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International Outsourcing and the Productivity of Low-skilled Labour in the EU

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International outsourcing and the productivity of low-skilled labor in the EU

Hartmut Egger*and Peter Egger†

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Abstract

This paper presents first insights into the role of international outsourcing on the productivity of low-skilled workers in EU manufacturing. Whereas in the short run international outsourcing exhibits a negative marginal effect on real value added per low-skilled worker, the long-run parameter estimates reveal a positive impact. This may be explained by imperfections on European labor and goods markets, which prohibit an instant adjustment in the factor employment and the output structure. The change in the outsourcing intensity since 1993 alone acounts for a long-run increase of about 3.3% in the real value added per low-skilled worker.

Key words: International outsourcing; Productivity effects; Panel Econometrics

JEL classification: C33; F14; F15;

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1 Introduction[1]

In recent years, international outsourcing (international fragmentation of the value added chain) has become one of the core interests in international economics and it is now seen as an important source of the observed change in factor productivity and factor rewards in the recent past (compare Feenstra & Hanson, 1999). However, from a theoretical point of view the impact on factor productivity and factor rewards is not clear-cut but critically depends on which factors are substituted by the international fragmentation of production, which sectors are engaged in international outsourcing and the intersectoral and international mobility of factors. In addition, factor and product market imperfections affect the outcome (at least in the short run).

Empirical research has predominantly been concerned with the effects of outsourcing on the US labor market (Siegel & Griliches, 1991; Feenstra & Hanson, 1999; Slaughter, 2000; etc.). Research on the importance for European economies has concentrated on the effects of trade with less developed countries on labor markets rather than focussing on direct measures of outsourcing (Hine & Wright, 1998; Anderton & Brenton, 1999; Greenaway et al., 1999; Greenaway et al. 2000; etc.).

This paper investigates the effect of outsourcing on the productivity of low-skilled labor. Interestingly, in a CES nonlinear estimation framework we find a Hicks non-neutral, augmenting effect of outsourcing on physical capital and high-skilled labor (both relative to low-skilled labor) of approximately the same size. In the short run, outsourcing exhibits a negative effect on real

[1] We should like to thank Michael Pfaffermayr and Rudolf Winter-Ebmer for helpful comments.

value added per low-skilled worker. This might be caused by imperfections on factor and product markets. In the long run, outsourcing increases real value added per low-skilled employee. According to our simulations, the observed change in EU outsourcing since 1993 alone accounts for a long run effect of about 3.3 percent of the observed change in the real productivity of low-skilled labor.

2 Theoretical Background

In general the value added of industry i can be written as

$$Y_i - \sum_{j=1}^{n} O_i^j - \sum_{j=1}^{n} D_i^j = Q_i\left(\mathbf{V}_i\right), \tag{1}$$

where Y_i is the amount of commodity i produced in industry i, D_i^j is the amount of domestically sourced intermediate good j and O_i^j describes the amount of the imported intermediate good j employed in the production of industry i. Below, we focus on the role of O_i^i. Y_i, D_i^j and O_i^j are given in real terms. Q_i is the value added produced at home with a vector of input factors $\mathbf{V}_i$. For notational simplicity, we omit time and country indices in the theoretical part of the paper. Using a *CES*-specification for the production of Q_i, gives

$$Q_i = A_i\left\{\delta K_i^{*-\rho} + (1-\delta) L_i^{*-\rho}\right\}^{-r/\rho}, \tag{2}$$

where A_i subsumes information about the level of technology, the degree of competition and the level of outsourcing activities.[2] δ and $(1-\delta)$ are the

[2] According to the availability of data, we have to assume that the effect of D_i^j is comprehensively accounted for by A_i.

weights of effective capital and labor in the production process. r indicates the degree of scale economies in the production of the value added. K^* and L^* denote levels of *effective* capital and labor. We define $K_i^* \equiv a_K(O_i) K_i$, where $a_K(O_i)$ is an efficiency measure and K_i is the capital input used in industry i.[3] By allowing for two types of labor, we define $L_i^* \equiv a_H(O_i) H_i + a_L(O_i) L_i$, where $a_H(O_i)$ and $a_L(O_i)$ are again efficiency measures and H_i and L_i denote the amount of high-skilled and low-skilled labor employment in industry i, respectively. $a_K(O_i)$, $a_H(O_i)$ and $a_L(O_i)$ depend on the intensity of narrow outsourcing of industry i (O_i), where $O_i \equiv O_i^i / Y_i$.[4] This assumption can be justified in the following way. First, outsourcing decisions themselves may be driven by specialization effects, possibly increasing the factor productivity in different ways (compare the discussion in Burda & Dluhosch, 1998). Second, if production processes differ in terms of factor productivity, outsourcing of some production processes in general implies changes in the productivity of home-supplied production factors K, H and L (compare Arndt, 1997). Finally, international outsourcing may also alter the degree of substitutability of factors in the production process, which is also taken into account by allowing efficiency measures a_K, a_H and a_L to depend in different ways on O_i.

For our empirical analysis, we have to specify A_i, $a_K(O_i)$, $a_H(O_i)$ and

[3] Compare Griliches (1998) for a similar approach when estimating the productivity effects of R&D.

[4] *"We do not normally think of, say, the import of steel by a U.S. automobile producer as outsourcing. But it is common to consider the purchase of automobile parts by that company as outsourcing, especially if the parts were formerly made by the same company, or at least purchased in the United States."* (Feenstra & Hanson, 1999, p. 924)

$a_L(O_i)$. In the following, we assume $A_i \equiv \overline{A}\, e^{\vartheta_i + \gamma O_i}$, $a_K(O_i) \equiv e^{\beta_K O_i}$, $a_H(O_i) \equiv e^{\beta_H O_i}$ and $a_L(O_i) \equiv e^{\beta_L O_i}$. After inserting, (2) can be rewritten as

$$Q_i = \overline{A} e^{\vartheta + \gamma O_i} \left\{ \delta \left[K_i e^{\beta_K O_i} \right]^{-\rho} + (1-\delta) \left[H_i e^{\beta_H O_i} + L_i e^{\beta_L O_i} \right]^{-\rho} \right\}^{-r/\rho} \tag{3}$$

This closes the theoretical discussion. In the empirical analysis, we try to measure the impact of international outsourcing on the average product of low-skilled labor $q_i \equiv Q_i / L_i$ for different industries of the EU-member countries.

3 Data and Empirical Results

We use data from New Cronos (EUROSTAT) on education, employment, real value added and real gross production with 1996 as the base year. Additionally, investment-to-value-added ratios come from STAN (OECD). The construction of our narrow outsourcing measure requires data from the EU Input-Output tables (EUROSTAT) together with intermediate goods trade figures from UNO. We use data for 22 NACE 2-digit manufacturing industries in 12 EU members (EU-15 without the joining countries of 1995) for the period 1992-1997 at constant prices and US dollars. This database does neither provide information on skill-specific wages nor on R&D at the required level of disaggregation and the countries under consideration. We define the ratio between upper secondary plus tertiary to lower secondary workers' education figures at the industry level from New Cronos as the high-skilled to low-skilled labor ratio (H/L), which is applied in order to construct skill-specific employment figures in levels using industry employment. Industry gross fixed

capital formation is constructed by the use of investment-to-value-added ratios at ISIC together with real value added from New Cronos at NACE. We follow Keller (2000) in the perpetual inventory construction of the time (t), country (c) and industry (i) specific capital stock:

$$\begin{aligned} K_{1986,ic} &= \left(\frac{\frac{1}{4}(I_{1986,ic} + I_{1987,ic} + I_{1988,ic} + I_{1989,ic})}{g_{ic} + \delta} \right) \\ K_{t>1986} &= \left((1-\delta)K_{t-1,ic} + I_{tic} \right), \end{aligned} \tag{4}$$

with K denoting real capital stocks, I is real gross fixed capital formation (assuming that the nominal investment-to-value-added ratio corresponds to the real one), g is the real average annual growth of industry specific investment between 1986 and 1997, and δ is the depreciation rate. As suggested by Hofer et al. (1997), the latter is assumed at 10% for each industry, country and year. Following Feenstra and Hanson (1999), we use a narrow measure of outsourcing (O_{tic}), which is defined as

$$O_{tic} = \left(\frac{D_{ic} M_{tic}}{Y_{tic}} \right), \tag{5}$$

with D_{ic} as the diagonal share of the NACE 2-digit Input-Output tables for each EU economy in 1995 (assumed as constant between 1992-1997), Y_{tic} is real gross production, and M_{tic} are NACE 2-digit real intermediate goods imports. The latter are constructed from UNO Broad Economic Categories at SITC 5-digit (compare Fontagné et al., 1996) and the Correspondence Table between SITC 5-digit and NACE 3-digit provided from Statistics Austria. Hence, we focus on the effects of outsourcing of intermediate goods from the same industry. The specifications include time dummies (λ_t), country dummies (η_c), and industry dummies (μ_i). These time specific, country specific

and industry specific effects have also been considered in the theoretical discussion and were subsumed under parameter ϑ_i above. Whereas λ_t controls for overall technological improvements equal for all industries and countries, η_c and μ_i account among others for persistent differences between countries in the degree of competition induced by legislation (e.g. for mergers, market power) and persistent industrial differences within countries (e.g. chemistry and pharma industry versus food production). Due to the unbalancedness of the panel, we come up with 992 observations in the econometric analysis.

We estimate three specifications, which are labeled as Model 1, Model, 2, and Model 3 below. Model 1 is the nonlinear specification of the primary production framework, which uses contemporaneous outsourcing as an explanatory variable:

$$\begin{aligned}\log q_{tic} = \beta_0 + \beta_A O_{tic} + (r-1)\log L_{tic} - \\ \frac{r}{\rho}\log\left[\delta\left(k_{tic}e^{\beta_k O_{tic}}\right)^{-\rho} + (1-\delta)\left(1 + h_{tic}e^{\beta_h O_{tic}}\right)^{-\rho}\right] \\ + \lambda_t + \mu_i + \eta_c + \varepsilon_{tic}, \quad (6)\end{aligned}$$

where $k \equiv K/L$, $h \equiv H/L$, $\beta_k \equiv \beta_K - \beta_L$, $\beta_h \equiv \beta_H - \beta_L$ and $\beta_A = \gamma + r\beta_L$.[5] Model 2 is similar to Model 1 but it includes lagged rather than contemporaneous outsourcing in order to check the possible relevance of the endogeneity of this variable:

$$\begin{aligned}\log q_{tic} = \beta_0 + \beta_A O_{(t-1),ic} + (r-1)\log L_{tic} - \\ \frac{r}{\rho}\log\left[\delta\left(k_{tic}e^{\beta_k O_{(t-1),ic}}\right)^{-\rho} + (1-\delta)\left(1 + h_{tic}e^{\beta_h O_{(t-1),ic}}\right)^{-\rho}\right] \\ + \lambda_t + \mu_i + \eta_c + \varepsilon_{tic}. \quad (7)\end{aligned}$$

[5] Taking logs from (3), after some transformations one obtains (6).

Finally, Model 3 represents the Between model, which is estimated as a cross–sectional regression on the variable means (indicated by subscript "." instead of "t") in the time dimension:

$$\log q_{.ic} = \beta_0 + \beta_A O_{.ic} + (r-1)\log L_{.ic} - \frac{r}{\rho}\log\left[\delta\left(k_{.ic}e^{\beta_k O_{.ic}}\right)^{-\rho} + (1-\delta)\left(1+h_{.ic}e^{\beta_h O_{.ic}}\right)^{-\rho}\right] + \varepsilon_{.ic}, \quad (8)$$

Note that Model 1 - Model 3 for simplicity are labeled by identical parameter letters, which does not imply any restrictions on parameters across equations.

> Table 1 <

Table 1 presents the regression results for the three estimated specifications. In Model 1 and 2, we use 0 as the starting value for the most parameters except for r (1.2), ρ (0.5), and δ (0.5), which are motivated by previous research on labor productivity.[6] First of all, there is both neutral and non-neutral technological change due to outsourcing. The first parameter (β_A) measures a composite of influences comprising a neutral shifting effect, the impact on low-skilled labor and r. However, we also find a significant and positive relative physical capital augmenting and relative high-skilled labor augmenting effect of outsourcing ($\beta_k, \beta_h > 0$). We estimate an elasticity of substitution between effective capital and effective labor of $\frac{1}{1-\rho} \simeq 6.6$ for efficiency units of capital and labor, which is fairly high. However, our estimates are not directly comparable with those of other authors, since we focus on

[6] We find that the present models face excellent convergence properties. Especially, the parameter estimates for β_A, β_k, and β_h are not sensitive to the choice of starting values, even in terms of their sign.

efficiency units rather than labor in heads and capital stocks per se. The parameter estimate of r on the average implies decreasing returns to scale at the industry level (possibly due to free capacity in the short run). The low parameter estimate for δ reflects the fact that we could not use information on capital services, and that the capital stock variable represents a multiple of the required capital services. Model 2 gives results, which are very similar to those from Model 1. This provides insights that the parameter estimates in Model 1 are not severely affected by an endogeneity problem of the outsourcing variable.[7] Therefore, we concentrate on the results from Model 1 in what follows as long as short run relationships are considered.

With the parameter estimates at hand, we can investigate the marginal effect of outsourcing:

$$\frac{\partial \log q_{tic}}{\partial O_{tic}} = \beta_A + \frac{r}{\rho}\left[\frac{\delta\rho\beta_k\left(\widehat{k}_{tic}\right)^{-\rho} + (1-\delta)\rho\beta_h\widehat{h}_{tic}\left(1+\widehat{h}_{tic}\right)^{-\rho}}{\delta\left(\widehat{k}_{tic}\right)^{-\rho} + (1-\delta)\left(1+\widehat{h}_{tic}\right)^{-\rho}}\right], \qquad (9)$$

where $\widehat{h}_{tic} \equiv h_{tic}e^{\beta_h O_{tic}}$ and $\widehat{k}_{tic} \equiv k_{tic}e^{\beta_k O_{tic}}$ are used. Evaluated at the variable means, this effect is -0.181 and indicates that a one percentage point increase of the outsourcing intensity induces a decrease in the productivity of low-skilled labor of about 0.2 percent.[8]

The usual caveats apply, since capital services are accounted for by (es-

[7] We also estimated a nonlinear GMM model with transport costs and the gross-production-to-value-added ratio as instruments. However, this econometric model did not converge, possibly due to the poor quality of the instruments.

[8] Using 4-digit industry data, Siegel & Griliches (1991) find that productivity growth in US manufacturing was negatively (but insignificantly) related to the change in the share of imported materials. However, the latter is only a broad measure of outsourcing as compared to the narrow one used in the present paper. This result seems also consistent

timated) capital stocks and labor inputs are measured by employment in heads. The former leads to a downward bias of the estimated capital coefficient (δ), and the latter omits the importance of the volume and the quality of hours worked (compare Jorgenson et al., 1987, and Siegel & Griliches, 1991, for an overview on this problem). Additionally, we cannot explicitly control for the effects of R&D but we have to rely on the assumption that these effects are comprehensively accounted for by the fixed effects.

Following the well-established literature on Within and Between estimators (Pirotte, 1999) we can associate the fixed effects estimator with the short run parameter estimates and interpret the Between estimator as a proxy for their long run counterparts.[9]

From comparing parameter estimates from Model 1 with those of Model 3 we find the following main differences. First, the production of the value added exhibit diseconomies of scale in the short run, whereas the long run regression comes up with constant scale economies, given by a value of r near unity in Model 3. The reason for this finding may be that firms cannot perfectly adjust factor employment in the short run. The impact of this inefficiency may be more pronounced in larger firms explaining the diseconomies of scale in the short run. Second, the elasticity of substitution of efficiency

with the finding from a linearized specification of Model 1. The results from the Taylor approximated models are not presented for the sake of brevity. However, they are available upon request from the authors.

[9]Pirotte (1999) demonstrates that the Between estimates are close to the long run effects also for fixed time and large cross-sectional dimension. This is especially a useful result, if the time dimension is too short in order to estimate a dynamic model, which is the case in our application.

units of capital and labor is much more pronounced within industries and countries ($\frac{1}{1-\rho} \simeq 6.6$) than between them ($\frac{1}{1-\rho} \simeq 1.2$). An intuition for this result may be again that the adjustment of factor employment is imperfect in the short run. Therefore within firms/industries, factors (in our view mainly low-skilled labor) serve activites, which they would not serve in the long run, when factors are optimally allocated. This drives up the short run elasticity of substitution over its long run (optimal) counterpart (narrowed by the Between estimate).

The marginal long run effect of narrow outsourcing from the Between regression (Model 3, using variable means over time) is positive and amounts to 0.530, which is much higher in absolute value as compared to its negative short run counterpart.

4 Discussion of the short run and long run effects

This result seems plausible from a theoretical point of view, and the difference in sign between the short-run and the long-run effects may stem from the following sources.

(i) Outsourcing shifts part of production to foreign economies. First, for a given output level and a given factor employment, this implies a decline in low-skilled labor productivity. Second, due to decreasing returns to scale (at least in the short run) at the industry level, a decline in the value added Q for a given outsourcing intensity results in an increase in the average product of low-skilled labor. In general, it seems to be plausible that the direct *level*

effect of outsourcing is stronger than the indirect *economies of scale* effect, so that the overall impact of the production shift on the average product of low-skilled labor is negative. Moreover, the gain from international outsourcing has also its costs in terms of physical and human capital resources, associated with foreign direct investment and coordination activities, respectively.[10] For a given amount of low-skilled labor employment, a decline in the stock of capital used for the value added production process (induced by foreign direct investment), has a negative impact on the low-skilled labor productivity. Using high-skilled labor for coordination activities rather than in the production of the value added does not have a direct impact on the amount of high-skilled labor counted in the value added process, but reduces the value added Q for a given low-skilled labor employment. This implies a negative impact on the low-skilled labor productivity.

(*ii*) By maximizing their profits, firms want to adjust their factor employment. Whereas imperfections on human and physical capital markets are rather negligible, rigid markets for low-skilled labor in Europe are often mentioned to be responsible for adjustment delays. In the short run, trade unions (under efficient bargaining), legal regulation (protection against dismissal) or social pressure prohibit perfect adjustment of employment, explaining the negative impact of international outsourcing on the low-skilled labor productivity. In the long run, employment adjustments (due to higher fall-back profits of firms and lower fall-back income of workers in the bargain, due to the natural quit rate, etc.) lead to a positive impact of international

[10] For a discussion of resource requirements for international outsourcing compare for example Jones & Kierzkowski (2001) and Glass & Saggi (2001).

outsourcing on the average product of low-skilled labor.

(*iii*) The difference between the short run and the long run effects of international outsourcing may be magnified by product market imperfections. If international outsourcing has a cost reducing effect, product market imperfections may, first, retard the output shift within one industry from firms producing in an integrated way to firms making use of outsourcing opportunities. Second, there may also be some delay in the adjustment of the output structure across sectors from those with relatively little advantage of international outsourcing to those with a high cost saving effect.[11]

Taking into account (*i*)-(*iii*) it seems to be plausible from a theoretical point of view that the marginal effect of the outsourcing intensity on the productivity of low-skilled labor exhibits a different sign in the short run and the long run.

5 Simulating the outsourcing effect

Since the marginal effect exhibits variation over time, countries and industries in the fixed effects regression and over countries and industries in the Between model, it seems appropriate to undertake some simulations in order to quantify the importance of outsourcing for different industries at least for the period under consideration. In a thought experiment, we derive predictions from our model assuming that the outsourcing intensity (O_{tic}) were constant since 1993. Over the same period, the observed real value added per

[11] Additionally, one may argue that international outsourcing substitutes mainly those processes in which low-skilled labor has highest productivity. However, this cannot explain the difference in sign between the short-run and long-run effect.

low-skilled worker grew by 9.3% p.a. in the average country, manufacturing industry and year.

> Table 3 <

Table 3 provides more details on industry specific growth rates. However, also the outsourcing intensity (O_{tic}) grew by 3.2% on average. Assuming a constant O_{tic} in the thought experiment means to focus on a situation, where annual real intermediate imports growth and real production growth were equal. The last two columns of Table 3 present the difference between the model prediction for observed outsourcing growth and the thought experiment with zero outsourcing intensity growth since 1993 for both the fixed effects (short run) and the Between regression (long run). According to our econometric results, in the short run the increase in the outsourcing intensity has lowered the average annual change in real value added per low-skilled worker by about 1.4% in the average industry, indicating that the short-run marginal effect of outsourcing is negative throughout the sample. In contrast, the long-run stimulus due to the change in the outsourcing intensity is positive and amounts to about 3.3% measured in terms of the prediction for observed outsourcing. In accordance with our priors, this effect is highest in the textiles and wood industries but, less expected, also in the radio, television and communication equipment industries. This result shows that international outsourcing affects the low-skilled labor productivity in low-tech as well as in high-tech industries.

6 Conclusions

This paper presents first insights in the role of international outsourcing on the productivity of low-skilled workers in EU manufacturing. Because of its reliability, we follow Feenstra and Hanson (1999) in using a narrow measure of the cross-border fragmentation phenomenon. According to the unavailability of data on skill-specific factor rewards, we estimate a primary production function for 12 EU countries and 22 NACE 2-digit industries over the period 1992-1997. Our short run evidence is inconsistent with the findings by Feenstra & Hanson (1999) for the US economy, since outsourcing seems to exert a significant, negative marginal effect on real value added per low-skilled worker. However, to some extent this coincides with a similar but insignificant finding by Siegel & Griliches (1991, for the US as well). In contrast, our long run parameter estimates reveal a positive impact of outsourcing on real value added per low-skilled worker, which fits well into the literature on the productivity effects of outsourcing. There is evidence that international outsourcing augments physical capital and high-skilled labor (both relative to low-skilled labor) to roughly the same extent in the short run as well as the long run.

For our sample of countries and the underlying level of aggregation, no data on hours per worker and the actual capital services are available. Therefore, we have to rely on employment figures and estimates of the capital stocks as our controls. This might have some impact on the results. Our preliminary findings suggest that low-skilled labor productivity growth in European manufacturing - besides unobserved influences - in the short run was mainly induced by the change in physical capital stocks and skill-upgrading rather

than fragmentation of production across borders. But the impact of international outsourcing becomes more pronounced in the long run. Future research - especially at the firm level - could help to provide deeper insights into the role of outsourcing on productivity.

7 References

Arndt, Sven W. (1997), Globalization and the Open Economy, *North American Journal of Economics and Finance* **8**, pp. 71-79.

Burda, Michael C., and Barbara Dluhosch (1998), Globalization and European Labor Markets, CEPR Discussion Paper No. 1992.

Feenstra, Robert, and Gordon Hanson (1999), The Impact of Outsourcing and High-technology Capital on Wages: Estimates for the United States, 1979-1990, *Quarterly Journal of Economics* **114**, pp. 907-940.

Fontagné, Lionel, Michael Freudenberg, and Deniz Ünal-Kesenci (1996), *Statistical Analysis of EC in Intermediate Products*, EUROSTAT, Paris.

Glass, Amy J., and Kamal Saggi (2001), Innovation and wage effects of international outsourcing, *European Economic Review* **45**, pp. 67-86.

Greenaway, David, Robert Hine, and Peter Wright (1999), An Empirical Assessment of the Impact of Trade on Employment in the United Kingdom,

European Journal of Political Economy **15**, pp 485-500.

Greenaway, David, Robert Hine, and Peter Wright (2000), Further Evidence on the Effect of Foreign Competition on Industry Level Wages, *Weltwirtschaftliches Archiv* **136**, pp 522-538.

Griliches, Zvi (1998), *R&D and Productivity: The Econometric Evidence*, The University of Chicago Press, Chicago.

Hine, Robert, and Peter Wright (1998), Trade with Low Wage Economies, Employment and Productivity in UK Manufacturing, *Economic Journal* **108**, pp. 1500-1510.

Hofer, Helmut, Christian Keuschnigg, and Wilhelm Kohler (1997), A Dynamic Applied General Equilibrium Model for the Austrian Economy with Special Emphasis on the Eastern Enlargement, University of Linz Working Paper No. 9724, University of Linz.

Jones, Ronald W., and Henryk Kierzkowski (2001), A Framework for Fragmentation, in Sven W. Arndt and Henryk Kierzkowski (ed.), *Fragmentation: New production Patterns in the World Economy*, Oxford University Press, New York.

Jorgenson, Dale W., Frank. M. Gollop, and Barbara Fraumeni (1987), *Productivity and US Economic Growth, 1979-1985*, Harvard University Press,

Cambridge, Mass.

Keller, Wolfgang (2000), Trade Patterns, Technology Flows, and Productivity Growth, *World Bank Economic Review* **14**, pp. 17-47.

Pirotte, Alain (1999), Convergence of the Static Estimation Toward the Long Run Effects of Dynamic Panel Data Models, *Economics Letters* **63**, pp. 151-158.

Siegel, Donald, and Zvi Griliches (1991), Purchased Services, Outsourcing, Computers, and Productivity in Manufacturing, NBER Working Paper No. 3678, Cambridge, Mass.

Slaughter, Matthew J. (2000), Production transfer within multinational enterprises and American wages, *Journal of International Economics* **50**, pp. 449-472.

Table 1: Regression Results for Real Value Added per Low-skil Employee

	Nonlinear Fixed Effects		**Nonlinear Between**
Parameters[1)]	Model 1	Model 2	Model 3
β_A	-0.605 **)	-0.613 **)	-0.014 ***)
	(0.250)	*(0.261)*	*(0.004)*
β_k	0.703 **)	0.704 **)	0.021 ***)
	(0.287)	*(0.300)*	*(0.006)*
β_h	0.704 **)	0.704 **)	0.010 ***)
	(0.287)	*(0.300)*	*(0.002)*
δ	0.045 **)	0.040 *)	0.406 ***)
	(0.020)	*(0.021)*	*(0.092)*
r	0.860 ***)	0.860 ***)	0.997 ***)
	(0.015)	*(0.017)*	*(0.017)*
ρ	0.849 ***)	0.851 ***)	0.179
	(0.142)	*(0.167)*	*(0.112)*
β_0	0.020	0.020	-1.300 ***)
	(0.177)	*(0.199)*	*(0.258)*
Observations	992	755	225
Adjusted R^2	0.935	0.934	0.885
Time Effects[2)]	7.19 ***)	9.26 ***)	
Country Effects[3)]	36.59 ***)	29.3 ***)	
Industry Effects[4)]	19.70 ***)	16.07 ***)	

1) Standard errors in parentheses. - 2) Distributed as F(5, 950) in Model 1, as F(5, 949) in Model 2, and as F(4, 713) in Model 3. - 3) Distributed as F(11, 949) in Model 1 and as F(11, 713) in Model 2.- 4) Distributed as F(20, 949) in Model 1 and as F(20, 713) in Model 2.

*) significant at 10%; **) significant at 5%; ***) significant at 1%.

Table 2: Average Annual Growth of Outsourcing and Productivity of Low-skilled Labour in the EU
Average Annual Change as Percent (1993-1997)

NACE 2-digit industry	Outsourcing intensity	Productivity of low-skilled labour	Productivity observed - simulated short-run	long-run [1)]
Manufacture of food products and beverages	3.15	4.94	-0.16	1.05
Manufacture of textiles	7.03	9.45	-0.14	9.07
Manufacture of wearing apparel; dressing; dyeing of fur	15.02	12.31	-0.03	0.40
Tanning, dressing of leather; manufacture of luggage	8.08	8.57	-0.03	5.20
Manufacture of wood and of products of wood and cork, except furniture	-7.16	10.78	-0.04	8.66
Manufacture of pulp, paper and paper products	1.44	15.92	-0.11	5.40
Publishing, printing, reproduction of recorded media	-0.83	5.66	-0.07	0.53
Manufacture of coke, refined petroleum products and nuclear fuel	-0.62	-0.02	-0.01	6.09
Manufacture of chemicals and chemical products	5.28	4.00	-0.05	2.22
Manufacture of rubber and plastic products	3.74	6.91	-0.03	0.16
Manufacture of other non-metallic mineral products	4.66	1.82	-0.05	0.40
Manufacture of basic metals	2.33	14.34	-0.10	7.30
Manufacture of fabricated metal products, except machinery and equipment	-0.28	11.04	-0.11	1.77
Manufacture of machinery and equipment n.e.c.	1.70	17.17	-0.14	4.67
Manufacture of office machinery and computers	-4.31	12.02	0.00	0.12
Manufacture of electrical machinery and apparatus n.e.c.	4.31	17.66	-0.13	4.78
Manufacture of radio, television and communication equipment and apparat	1.20	13.85	-0.04	8.77
Manufacture of medical, precision and optical instruments, watches and cloc	9.83	6.98	-0.01	1.63
Manufacture of motor vehicles, trailers and semi-trailers	6.02	7.82	-0.10	2.90
Manufacture of other transport equipment	1.18	8.16	-0.01	0.39
Manufacture of furniture; manufacturing n.e.c.	-8.47	10.79	-0.05	1.69
Total manufacturing	3.22	9.28	-1.39	3.25

1) Calculated as predicted productivity due to observed outsourcing minus predicted productivity due to simulated counterfactual outsourcing in terms of the former.

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