


International Outsourcing and Productivity Growth


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Abstract: This study investigates the impact of international outsourcing to low and high income countries on total factor productivity (TFP) growth based on manufacturing industry data for 14 OECD countries for the period 1995-2000. We find that both the broad and narrow measure of international outsourcing of material inputs to low income countries are not significantly related to total factor productivity growth. In contrast, there is significant impact of purchased services from abroad on TFP growth. In particular, purchased services from abroad account for 20 percent of total factor productivity growth in the manufacturing sector in the selected OECD countries.

JEL classification: F23; L23; F14

Keywords: international outsourcing, purchased services from abroad, total factor productivity growth

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1 Introduction

In the last 20 years there has been a rise in the fragmentation of the production processes in industrialized countries. This is manifested in the increase in the share of imported intermediate material and services inputs, in particular from low and medium income countries (see Ahn et al. 2008; Amiti & Wei, 2006, 2009; Feenstra & Hanson, 1999; Falk & Wolfmayr, 2008). Despite the increasing literature on the productivity effects of international outsourcing to date, there is still no consensus on the direction and magnitude of the effects (for a survey see Olsen, 2006). For instance, both Amiti & Wei (2006, 2009) and Crinò (2008) find a significant positive effect on productivity of purchased services from abroad and a somewhat smaller positive effect of imported intermediate materials based on US and European manufacturing data, respectively. In contrast, using industry level data for Italian manufacturing, Daveri & Jona-Lasinio (2008) find a positive impact of outsourcing of materials on productivity, while purchased services from abroad are significantly negatively related to productivity. Furthermore, there are an increasing number of studies investigating the productivity effects of outsourcing at the firm level (see among others Girma & Görg, 2004; Görg et al., 2008). For instance, Görg et al. (2008) find that outsourcing of services inputs is positively related to productivity growth based on firm-level data for the Irish manufacturing sector. A common feature of the studies is that they do not distinguish between imported materials and imported services from low wage and high wage countries.

This paper reinvestigates the productivity effects of international outsourcing distinguishing between outsourcing of service and material inputs at the industry level. Based on Input-Output tables, we construct several different measures of international outsourcing. We distinguish between the narrow measure of outsourcing that includes only imported intermediate inputs from the same industry class, the broad measure of outsourcing comprising all imported materials and an indicator of international outsourcing of service inputs. Furthermore, we combine the trade statistics for goods and services imports with information from Input-Output tables. This enables us to identify the imported intermediates by their country of origin. Specifically, we distinguish between imported intermediate materials from low and medium wage countries (i.e. new EU member states and developing and newly industrialized countries, NICs) and high wage countries (i.e. former EU15 member states and the remaining OECD countries). The total factor productivity equation is estimated by OLS using a cross-section of long-differences (i.e. changes in logarithms between 1995 and 2000).

The structure of this paper is as follows. Section 2 presents the previous literature and section 3 introduces the empirical model and the hypotheses. Section 4 presents the data used, while the empirical results are discussed in section 5. Some concluding remarks are provided in section 6.

2 Previous Literature

In recent years, there have been numerous studies investigating the relationship between international outsourcing and productivity (for a recent survey of the literature see Olsen, 2006 and Heshmati, 2003). There is also a large amount of literature investigating the effects of services and materials outsourcing on domestic employment and/or employment of different skill levels (see for a survey Crinò 2009, Falk & Wolfmayr, 2008). However, consideration of the literature on the employment effects of international outsourcing is outside the scope of the present paper. Productivity effects of purchased services can be measured in several ways. One way is to decompose the change in output into the contribution of various inputs. The other way is to use the regression method with the change in value added as a left hand variable and the input factors (including service inputs) as explanatory variables.

The theoretical literature suggests that the effects of purchased services and materials from abroad (i.e. international materials and services outsourcing) are positive, especially when outsourcing leads to lower costs of production and/or when inefficient production processes are relocated. So far, empirical evidence on the productivity effects of outsourcing is rather positive at least when industry level studies are considered. However, it is difficult to generalize the findings since the studies differ widely in the dimensions, as they are based on different sample periods and countries, different definitions of the purchased services as well as on different model specifications and estimation techniques.

Using US industry data for the period 1992-2000, Amiti & Wei (2006) find a significant positive effect on labor productivity of international services outsourcing and a somewhat smaller positive effect of international outsourcing of materials. In particular, the authors find that international service outsourcing accounted for 11 percent to 13 percent of the total growth in labor productivity in the US manufacturing sector and that material offshoring accounted for 3 percent to 6 percent (see also Amiti & Wei, 2009). More recently, Crinò (2008) finds that service offshoring has a significant and large positive effect on productivity in the home countries. The underlying data consists of a panel of twenty industries (both manufacturing and services) for nine Western European countries for the period 1990-2004. Using industry level for German manufacturing for the period 1995-2006, Winkler (2010) finds that purchased services from abroad has a positive and significant impact on labour productivity. However, the effects of share of intermediate materials either from domestic suppliers or from abroad are small or even negative. Girma and Görg (2004) also find a positive relationship between purchased services from abroad and both total factor productivity and labor productivity based on data for three manufacturing industries for the UK between the period 1980-1992. In contrast, Daveri &

Jona-Lasinio (2008) find that imported intermediate materials have a positive and significant impact on overall productivity growth, while purchased services have a negative impact on productivity. The data is based on 21 industries for the Italian manufacturing sector for the period 1995-2003. Earlier studies at the industry do not distinguish between purchased services from domestic and foreign suppliers. For instance, Ten Raa & Wolff (2001) find that TFP growth in manufacturing industries is positively related to change in outsourcing, defined as inputs purchased from services industries. Using industry data for US manufacturing, Fixler & Siegel (1999) find that the growth of labour productivity and the growth of purchased services are significantly positively related.

The results on the relationship between purchased services and a measure of productivity at the firm level is mixed. Using data on 43 000 German manufacturing firms, Görzig & Stephan (2002) find a negative relationship between the ratio of external services to wage costs and labour productivity. Other studies based on firm-level data for Ireland and the UK also find no clear relationship. For instance, based on Irish manufacturing data Görg et al. (2008) find that the relationship between external services from abroad and TFP is only significant for exporters. Based on firm level data for the UK, Girma & Görg (2004) find that the impact of purchased services depends on the industry affiliation. Görg & Hanley (2005) find no significant relationship between international outsourcing and the ratio of net profits to output for the Irish electronics sector.

Most of the studies based on firm level data provided by the business and management literature is based on small samples. Furthermore, most studies at the firm level do not distinguish between purchased services and intermediate material inputs or between purchased services from domestic and foreign suppliers because of data availability. For instance, Broedner et al. (2009) only look at the relationship between material inputs and productivity. Tomiura (2007) and Wagner (2011) only use a general measure of international outsourcing (i.e. outsourcing to foreign suppliers not distinguished by the type of activity). Overall, it is difficult to generalize the findings based on firm-level and/or industry data since they widely differ in scope: they are based on different sample periods and countries, different definitions of the purchased services and intermediate materials from abroad.

Finally, a particular estimation problem is endogeneity of outsourcing. Antràs & Helpman (2004) suggest that firms that purchase services from abroad already have a higher productivity than firms totally supplied by in-house production or that purchase service from domestic suppliers (for recent empirical evidence see Tomiura 2007). Acemoglu et al. (2010) find that the degree of international outsourcing depends on the R&D intensity in the final goods industry. However, few papers account for endogeneity of outsourcing.

3 Empirical Model

In order to investigate the productivity gains from international outsourcing we use industry data for several countries. The relationship between the level of total factor productivity and international outsourcing can be described as:

$$\ln TFP_{ijt} = \beta_0 + \beta_1 Z_{ijt}^k + \beta_2 T + \mu_{ij} + \varepsilon_{ijt}$$

where t denotes time, j denotes industry and i denotes country. TFP is the quality adjusted level of total factor productivity based on the EUKLEMS database, Z_{ijt}^k are various k indicators of international outsourcing measured as imported materials and purchased services from abroad in relation to the industry's output. μ_{ij} is a sector effect that is allowed to be different across countries. T is the time trend, and ε_{ijt} is the error term. Taking "long differences" across the whole of our time period and adding industry $DSEC_j$ and country dummy variables DCO_{il} gives the following TFP equation:

$$\Delta \ln TFP_{ijt} = \alpha_0 + \alpha_1 \Delta Z_{ijt}^k + \sum_{j=1}^J \alpha_j DSEC_j + \sum_{l=1}^L \alpha_l DCO_{il} + v_{ijt},$$

where the new error term, $v_{ijt} = \varepsilon_{ijt} - \varepsilon_{ijt-1}$, has a zero mean and constant variance. Δ refers to the change of the variables from 1995 to 2000. Time differencing of the time trend generates the constant α_0 . It is well known that the use of long differences estimators reduce the problem of measurement error (Griliches & Hausman, 1986). Note that the problem of measurement error is more likely to arise based on annual variation of Input-output tables as compared to five year changes.

We use the so-called broad and narrow measure of international outsourcing, Z_{ij}^B and Z_{ij}^N , omitting indices i for country and t for time:

$$Z_j^N = \frac{MI_{jj}}{Y_j}$$

$$Z_j^B = \frac{\sum_{n=1}^N MI_{jn}}{Y_j}.$$

MI_{jj} denotes imported manufactured intermediates from the same industry (narrow measure), whereas MI_{jn} is industry j 's use of imported materials from industries n (broad measure). Y_j is output in industry j . Furthermore, we disaggregate both variables by country of origin. In particular, we distinguish between high wage countries on the one hand and low wage and medium wage countries on the other hand. We multiply each type of imported inputs (MI_{jj}) or (MI_{jn}), which are obtained from the Input-Output

tables, by the respective country's (regional) import shares for total imports (M_{nc}/M_n), which are in turn obtained from trade statistics. That is, imported inputs of type (n), purchased by industry (j) from country (country group) (c) are given by (omitting indices i for country and t for time):

$$Z_{jc}^N = \frac{MI_{jj} \frac{M_{nc}}{M_n}}{Y_j}$$

$$Z_{jc}^B = \frac{\sum_{n=1}^N MI_{jn} \frac{M_{nc}}{M_n}}{Y_j}$$

Note that we must assume that the breakdown by country of origin of intermediate imports of type (n) is the same across all of the input purchasing sectors (j). Low and medium wage countries include the new EU member states and the NICs (i.e. China, Hong Kong, South Korea, Malaysia, Singapore, Taiwan, and Thailand) and other East Asian countries (i.e. Indonesia, India, Philippines, Brunei, Myanmar, Vietnam, Laos, and Cambodia). High wage countries include the EU-15 countries and other industrialized OECD countries (e.g. the USA, Japan, Australia etc., but excluding Mexico, South Korea, and the four large new EU member states). Finally, we also employ the share of purchased services from abroad. However, it is not possible to disaggregate service imports by country of origin because of data availability.

Note that a positive association between TFP growth and the change in international outsourcing may reflect reverse causality, that is, increased outsourcing activities is rather the result of productivity growth and not the source of it. It may be the case that industries with a high productivity growth rate are increasing their outsourcing activities more than average. In order to control for the reversed causality problem we estimate the relationship between the initial level of international outsourcing and total factor productivity growth:

$$\Delta \ln TFP_{ijt} = \alpha_0 + \alpha_1 Z_{1995,ij}^k + \sum_{j=1}^J \alpha_j DSEC_j + \sum_{l=1}^L \alpha_l DCO_{il} + v_{ijt},$$

where $Z_{1995,ij}^k$ is the initial level share of various indicators of international outsourcing.

We expect a positive effect of international outsourcing on TFP since outsourcing allows firms to relocate their inefficient production activities to more efficient firms abroad. Amiti & Wei (2006) suggest that the TFP from offshoring service inputs is higher than that from offshoring material inputs because service offshoring is often associated with restructuring and organizational change.

4 Data and Descriptive Statistics

Information about the use of imported materials is from the OECD Input-Output tables for the year 1995 and 2000. TFP is drawn from the EUKLEMS database (see Inklaar et al., 2008). Overall we obtain data for 14 countries (i.e. Austria, Belgium, Denmark, Finland, France, Germany, Ireland, Italy, Netherlands, Portugal, Spain, Sweden, USA and United Kingdom). Table 1 shows the summary statistics of the total sample over all industries and countries. The narrow outsourcing share is about 9.3 percent in 2000 based on unweighted averages across industries and countries. The corresponding share of broad international outsourcing is 18.6 percent. Table 1 also shows both the narrow and broad measure for two different regions, namely low and high wage regions. The share of narrow outsourcing to high wage countries is about 7.4 percent in 2000. This indicates that roughly 80 percent of the total imported materials of the 14 OECD countries are still from other industrialized countries. Therefore, it seems unlikely that the increase in international outsourcing to low wage countries explains much of the productivity increase in manufacturing. It can be observed that international outsourcing increased between 1995 and 2000. This holds for both the narrow and broad measure of international outsourcing of manufacturing goods as well as for the share of purchased services. Furthermore, the increase of the share of international outsourcing to low and medium wage countries is higher than that of the high wage countries.

Table 2 displays the means across countries for each manufacturing industry. The international outsourcing of materials to low and medium wage countries is most intensive in textiles, wearing apparel and leather and electrical and optical equipment with shares of 4.3 percent and 2.9 percent. Furthermore, the evolution of the share of international outsourcing of materials to low and medium wage is uneven across industries.

Table 1 - Descriptive Statistics (Total Sample)

	Means		St.dev		Min		Max	
	1995	2000	1995	2000	1995	2000	1995	2000
Total factor productivity (2000=100)	100.0	111.3	0.0	23.5	100.0	75.6	100.0	248.1
Broad international outsourcing, % of output	17.7	18.6	9.9	10.1	1.8	1.6	51.1	52.2
Broad intern. outsourcing to low wage country, % of output	1.6	2.2	1.7	1.8	0.1	0.2	13.1	11.3
Broad intern. outsourcing to high wage country, % of output	15.0	15.1	8.8	8.9	1.0	0.9	45.6	47.8
Narrow international outsourcing, % of output	8.6	9.3	7.1	7.3	0.1	0.2	40.4	37.3
Narrow intern. outsourcing to low wage country, % of output	0.9	1.2	1.3	1.5	0.0	0.0	9.4	7.9
Narrow intern. outsourcing to high wage country, % of output	7.2	7.4	6.2	6.3	0.1	0.1	36.6	35.1
Purchased services from abroad, % of output	1.7	2.1	2.5	4.9	0.1	0.1	21.9	49.8

Notes: Narrow outsourcing measure: imported intermediate materials within the industry divided by the gross output of the industry. Unweighted figures across industries and countries. The number of observations is 167.

From 1995 to 2000, growth in intermediate imports was the most pronounced in transport equipment, electrical and optical equipment and in textiles, wearing apparel and leather. This is consistent with the findings of Ahn et al. (2008) for Japan and Korea. Furthermore, the share of imported

Table 2 - Means of the Variables by Industry (NACE rev. 1.1)

	1516	1719	20	2122	24	25	26	2728	29	3033	3435	3637
TFP 1995 (1995=100)	100	100	100	100	100	100	100	100	100	100	100	100
TFP 2000 (1995=100)	99.1	109.6	112.4	107.1	112.8	109.9	107.0	106.6	104.9	146.7	112.8	106.6
Broad measure of international outsourcing in % of gross output												
Total share in 1995	7.0	23.5	12.6	13.1	19.4	22.7	9.3	18.2	20.3	24.0	27.0	15.7
Total share in 2000	8.1	23.0	13.9	12.6	21.3	23.6	9.4	19.1	21.6	26.2	29.3	15.8
Share of low wage country 1995	0.4	4.1	1.5	0.5	1.0	1.3	0.9	1.2	1.7	3.5	1.6	2.0
Share of low wage country 2000	0.5	5.0	2.1	0.7	1.2	1.7	0.9	1.6	2.2	4.7	2.8	2.7
Share of high wage country 1995	6.0	17.2	9.6	12.0	17.3	20.4	8.0	15.5	17.8	19.6	24.5	12.3
Share of high wage country 2000	6.8	15.4	10.0	11.3	18.7	20.9	7.9	15.6	18.4	20.3	25.5	11.6
Narrow measure of international outsourcing in % of gross output												
Total share in 1995	4.5	16.1	8.7	9.6	15.1	3.2	2.8	7.1	7.6	12.2	14.1	2.4
Total share in 2000	4.9	15.0	9.6	8.9	16.6	3.8	3.4	7.7	8.8	13.7	16.5	3.2
Share of low wage country 1995	0.2	3.7	1.2	0.2	0.6	0.3	0.2	0.4	0.3	2.2	0.4	0.7
Share of low wage country 2000	0.2	4.3	1.7	0.4	0.8	0.4	0.4	0.7	0.7	2.9	1.1	1.0
Share of high wage country 1995	3.8	10.5	6.2	9.1	13.8	2.9	2.5	6.0	7.2	9.7	13.3	1.5
Share of high wage country 2000	4.1	8.4	6.3	8.2	15.1	3.3	2.9	6.2	7.9	10.3	15.1	1.9
Purchased services from abroad in % of gross output												
Purchased service from abroad, 1995	2.0	1.3	1.0	2.7	2.7	1.6	1.5	1.3	1.5	1.8	1.2	1.6
Purchased service from abroad, 2000	1.4	1.5	1.0	4.8	4.7	1.5	1.3	1.3	1.6	2.8	1.5	1.6

Note: 1516=food, beverages and tobacco; 1719=textiles, wearing apparel, leather; 20=wood and products; 2122=Pulp, paper, publishing, printing; 24=chemicals; 25=rubber, plastic; 26=non-metallic mineral products; 2728=basic and fabricated metals; 29=machinery and equipment; 3033=office machinery, computers, electrical machinery, telecommunication equipment, medical, precision and optical instruments; 3435=motor vehicles, other transport equipment; 3637=furniture, manufactures nec, recycling.

service inputs is still low with a share of 2.1 percent in 2000.

Finally, Table 3 shows the magnitude of international outsourcing by country. International outsourcing of materials defined narrowly in 2000 is most intensive for Belgium, Austria and the Netherlands with imported intermediates accounting for 20 percent, 13 percent and 12 percent of their gross production, respectively.

The magnitude of international material outsourcing does not vary excessively across the rest of the countries in turn reaching levels of approximately 8 percent of their gross output. The only exception is the United States where the narrow outsourcing share is about 3 percent on average across industries. Looking at the evolution over time we find an increase in the narrow measure of international outsourcing except for Ireland, Sweden and the United States where we observe a reduction between 1995 and 2000. Outsourcing to low and medium wage countries increased rapidly in almost all countries, while outsourcing to high wage countries is decreasing in six out of 14 countries. Table 3 also shows a wide variation of productivity growth in the manufacturing sector across countries.

In order to provide some first evidence for the relationship between international outsourcing and the change in TFP, we present simple scatter plots for 12 out of 14 countries and 6 out of 13 industries (see Figure 1 and Figure 2 in appendix). International outsourcing is measured as the output share of imported materials from the same industry from low wage countries in 1995 (narrow measure). We find that both variables are positively

Table 3 - Means of the Variables by Country

	AT	BE	DK	FI	FR	DE	IE	IT	NL	PL	ES	SE
TFP 1995 (1995=100)	100	100	100	100	100	100	100	100	100	100	100	100
TFP 2000 (1995=100)	128	110	96	116	119	111	114	102	113	114	96	120
Broad measure of international outsourcing in % of gross output												
Total share in 1995	21.3	26.2	22.3	16.6	11.3	11.9	28.8	13.1	25.6	17.9	14.6	17.6
Total share in 2000	24.6	29.9	22.6	17.3	10.7	14.9	25.1	14.3	25.6	19.8	18.2	17.2
Outsourcing to low wage countries 1995	2.2	1.3	1.8	1.6	0.8	1.9	3.7	1.3	2.3	0.8	1.0	1.4
Outsourcing to low wage countries 2000	3.5	2.7	2.5	2.3	1.1	2.9	2.5	1.7	3.1	0.9	1.6	1.9
Outsourcing to high wage countries 1995	18.7	23.5	19.5	13.6	9.6	9.2	24.0	10.6	21.1	16.3	12.7	15.8
Outsourcing to high wage countries 2000	20.5	25.2	19.1	13.4	8.6	10.8	21.5	11.2	19.6	18.1	15.1	14.9
Narrow measure of international outsourcing in % of gross output												
Total share in 1995	10.8	16.0	8.5	8.0	5.6	6.2	12.8	7.6	11.8	8.4	7.3	7.6
Total share in 2000	13.2	19.6	9.2	8.0	5.5	7.7	11.2	8.3	11.9	9.8	9.7	7.2
Outsourcing to low wage countries 1995	1.1	0.9	0.9	1.0	0.4	1.1	1.4	0.8	1.2	0.5	0.5	0.8
Outsourcing to low wage countries 2000	2.0	1.9	1.4	1.4	0.6	1.8	1.4	1.1	1.5	0.5	1.0	0.9
Outsourcing to high wage countries 1995	9.4	14.3	7.2	6.5	4.6	4.6	10.6	6.1	9.6	7.5	6.3	6.7
Outsourcing to high wage countries 2000	10.9	16.2	7.3	6.1	4.3	5.3	9.2	6.5	9.1	8.8	8.0	6.0
Purchased services from abroad in % of gross output												
Purchased services abroad, 1995	1.0	2.3	1.4	2.7	0.6	0.6	7.8	1.1	1.6	0.9	1.0	1.8
Purchased services abroad, 2000	1.0	2.7	1.5	1.8	0.5	0.9	11.6	1.2	1.9	0.9	1.6	2.6

correlated but generally not significant at the 10 percent level. This also holds for other indicators of international outsourcing.

5 Empirical Results

Table 4 shows the OLS estimation results of the impact of the different international outsourcing indicators on TFP when the different outsourcing indicators are included jointly in the regression. Furthermore, this table also includes results obtained from the robust regression method which reduces the impact of extreme outliers that may result from measurement errors in the outsourcing variables. In addition, results of alternative specifications are provided in which the outsourcing variables are specified as the initial level instead of its change. For comparison, Table 5 and Table 6 in appendix show OLS estimates and estimates obtained from the robust regression techniques when each of the different outsourcing indicators is included separately. For each of the 14 OECD countries, we use data on 12 industries that results in a total of 167 observations.¹

OLS estimates show that the change in the broad measure of international outsourcing of material inputs to low wage countries does not have a significant impact on total factor productivity growth. Similar results are obtained using the robust regression technique that minimizes the impact of influential observations. Therefore, we can conclude that the increase in international outsourcing to low wage countries does not lead to higher growth rate of technological change. Similarly, the impact of international

¹ Data for industry NACE 23 is excluded because the data seems to be erratic.

outsourcing to low- and medium wage countries is insignificant when the narrow measure of international outsourcing is considered. When international outsourcing of manufactured inputs is measured by the initial level we again find that TFP growth does depend on the magnitude of international outsourcing of materials. Overall, this is consistent with Winkler (2010) who finds only small or insignificant effects of international outsourcing of materials on productivity growth.

Concerning outsourcing of service inputs, we find a significant and positive impact of both the initial share of purchased services from abroad as well as the change in purchased services from abroad on TFP growth. The coefficient on the change in purchased services amounts to 1.51 and is significant at the 1 percent significance level using OLS estimates (see Table 4 specification *ii*). Robust regression estimation produces regression coefficient of 1.47 that is significant at the 1 percent level (see Table 4 middle part, *ii*).

The positive coefficient of the share of purchased services from abroad in 1995 indicates that industries with high initial shares of purchased services exhibit higher TFP growth than those with low shares. Sectors such as chemicals (ISIC 24) and machinery (ISIC 29) for example, are among the manufacturing industries with the highest share of purchased services while industries like wood (ISIC 20) and rubber plastics (ISIC 25) are those with the lowest shares. It is interesting to note that the productivity effect of the initial share of purchased services is larger than those of its changes over the period 1995-2000 (2.52. vs 1.51 based on specification *ii* in Table 4). This may indicate that industries that started earlier to source services from abroad and/or those with more experiences in service outsourcing in the past realize additional productivity gains than those that started services outsourcing at a later date.

Overall, the results for the relationship between purchased services from abroad and productivity are consistent with Crinò (2008) for the EU-15 countries. In order to provide an indication of the magnitude of the results, we calculate the contribution of the change in purchased services on TFP growth. Given the coefficient and the average change in the share of imported services over the sample we find that international outsourcing of service inputs has increased TFP by 2.4 percentage points over the sample period. Given the productivity growth of 11 percent between 1995 and 2000, international services outsourcing accounted for 20 percent of the growth of total factor productivity in the manufacturing sector in the selected OECD countries. Amiti & Wei (2006) find that for the U.S service outsourcing accounted for 11 percent to 13 percent of the total growth in labor productivity in the manufacturing sector from 1992-2000.

Table 4 - Impact of International Outsourcing on the Change in TFP (OLS and Robust Regression Method)

	OLS estimates of impact of the change in international outsourcing							
	(i)		(ii)		(iii)		(iv)	
	Coeff.	t	Coeff.	t	Coeff.	t	Coeff.	t
Δ international outsourcing of materials, broad, % of output	-1.22	-1.45						
Δ international outsourcing of materials to low wage country, broad, %					3.68	1.46		
Δ international outsourcing of materials to high wage country, broad, %					-1.73*	-1.74		
Δ international outsourcing of materials, narrow, % of output			-0.01	-0.03				
Δ international outsourcing of materials to low-wage country, narrow, %							8.37*	1.89
Δ international outsourcing of materials to high-wage country, narrow, %							-1.06	-1.21
Δ purchased services from abroad, % of output	1.19***	2.81	1.51***	4.45	0.97**	2.15	1.43***	4.86
Industry and country dummies	yes		yes		yes		yes	
Constant	0.20***	2.79	0.21***	2.97	0.18**	2.34	0.17**	2.26
R-squared	0.45		0.43		0.47		0.47	
no. of obs	167		167		167		167	
	robust regression estimates of the change in international outsourcing							
	(i)		(ii)		(iii)		(iv)	
	Coeff.	t	Coeff.	t	Coeff.	t	Coeff.	t
Δ international outsourcing of materials, broad, % of output	-0.90***	-2.64						
Δ international outsourcing of materials to low wage country, broad, %					0.54	0.40		
Δ international outsourcing of materials to high wage country, broad, %					-1.35***	-3.51		
Δ international outsourcing of materials, narrow, % of output			0.27	0.71				
Δ international outsourcing of materials to low-wage country, narrow, %							-0.73	-0.38
Δ international outsourcing of materials to high-wage country, narrow, %							0.49	1.04
Δ purchased services from abroad, % of output	1.14***	3.18	1.47***	4.04	0.98***	2.73	1.49***	4.05
Industry and country dummies	yes		yes		yes		yes	
Constant	0.18***	3.96	0.18***	3.88	0.17***	3.69	0.19***	3.92
R-squared	167		167		167		167	
	OLS estimates of the impact of the initial level of outsourcing							
	(i)		(ii)		(iii)		(iv)	
	Coeff.	t	Coeff.	t	Coeff.	t	Coeff.	t
International outsourcing of materials, broad, % of output, 1995	0.36	1.13						
International outsourcing of materials to low wage country, broad, % '95					-0.83	-0.46		
International outsourcing of mat. to high wage country, broad, % '95					0.49	1.04		
International outsourcing of materials, narrow, % 1995			0.35	1.05				
International outsourcing of mat. to low wage country, narrow, % '95							-1.88	-0.89
International outsourcing of mat. to high wage country narrow, % '95							0.61	1.33
Purchased services from abroad, % of output, 1995	2.68***	3.36	2.52***	3.44	2.59***	3.28	2.53***	3.53
Industry and country dummies	yes		yes		yes		yes	
Constant	0.18**	2.27	0.18**	2.54	0.19**	2.41	0.19***	2.73
R-squared	0.44		0.43		0.44		0.44	
no. of obs	167		167		167		167	
	robust regression estimates of the impact of the initial level of outsourcing							
	(i)		(ii)		(iii)		(iv)	
	Coeff.	t	Coeff.	t	Coeff.	t	Coeff.	t
International outsourcing of materials, broad, % of output, 1995	0.26	1.18						
International outsourcing of materials to low-wage country, broad, % '95					0.75	0.70		
International outsourcing of mat. to high-wage country, broad, % , 1995					0.17	0.61		
International outsourcing of materials, narrow, % 1995			0.17	0.73			1.14	0.88
International outsourcing of mat. to low wage country, narrow, % 1995							0.00	0.01
International outsourcing of mat. to high wage co. narrow, % , 1995								
Purchased services from abroad, % of output, 1995	2.50***	3.95	2.31***	3.77	2.52***	3.96	2.27***	3.72
Industry and country dummies	yes		yes		Yes		yes	
Constant	0.16***	3.14	0.17***	3.34	0.16***	3.25	0.17***	3.43
no. of obs	167		167		167		167	

Notes: ***, ** and * denote significance at the 1 percent, 5 percent and 10 percent level. Sector and country dummy variables are included but not reported. T-values are based on heteroscedasticity consistent standard errors.

6 Conclusions

This paper presents further insights into the productivity effects of the international outsourcing of services and materials. We estimate the rela-

tionship between the change in TFP and various indicators of international outsourcing based on a sample of manufacturing industries for 14 OECD countries from 1995-2000. A key feature of our analysis is the use of disaggregated bilateral trade data enabling in turn a separation between intermediate material inputs from high and low wage countries. The results for 14 OECD countries controlling for industry and country effects show, that both the narrow and broad measures of international outsourcing of manufactured inputs are not significant. Furthermore, while the measures of international outsourcing of materials are not significant, the change in purchased services from abroad has a significant and positive effect on TFP growth. The magnitude of the effects indicates that international outsourcing of service inputs has raised the rate of TFP by 2.4 percentage points over the sample period. Given the total productivity growth of 11 percent from 1995-2000 (unweighted across industries and countries), the increase in the intensity of international services outsourcing accounted for 20 percent of the growth of total factor productivity in the manufacturing sector in the 14 OECD countries.

There are several directions for future research in this area. One possibility for extending the work is to use more recent data. Detailed data on service trade by destination countries have only recently become available. The most interesting direction of future work, in our view is to investigate the impact of the international outsourcing on productivity based on the "international sourcing activity" database which is available at the firm level for a number of EU countries. However, this requires matching of firm level obtained from the international sourcing statistics with structural business statistics data.

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Appendix

Figure 1 - Relationship between the Share of Narrow International Outsourcing in 1995 and TFP Growth between 1995-2000

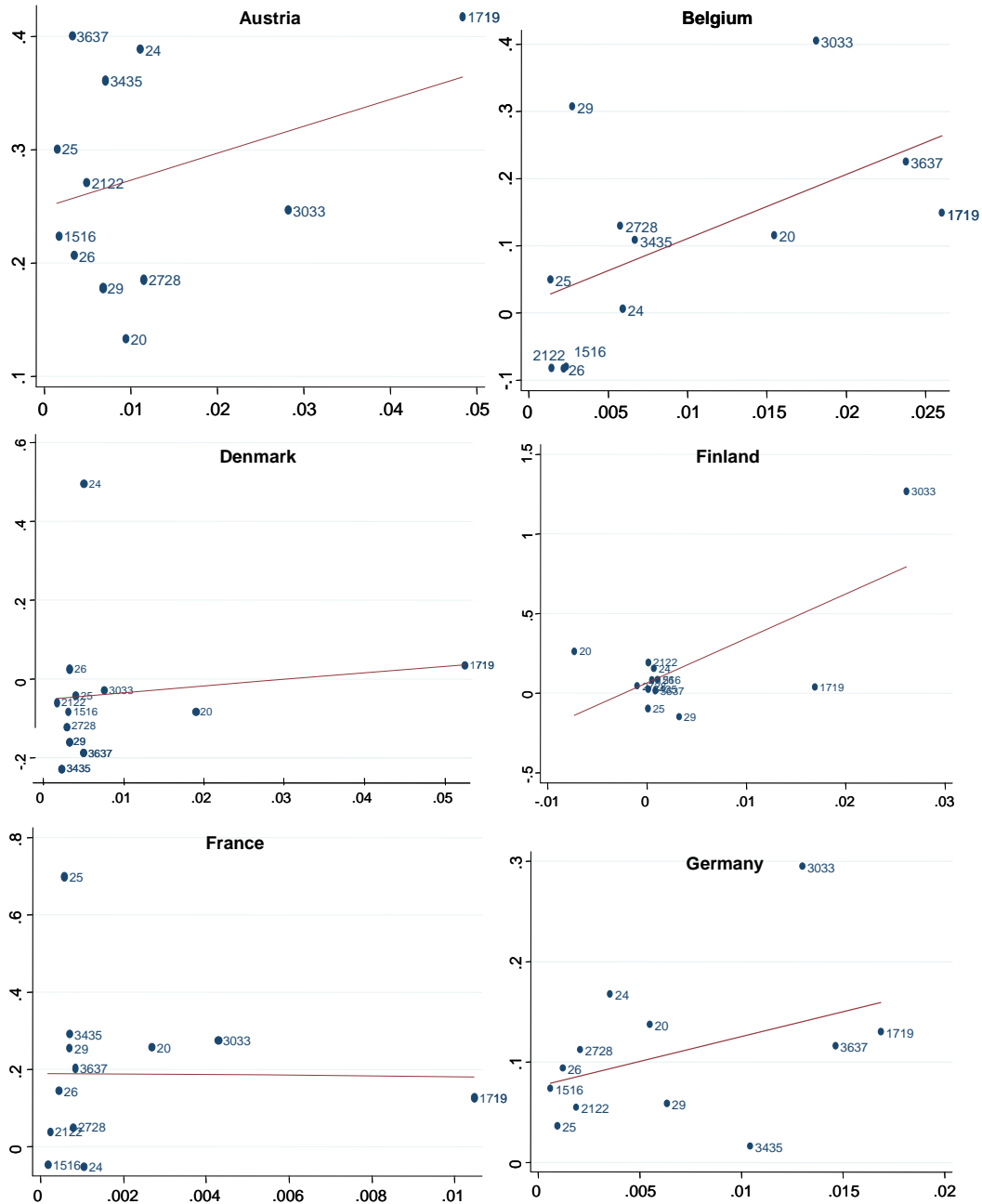


Figure 1 - continued

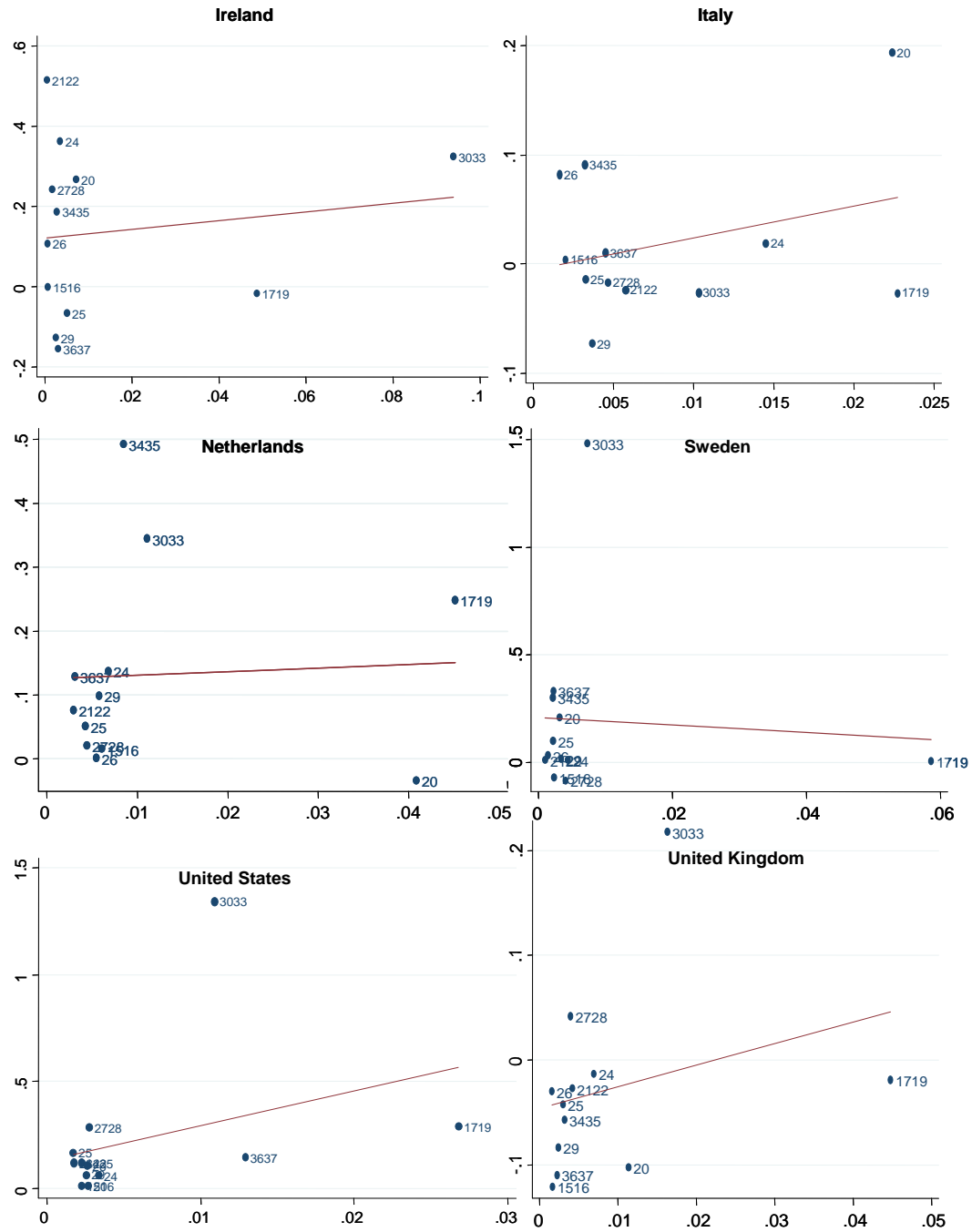


Figure 2 - Relationship between the Share of Narrow International Outsourcing to Low Wage Countries in 1995 and TFP Growth between 1995 2000 (Selected Industries)

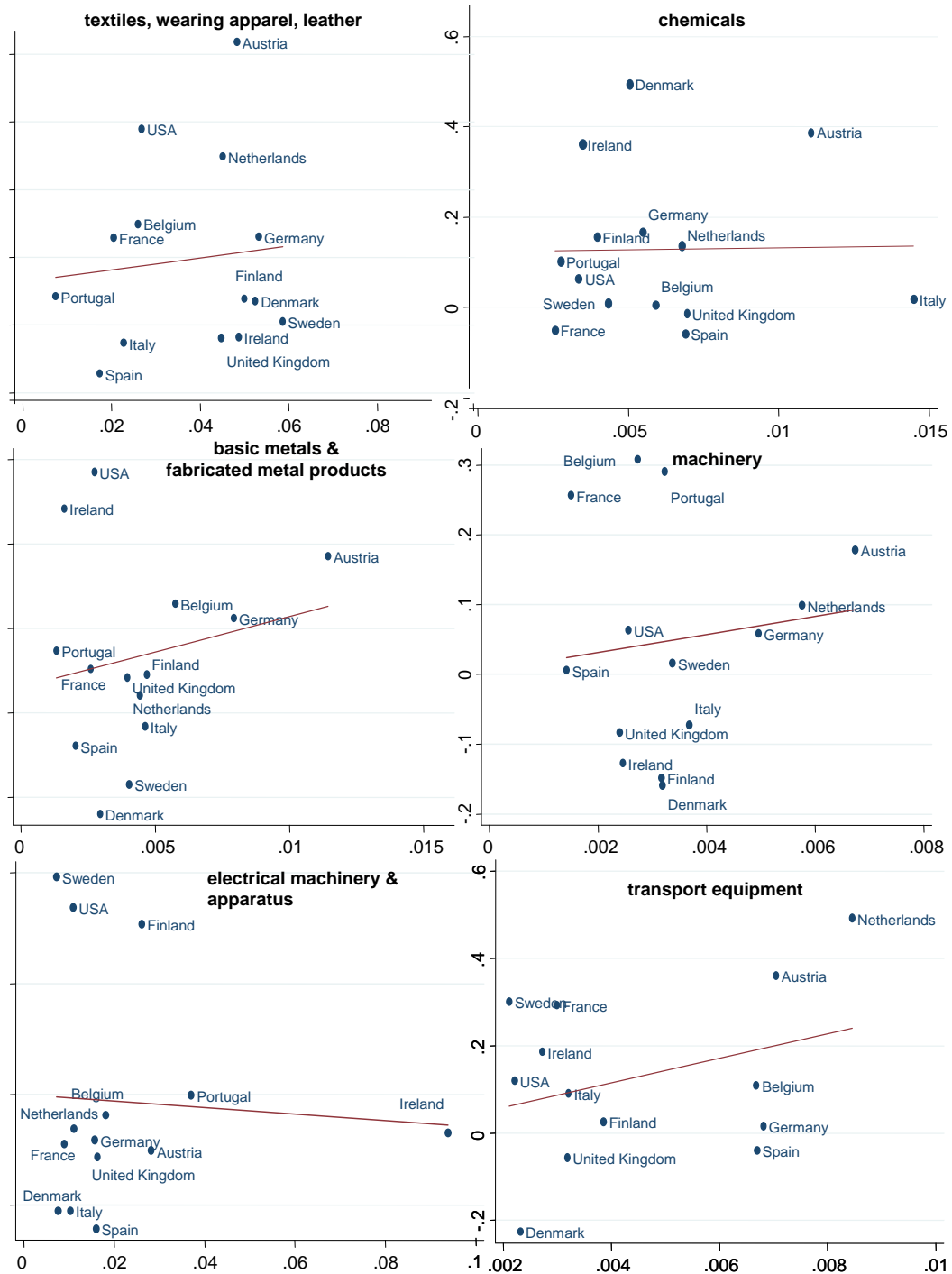


Table 5 - OLS Estimates of the Impact of International Outsourcing on the Change in TFP

<i>Impact of change in different outsourcing indicators</i>							
	<i>coeff. (t)</i>	<i>coeff. (t)</i>	<i>coeff. (t)</i>	<i>coeff. (t)</i>	<i>coeff. (t)</i>	<i>coeff. (t)</i>	<i>coeff. (t)</i>
<i>Δ international outsourcing of materials, broad, % of output</i>	-1.50*						
	(-1.77)						
<i>Δ international outsourcing of materials to low wage countries, broad, % of output</i>		-1.95*					
		(-1.95)					
<i>Δ international outsourcing of materials to high wage countries, broad, % of output</i>			3.35				
			(1.30)				
<i>Δ international outsourcing of materials, narrow, % of output</i>				-0.20			
				(-0.37)			
<i>Δ international outsourcing of materials to low-wage countries, narrow, % of output</i>					6.71*		
					(1.77)		
<i>Δ international outsourcing of materials to high-wage countries, narrow, % of output</i>						-0.63	
						(-0.73)	
<i>Δ purchased services from abroad, % of output</i>							1.51***
							(4.43)
<i>R²</i>	0.44	0.45	0.41	0.41	0.43	0.41	0.43
<i>no of observations</i>	167	167	167	167	167	167	167
<i>Wald test of joint significance of sector dummies (p)</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.02
<i>Wald test of joint significance of country dummies (p)</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Impact of initial level of outsourcing indicators</i>							
	<i>coeff. (t)</i>	<i>coeff. (t)</i>	<i>coeff. (t)</i>	<i>coeff. (t)</i>	<i>coeff. (t)</i>	<i>coeff. (t)</i>	<i>coeff. (t)</i>
<i>International outsourcing of materials, broad, % of output, 1995</i>	0.03						
	(0.09)						
<i>International outsourcing of materials to low-wage countries, broad, % of output, 1995</i>		0.04					
		(0.11)					
<i>International outsourcing of materials to high-wage countries, broad, % of output, 1995</i>			-0.92				
			(-0.59)				
<i>International outsourcing of materials, narrow, % of output, 1995</i>				0.11			
				(0.32)			
<i>International outsourcing of materials to low-wage countries, narrow, % of output, 1995</i>					-1.25		
					(-0.65)		
<i>International outsourcing of materials to high-wage countries, narrow, % of output, 1995</i>						0.16	
						(0.42)	
<i>Purchased services from abroad, % of output, 1995</i>							2.30***
							(3.31)
<i>R²</i>	0.41	0.41	0.41	0.41	0.41	0.41	0.43
<i>no of observations</i>	167	167	167	167	167	167	167
<i>Wald test of joint significance of sector dummies (p)</i>	0.08	0.06	0.03	0.03	0.01	0.02	0.00
<i>Wald test of joint significance of country dummies (p)</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Notes: ***, ** and * denote significance at the 1 percent, 5 percent and 10 percent level. Sector and country dummy variables are included but not reported. T-values are based on heteroscedasticity consistent standard errors.

Table 6 - Robust Regression Estimates of the Impact of International Outsourcing on the Change in TFP

<i>Impact of change in different outsourcing indicators</i>							
	<i>coeff. (t)</i>	<i>coeff. (t)</i>	<i>coeff. (t)</i>	<i>coeff. (t)</i>	<i>coeff. (t)</i>	<i>coeff. (t)</i>	<i>coeff. (t)</i>
<i>Δ international outsourcing of materials, broad, % of output</i>	-1.42***						
	(-4.25)						
<i>Δ international outsourcing of materials to low wage countries, broad, %</i>	-1.85***						
	(-4.98)						
<i>Δ international outsourcing of materials to high wage countries, broad, %</i>			-1.02				
			(-0.70)				
<i>Δ international outsourcing of materials, narrow, % of output</i>			0.16				
			(0.41)				
<i>Δ international outsourcing of materials to low wage countries, narrow, %</i>					-0.59		
					(-0.32)		
<i>Δ international outsourcing of materials to high wage countries, narrow, %</i>					0.29		
					(0.65)		
<i>Δ purchased services from abroad, % of output</i>						1.43***	
						(3.95)	
<i>Impact of initial level of outsourcing indicators</i>							
	<i>coeff. (t)</i>	<i>coeff. (t)</i>	<i>coeff. (t)</i>	<i>coeff. (t)</i>	<i>coeff. (t)</i>	<i>coeff. (t)</i>	<i>coeff. (t)</i>
<i>International outsourcing of materials, broad, % of output, 1995</i>	0.11						
	(0.54)						
<i>International outsourcing of materials to low wage countries, broad, % 1995</i>	0.07						
	(0.31)						
<i>International outsourcing of materials to high wage countries, broad, % 1995</i>			0.60				
			(0.63)				
<i>International outsourcing of materials, narrow, % of output, 1995</i>			0.05				
			(0.24)				
<i>International outsourcing of materials to low wage countries, narrow, % 1995</i>					1.14		
					(0.98)		
<i>International outsourcing of materials to high wage countries, narrow, % 1995</i>					-0.04		
					(-0.16)		
<i>Purchased services from abroad, % of output, 1995</i>						2.17***	
						(3.67)	

Notes: ***, ** and * denote significance at the 1 percent, 5 percent and 10 percent level. Sector and country dummy variables are included but not reported.