing and labour demand: Evidence from Finnish firm-level data* /

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Abstract: We examine the employment effects of international outsourcing by using firm-level data from the Finnish manufacturing sector. A major advantage of our data is that outsourcing is defined based on firms' actual use of intermediate inputs from foreign trade statistics. The estimates show that intensive outsourcing (more than two times the 2-digit industry median) does not reduce employment nor have an effect on the share of low-skilled workers. JEL no. F16, F23

Keywords: International outsourcing; offshoring; labour demand; propensity score matching

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1 Introduction

This paper takes advantage of matching methods to evaluate the employment effects of outsourcing. International outsourcing and offshoring have become one of the key devices that firms use to change their production structure across the developed countries. Blinder (2006) argues that offshoring constitutes the next industrial revolution. It has led to the vertical fragmentation of production. Linden et al. (2007) describe this process in the case of production of Apple's iPod. The volume of outsourcing has increased at a rapid pace recently, inspiring a lot of debate in Europe. International outsourcing has been seen, as a threat to employment, especially in public debate.

Micro-level evidence on the causal effect of international outsourcing on employment is relatively sparse despite the apparent importance of the topic. Assessing the causal impact of outsourcing on employment is an empirical challenge since outsourcing and employment are most likely to be co-determined by other firm factors such as export activity. Thus, even though international outsourcing is connected to the changes in employment, we do not know whether it is because of a selection of firms to the conduct of outsourcing or due to the underlying causal effect of outsourcing *per se.* This paper contributes to the literature by analysing the employment effects of international outsourcing through the use of data from the Finnish manufacturing sector. A major advantage of our data is that outsourcing is defined based on firms' actual use of intermediate inputs from foreign trade statistics. Many of the earlier studies had been based on survey data from firms. Survey data is not as reliable as the one based on firms' actual use of intermediate inputs.

Our data also cover the total population of firms in the manufacturing sector. Hence, we are not using a sample as some of earlier research. Moreover, we use firm-level information on outsourcing. Some of earlier research has taken advantage of industry-level proxies for the amount of outsourcing (e.g. Bertrand 2004). Macro data may suffer from serious aggregation bias that hinders the identification of employment effects (e.g. Geishecker 2008). Regarding the methods, most of the literature has relied on parametric models. In this paper, we use non-parametric, matching methods, instead. This allows us to take into account the selection of firms into the conduct of outsourcing (e.g. Becker and Muendler 2008).

The Finnish case has a broader interest. Since Finland is a small open country, international outsourcing can have a more profound effect on employment in Finland than in large countries. The pressures of globalization are also particularly pronounced in Finland, because it is one of the Nordic welfare states with high level of wages and benefits. The share of non-OECD countries of total Finnish manufacturing trade has increased roughly 10 percentage points in 1999-2004 (Figure 1). Within the manufacturing sector, the electronics industry has increased its outsourcing rapidly during the past 10 years, because it has become attractive for the reasons of cost savings to acquire intermediate inputs from the emerging countries such as China, India and Estonia. This has lead to job losses especially among blue-collar workers, according to the popular press.

Figure 1 around here

The article is structured as follows. Section 2 briefly summarises the literature. Section 3 discusses the theoretical arguments. Section 4 introduces our data. Section 5 describes the empirical framework and reports our estimation results. The last section concludes.

2 Review of relevant studies

There are a growing number of studies that examine whether globalization can explain the shift in the structure of labour demand in industrialised countries.[1] Revenga (1992), Abowd and Lemieux (1993), Borjas and Ramey (1995), Driffill et al. (1998), Burda (1999), Boeri et al. (2000), and Haffner et al. (2000) suggest that the changes in competitiveness of the product market have had a significant effect on employment. The idea behind this explanation is that foreign competition reduces firms' market power in the product market and thus labour rents.

One of the issues that has attracted most attention is whether international outsourcing has contributed to a shift in labour demand for different types of workers. The studies based on aggregate data (e.g. Feenstra and Hanson 1999; Falk and Koebel 2002; Geishecker 2002; Hijzen et al. 2002; Egger and Egger 2003) observe that there has been a decrease in the relative demand for low-skilled workers and an increase in the relative demand for high-skilled workers. More recent literature that has relied on micro-level data (e.g. Egger et al. 2003; Ekholm and Hakkala 2005; Marin 2005; Hsieh and Woo 2005; Munch and Skaksen 2005; Broccolini et al. 2008; Geishecker and Görg 2008; Kramarz 2008) typically reports negative effects of outsourcing on employment. There are also related studies that have evaluated the effects of outsourcing on the perception of job insecurity among affected workers (e.g. Becker and Muendler 2008; Geishecker 2008; Frijters and Geishecker 2008). These results are mixed.

There are some earlier studies on the effects of international outsourcing using Finnish data. This research has taken advantage of survey data. Ali-Yrkkö (2007) notes that cost savings

have been an important motivation behind outsourcing for Finnish companies. Maliranta et al. (2008) review the characteristics and magnitude of information technology (IT) outsourcing, based on a representative survey of Finnish businesses. They discover positive effects of IT outsourcing on labour productivity. Maliranta et al. (2008) do not report results on employment. Ali-Yrkkö and Deschryvere (2008) observe that the relationship between the in-house expansion of R&D abroad and domestic R&D employment turns out to be complementary. They use a survey data of Finnish manufacturing and service sector firms.

3 Theoretical considerations

Globalization gives access to foreign factors of production as well as domestic ones, either directly through foreign affiliates or indirectly through imported intermediate inputs. As a result of the removal of trade barriers mobility between countries will increase. This creates incentives for firms to economize on variable costs by outsourcing or fragmenting the production process. A change in capital costs affects together with labour costs on firms' price setting. The gross interest rate of the industry r_j is given for the firm. Gross wage of the industry w_j consists of the net-of-tax wage plus the social security contributions. We denote the unit costs of international outsourcing for the industry *j* by λ_j, and assume that these costs have a cumulative distribution function given by ψ_j. There are monitoring, switching and friction costs involved in letting an activity to be outsourced. It is profitable for the firm to outsource activities if

$$\frac{w_j}{r_j} > \lambda_j \tag{1}$$

which applies for a fraction

$$\psi_j(\lambda_j, \tau_j) = \Pr\left(\frac{w_j}{r_j} < \lambda_j\right) \tag{2}$$

The cumulative distribution function $\psi_j(\lambda_j, \tau_j)$ is also parameterized on trade costs (τ_j) reflecting the effect of increased globalization on the switching costs of outsourcing. As Wildasin (2000) argues, capital and labour are not homogeneous factors of production, but rather aggregates of several specific types of inputs. Firms cannot alter their stocks of capital and labour without substantial costs. The adjustment of production in response to shocks in the product market involves costs because it is costly for the firms to replace equipment, and to hire new workers. Globalization may lower the switching costs associated with outsourcing activities. Hence, we have

$$\frac{\partial \psi_j}{\partial \lambda_j} > 0, \tag{3}$$

$$\frac{\partial \psi_j}{\partial \tau_j} > 0. \tag{4}$$

The first inequality implies that the input-shares become more sensitive to the relative input-prices, when the switching costs of outsourcing decrease. The second inequality states that more globalization (lower trade costs) for a given relative input-price (switching costs) increases the share of firms choosing an outsourcing. Assuming that linear-homogenous technology can be represented by CES (Constant Elasticity of Substitution) cost function and that technology is also strongly separable between unskilled and skilled labour, the total cost function $C_j = \sum_g C_{jg}$ can be specified as the sum of sub-CES cost functions as follows

$$C_{jg} = Y_j\left[\psi_{jg} w_{jg}^{1-\sigma_{jg}} + (1-\psi_{jg}) r_{jg}^{1-\sigma_{jg}}\right]^{\frac{1}{1-\sigma_{jg}}} \tag{5}$$

where *j* and *g* refer to industry and input group, respectively, and Y_j is output. The industry *j*'s elasticity of substitution between capital and unskilled or skilled labour is denoted σ_{jg}. The

elasticity of substitution is defined as the effect of a change in the relative factor prices on the relative use of these two factors, while holding output constant. The distribution parameter ψ_{jg} can be defined as an index of augmenting technological change which is related to outsourcing. In particular, an increase in the volume of imported intermediate inputs should mainly have an effect on unskilled labour who finds it more difficult to adjust to the technological change. The CES function allows values $\sigma_{jg} \geq 0$ which can be thought as parameterized on trade costs (τ_j) to reflect that globalization expands the set of available factors by increasing the mobility of capital. Thus, firms can substitute other factors of production for immobile workers more easily by investing. As we consider an open industry in which there are many firms producing good Y_j with capital K_j and labour L_j as inputs, firm maximizes profits which are given by

$$\Pi_j = p_j Y_j - w_j L_j - r_j K_j . \tag{6}$$

Profit maximization with respect to labour yields the conditional labour demand function

$$L_{jg} = \psi_{jg} Y_j \left[\psi_{jg} w_{jg}^{1-\sigma_{jg}} + (1-\psi_{jg}) r_{jg}^{1-\sigma_{jg}} \right]^{\frac{\sigma_{jg}}{1-\sigma_{jg}}} w_{jg}^{-\sigma_{jg}} \tag{7}$$

By using equation (7), we observe that as a consequence of decreased trade costs (τ_j) it follows that industry *j*'s probability of outsourcing increases (i.e. ψ_{jg} falls), and labour demand decreases. As Koskela and Stenbacka (2009) stress, international outsourcing is a strategic mechanism, because the long-term production mode decisions require irreversible and firm-specific investments in order to establish a network of component suppliers. Therefore, firms can induce wage-moderating effects in the labour market with increased probability of outsourcing which decreases production costs and then outsourcing has counteracting effects on employment. The intuition behind this counteracting effect of

outsourcing is that labour costs become relatively more important cost-component when a larger fraction of activities is outsourced.

4 Data

We use panel data from the manufacturing sector, based on a diversity of sources: the Finnish Longitudinal Employer-Employee Data (FLEED) of Statistics Finland, the Longitudinal Database on Plants in Finnish Manufacturing (LDPM) of Statistics Finland, the Financial Market Statistics of Bank of Finland, and the Foreign Trade Statistics of National Board of Customs. FLEED gives information, at the individual level, about labour costs, and workers' qualifications like education and seniority, among other things. FLEED is aggregated to the firm level and then linked to the LDPM. Matching is possible, because all data sets that we use contain the same unique identifiers for firms. All firms in our data set belong to the LDPM. The firm-level panel data covers the period 1999-2004.

To examine the employment effects, we use the firm-level panel data that is based on the LDPM by Statistics Finland. The LDPM panel includes annual data for the manufacturing firms covering variables such as production, investments, the relevant price indices for production and investment, foreign-ownership, employment, hours worked, and nominal wages and employers' social security payments. Foreign affiliates are defined as having a foreign ownership share of at least 50 per cent, based on ultimate beneficiary.

The data on international outsourcing originates from the Foreign Trade Statistics maintained by the National Board of Customs. The data is comprehensive, covering the total population of Finnish manufacturing firms. It also contains all imports of intermediate goods. We

construct two different variables to measure foreign intermediate input outsourcing: the share of imports of intermediate inputs in production at the firm level, and the ratio of import penetration, which is defined as the ratio between the imports intermediate inputs of a firm and domestic demand (production minus net exports) of a firm. The import penetration rate reveals to what degree domestic demand is satisfied by imports of intermediate inputs. The data description is given in Appendix A.

5 Results

The features of international outsourcing have implications for modelling. Outsourcing is likely to be more common for firms with particular observable characteristics. Thus, self-selection of firms is an important characteristic of outsourcing that needs to be addressed in the analysis of the employment effects (e.g. Geishecker 2008), as noted in the introduction.

Propensity score matching aims to mimic a random experiment by constructing a control group from the group of untreated firms and ensuring that the control group is as similar as possible to the treatment group with respect to observable characteristics.[2] In our case the treatment is a situation in which the firm has outsourced beyond a threshold over the period 1999-2004. To construct the control group for the firms that have conducted international outsourcing over the period 1999-2004, we have included all manufacturing firms from the LDPM.

Matching is conducted as follows. First, probit models for the probability of conducting outsourcing are estimated to construct the control group. Second, the employment change of the firms that have conducted outsourcing beyond a threshold is compared to the firms that

have a similar propensity (based on the predictions of probit models) to be in the pool of firms that has conducted outsourcing beyond a threshold, but are not currently in the pool of those firms (i.e. the control group). We use the program by Leuven and Sianesi (2006) to conduct propensity score matching, kernel matching and the analysis of quality of matching. The main emphasis of our study is on the difference-in-differences estimates, but we also report results for the employment levels. A major advantage of difference-in-differences matching is that it removes the firm fixed effects.

The likelihood of outsourcing is explained with probit models by the firm-level variables. (Table 1 provides descriptive statistics.) We use two indicator variables for outsourcing as the dependent variables in probit models of Table 2. The indicator for the share of imports of intermediate inputs in production obtains value one if the volume of outsourcing in the firm is more than two times the median in the 2-digit industry, otherwise 0. The indicator is calculated for each year 1999-2004. We focus on the effects of intensive outsourcing, because almost all Finnish manufacturing firms import intermediate inputs from abroad, at least to some degree. We take advantage of the median in the 2-digit industry as the criteria for the amount of intensive outsourcing, because the distribution of international outsourcing across manufacturing firms is highly skewed. To check the robustness of the results, we also measure the share of imports in domestic demand, as noted earlier. The indicator for the share of imports in domestic demand obtains value one if the share of imports of intermediate inputs in domestic demand (production minus net exports) in the firm is over 0.5, otherwise 0. The values of the explanatory variables for the indicators of outsourcing are taken from the year t-1.[3]

Tables 1-2 around here

We briefly note some interesting patterns. The results show that intensive outsourcing is most typical for the firms that have plenty of prime-age workers (Table 2, Panel A). Outsourcing is least probable in the firms that contain a lot of workers with higher education. The negative effect of labour costs on outsourcing is most likely explained by the fact that we control for the educational structure of the firms, which captures a substantial part of the variation in labour costs. An increase in capital intensity decreases outsourcing. Therefore, outsourcing is most typical for the firms that use a lot of labour input in their production process. Small and middle-sized manufacturing firms are more likely to outsource. As expected, exporters and foreign-owned firms are more likely to be involved in outsourcing. These patterns are rather similar when we use our second measure of outsourcing, based on the share of imports of intermediate inputs in domestic demand (Table 2, Panel B).

The matching results are reported as the average treatment effect on the treated (ATT) for employment levels, and employment changes based on the difference-in-differences estimator. We also report estimates for the composition of labour demand both in levels and changes. We focus on the share of low-skilled workers (consisting of production workers), following the existing literature. Standard errors are calculated by using bootstrapping with 250 replications.

We report two sets of results for ATTs (Table 3). First, we take advantage of the nearest-neighbour matching method in which one treated firm is always matched to one untreated firm (with replacement) by using the region of common support for the scores. The second set of the estimates is based on the kernel method (Epanechenikov kernel) in which the firms that belong to the control group are weighted according to their proximity to the treated firm. To check the validity of the matching, covariate balancing is tested. For all the variables the

matching succeeds in making the means of the covariates close to each other for the treated and control firms.

Table 3 around here

The point estimates for the employment level reveal that there is some indication of a positive effect of intensive outsourcing on employment (Table 3, Panel A, Column 1). However, the effect is not statistically significant at any of the conventional levels. The specifications that use employment change as the outcome variable constitute our preferred estimates, because they remove the firm fixed effects that are important determinants of employment. The most important empirical finding is that international outsourcing does not lead to downsizing in manufacturing employment. In particular, the quantitative magnitude of the estimate is very small. According to the point estimate intensive outsourcing (more than two times the 2-digit industry median) reduces total employment by some 0.6 per cent in the manufacturing firms (Table 3, Panel A, Column 2). However, the estimate is not statistically significant, according to the standard errors that are calculated by bootstrapping. This key result of the paper is almost identical for our other measure of international outsourcing, which is based on the share of imports of intermediate inputs in domestic demand (Table 3, Panel B, Column 2). The results also remain the same when kernel matching is used instead of nearest-neighbour matching.

Next we study the effects of international outsourcing on the composition of labour demand (Table 3, Panels A-B, Columns 3-4). The results for the composition of labour demand in levels reveal some indication of a positive effect of international outsourcing on the share of low-skilled workers in the firms (Table 3, Panel A, Column 3). However, this positive effect

is not statistically significant, by a wide margin. After taking into account the firm fixed effects in difference-in-differences matching, we find absolutely no effects of outsourcing on the share of low-skilled workers (Table 3, Panel A, Column 4). This finding is robust for our other outsourcing measure (Table 3, Panel B, Column 4). The results also remain the same with kernel matching instead of taking advantage of nearest-neighbour matching.

6 Conclusions

This paper examines the employment effects of international outsourcing through the use of firm-level data from the Finnish manufacturing sector. A major advantage of our data is that international outsourcing is defined based on firms' actual use of intermediate inputs from foreign trade statistics. Many of the earlier empirical studies had been based on survey data from firms. Survey data is not as reliable as the one based on firms' actual use of intermediate inputs. Some of earlier research has also taken advantage of industry-level proxies to account for the amount of outsourcing. Our estimates show that intensive outsourcing (more than two times the 2-digit industry median) does not reduce employment nor have an effect on the share of low-skilled workers.

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Figure 1: *The Share of Manufacturing Trade with EU15, OECD and non-OECD of the Total Finnish Manufacturing Trade (Source: OECD Statistical Database)*

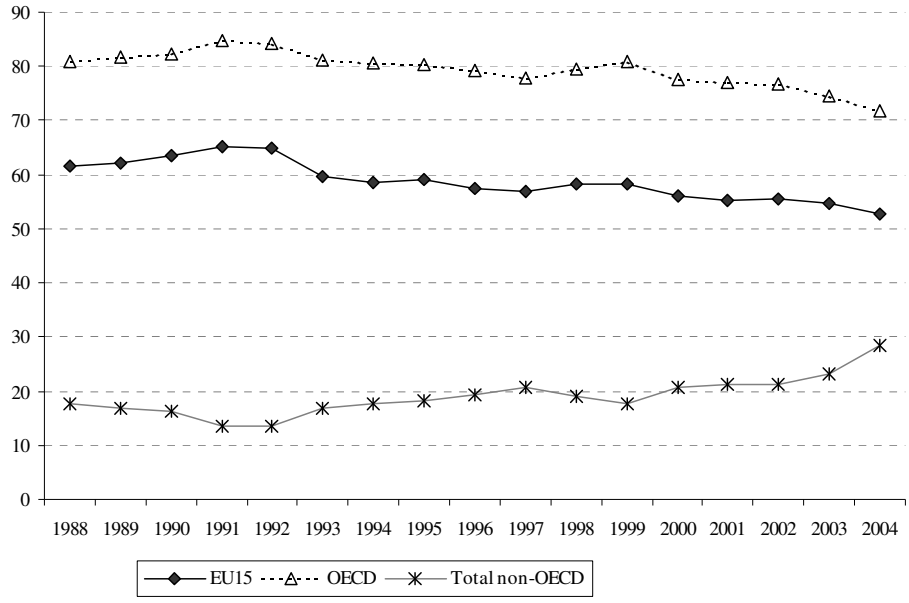

Table 1: *Summary Statistics*

Variables	Definition/measurement	Mean	Std. dev.
Age	The share of workers aged < 25	0.099	0.099
	The share of workers aged 25-34	0.226	0.121
	The share of workers aged 35-44 (ref.)	0.278	0.107
	The share of workers aged 45-54	0.284	0.127
	The share of workers aged 55-64	0.111	0.096
	The share of workers aged > 65	0.002	0.016
Education	The share of workers with primary education only	0.254	0.146
	The share of workers with lower secondary education (ref.)	0.483	0.171
	The share of workers with post-secondary education	0.211	0.143
	The share of workers with higher education	0.050	0.096
	The share of workers with doctoral education	0.003	0.014
Labour costs	Average real labour costs per hours worked (log)	3.036	0.296
Capital intensity	The share of investments in production	0.104	6.842
Firm size	The number of workers less than 100 (small firm)	0.752	0.432
	The number of workers 100-500 (middle-sized firm)	0.201	0.400
	The number of workers > 500 (ref.)	0.048	0.213
Exports	The share of exports in production	49.03	5837
FATS	Foreign ownership > 50 percent	0.135	0.342
	Foreign ownership ≤ 50 percent (ref.)	0.865	0.342
Years	5 year dummies		
Industries	17 industry dummies		
N		15 565	

Table 2: *The Estimation Results from the Probit Models for Explaining the Incidence of International Outsourcing*

Panel A: The share of imports of intermediate inputs in production

	Employment	Employment change	Share of low-skilled	Change in the share of low-skilled
Age < 25	-1.477	-1.449	-1.455	-1.452
	(0.139)***	(0.176)***	(0.147)***	(0.186)***
Age 25-34	-0.020	0.080	-0.003	0.111
	(0.126)	(0.158)	(0.141)	(0.178)
Age 45-54	-0.842	-0.894	-0.943	-1.030
	(0.122)***	(0.150)***	(0.137)***	(0.169)***
Age 55-64	-1.301	-1.371	-1.475	-1.591
	(0.143)***	(0.173)***	(0.162)***	(0.198)***
Age > 65	-6.496	-8.330	-6.470	-8.903
	(1.231)***	(1.788)***	(1.458)***	(2.200)***
Primary education only	0.985	1.005	1.016	1.049
	(0.097)***	(0.119)***	(0.101)***	(0.124)***
Post-secondary education	0.024	-0.073	0.012	-0.031
	(0.092)	(0.113)	(0.128)	(0.161)
Higher education	-0.533	-0.642	-0.649	-0.722
	(0.150)***	(0.184)***	(0.256)**	(0.322)**
Doctoral education	0.109	-0.693	-1.984	-2.638
	(0.866)	(1.082)	(1.396)	(1.673)
Labour costs	-0.185	-0.136	-0.071	-0.056
	(0.047)***	(0.058)**	(0.016)***	(0.019)***
Capital intensity	-0.059	-0.532	-0.052	-0.723
	(0.025)**	(0.114)***	(0.027)*	(0.128)***
Small firm	0.329	0.275	0.397	0.318
	(0.051)***	(0.058)***	(0.052)***	(0.059)***
Middle-sized firm	0.353	0.318	0.360	0.315
	(0.054)***	(0.061)***	(0.054)***	(0.061)***
Exports	0.00007	0.020	0.00006	0.023
	(0.00003)**	(0.002)***	(0.00003)*	(0.002)***
FATS (foreign ownership > 50%)	0.151	0.144	0.137	0.139
	(0.032)***	(0.037)***	(0.034)***	(0.039)***
Indicators				
Years	Yes	Yes	Yes	Yes
Industries	Yes	Yes	Yes	Yes

Panel B: The share of imports of intermediate inputs in domestic demand

	Employment	Employment change	Share of low-skilled	Change in the share of low-skilled
Age < 25	-1.063	-1.144	-0.996	-1.069
	(0.155)***	(0.198)***	(0.163)***	(0.207)***
Age 25-34	-0.234	-0.148	-0.224	-0.133
	(0.137)*	(0.172)	(0.152)	(0.191)
Age 45-54	-0.590	-0.629	-0.701	-0.760
	(0.133)***	(0.164)***	(0.149)***	(0.183)***
Age 55-64	-0.847	-0.959	-0.901	-1.069
	(0.157)***	(0.189)***	(0.177)***	(0.214)***
Age > 65	-3.504	-4.060	-2.960	-3.786
	(1.227)***	(1.665)**	(1.517)*	(2.286)*
Primary education only	0.448	0.545	0.478	0.619
	(0.106)***	(0.130)***	(0.111)***	(0.136)***
Post-secondary education	-0.161	-0.084	-0.020	0.146
	(0.101)*	(0.124)	(0.140)	(0.174)
Higher education	-0.302	-0.279	-0.842	-0.890
	(0.168)*	(0.206)	(0.294)***	(0.367)**
Doctoral education	-0.233	-1.007	0.024	-0.739
	(0.994)	(1.224)	(1.546)	(1.900)
Labour costs	-0.237	-0.248	-0.027	-0.012
	(0.054)***	(0.066)***	(0.017)	(0.021)
Capital intensity	-0.002	-0.281	-0.001	-0.400
	(0.016)	(0.125)**	(0.006)	(0.139)***
Small firm	1.337	1.302	1.392	1.348
	(0.096)***	(0.105)***	(0.096)***	(0.105)***
Middle firm	1.040	1.011	1.057	1.023
	(0.098)***	(0.107)***	(0.098)***	(0.107)***
FATS (foreign ownership > 50%)	-0.082	-0.091	-0.082	-0.081
	(0.037)**	(0.043)**	(0.039)**	(0.045)*
Indicators				
Years	Yes	Yes	Yes	Yes
Industries	Yes	Yes	Yes	Yes

Notes: Robust standard errors in parentheses. Significance: *** 1%, ** 5%, * 10%.

Table 3: *The Average Treatment Effects*

Panel A: The share of imports of intermediate inputs in production

Matching method	Employment	Employment change	Share of low-skilled	Change in the share of low-skilled
Nearest-neighbour	0.122	-0.006	0.017	0.000
	(1.181)	(0.009)	(0.027)	(0.007)
Kernel	0.120	-0.007	0.016	0.002
	(0.175)	(0.007)	(0.026)	(0.007)

Panel B: The share of imports of intermediate inputs in domestic demand

Matching method	Employment	Employment change	Share of low-skilled	Change in the share of low-skilled
Nearest-neighbour	0.012	-0.003	0.005	0.002
	(0.087)	(0.007)	(0.020)	(0.008)
Kernel	0.038	-0.008	0.009	0.000
	(0.089)	(0.009)	(0.018)	(0.006)

Notes: Bootstrap standard errors (250 replications) in parentheses. Significance: *** 1%, ** 5%, * 10%.

Appendix A: Data description

FLEED: The Finnish Longitudinal Employer-Employee Data (FLEED) of Statistics Finland provides information about wages at the individual level and workers' qualifications like education for the period 1988-2004. FLEED is constructed using the data of Employment Statistics (ES) which is linked to the firm-level data sources by using individual identification codes of the persons who are employed in the manufacturing sector. ES is essentially an annual population census maintained by Statistics Finland. We use ES to calculate the average characteristics of workers in terms of age and education levels at the firm level to take into account the differences in labour quality. The definition of skills is based on internationally comparable information following the International Standard Classification of Education (ISCED). We create five education groups and take into account the seniority of workers by creating six age groups, as described in Table 1.

LDPM: The Longitudinal Database on Plants in Finnish Manufacturing (LDPM) of Statistics Finland includes all plants owned by firms that have no fewer than 20 persons from 1995 onwards. For matching, we link all plants to their firms by using comprehensive information on ownership. From this annual database, we use the data for the manufacturing firms covering the following variables: production, investments, the price indices for production and investment, foreign-ownership, employment (production and non-production workers), hours worked, and nominal wages and employers' social security payments for production and non-production workers. Our approach requires measures of real labour costs, real investment, and real output for all firm-year observations. To deflate the relevant variables, we use industry-level prices for production and investment. For the total quantity of labour employed in the firm as well as for the number of production and non-production workers, we construct real labour costs as nominal annual wages and social security payments deflated by

the producer price index and divided by the hours worked. Foreign-owned enterprises are identified by using statistics on foreign affiliates which includes all foreign affiliates operating in Finland as well as the institutional units that control them.

Creation of Price Competitiveness Indicator: To deflate traded goods, imports and exports, we construct a real competitiveness indicator where euro-country weights are based on Finland's bilateral exports. Using industry-level (2-digit ISIC manufacturing industries) data, we compute a real competitiveness indicator of the industry relevant to each firm as nominal competitiveness indicator multiplied by the terms of trade ratio of export and import prices. The nominal competitiveness indicator for the period 1999-2004 is based on the Financial Market Statistics maintained by Bank of Finland. The industry-level prices of exports and imports are based on Producer Price Indices of Statistics Finland.

***Foreign Trade Statistics*:** The data on international outsourcing originates from Foreign Trade Statistics maintained by the National Board of Customs. The data is comprehensive. Thus, it contains all imports of intermediate goods in the manufacturing sector. We have also used information from the input-output tables of Statistics Finland to validate the measures for the purchases of intermediate inputs from abroad by the National Board of Customs. The customs data contain all exporting or importing firms and the amount of transactions in each year for each product of the CN (Combined Nomenclature) classification (8-digit equivalent of the SITC code). We have aggregated the product data to the firm level in the manufacturing sector for the period 1999-2004. To deflate our measures of firm-level international trade, we have used our real competitiveness indicator, described above. Information on firms' imports and exports is linked to the LDPM by using firm codes.

[1] Crinò (2009) provides a comprehensive survey of the literature.

[2] Caliendo and Kopeinig (2008) provide a summary of matching methods.

[3] In matching one need not control for all the observable factors. It suffices to condition on the propensity score (i.e. the probability of treatment).