Employment in Domestic Plants and Foreign Affiliates:
A Note on the Elasticity of Substitution

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September 1999

Abstract: For high wage countries, such as Austria, employment growth in foreign affiliates abroad is commonly expected to substitute for jobs at home. Estimates from bilateral data on the foreign and domestic activities of Austrian manufacturing firms over the period 1990-1996, covering the 10 most important host countries and 7 industrial sectors, indicate a significant and elastic substitution at the margin between employment at home and employment in foreign affiliates. However, this does not hold true of affiliates in Eastern Europe and there are significant differences across sectors. The size of total demand, as well as plant specific relative labour productivity, are also important determinants of relative labour demand.

JEL.: F23, J23, C33

Keywords: Labour demand, multinational enterprises, panel econometrics

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I Introduction

The massive increase in direct investment during recent years has led to controversial discussions on the role of multinational firms (MNEs). The removal of trade and investment barriers, the liberalisation of market access in most economies - especially the opening up of the Eastern European and Asian markets - and the advances in telecommunications technology have made it much easier for firms to produce abroad. From the home country's point of view, there is growing concern about the substitution of exports and domestic investment, which could result in diminished demand in domestic labour markets and/or decreasing wage rates. On the other hand, outward direct investment is an important strategy for corporate restructuring, firm growth and for gaining competitiveness in world markets. With production facilities in foreign countries, domestically based MNEs enhance their possibilities for adjusting labour and capital inputs and exploiting factor price differentials across countries.

From the point of view of a high wage country, such as Austria, negative effects on the labour market are commonly expected to be most harmful to labour intensive industries and the low-skill, low-wage segment of the labour market. Whether and to which extent this assertion holds true depends a great deal upon the nature of the foreign investment. On the one hand, horizontal investments abroad may reduce domestic labour demand, but on the other hand, market-oriented investments in downstream activities such as services and distribution (or in upstream production stages) may well increase both labour demand at home and abroad by inducing further intra-firm exports. The responsiveness of domestic labour to foreign direct investment abroad, especially to horizontal direct investments induced by changes in relative wages, is thus an empirical matter.

This paper contributes to the discussion by estimating the elasticity of substitution between employment in foreign affiliates and domestic employment in Austrian manufacturing at the industry and bilateral-country levels for the 10 most important host countries. Data cover the period 1990-1996 and include the neighbouring transition countries: the Czech and Slovak Republics[1], and Hungary, which received a relatively large share of Austrian outward direct investment during recent years. This approach allows the estimation of the responsiveness of relative labour demand over a wide range of relative wage levels. Although it cannot be claimed that the current pattern of adjustment during the transition period will prevail in the future, the estimates may nevertheless give some indication of the degree of substitution between employment at home and in foreign affiliates. Section II discusses the econometric specification, while Section III shortly describes the data and presents the estimation results. The last section concludes and summarises the main findings.

II Labour demand of home plants and foreign affiliates: a simple specification to estimate the elasticity of substitution

Consider a multinational enterprise (MNE) which is horizontally and vertically integrated across borders. Conceptually, there are two activities for which a MNE allocates labour to foreign affiliates: (1) the production of end products[2], q_F, (horizontal integration), and (2) additional downstream activities such as services and distribution, z_F. As in traditional models, horizontal activities are based on a trade-off between plant economies of scale and transportation costs (Horst, 1971; Brainard, 1993; Pfaffermayr 1997), which is formally represented by the elasticity of substitution between exports, x, and foreign production, q_F. To keep the analysis tractable, assume the plants at each location operate under a linear cost structure: $c_i(q_i) = a_i w_i q_i$, $i = H, F$ with a_i denoting the input coefficient and w_i the wage rate[3], at home and abroad respectively. Additionally, firms have the option to export. In contrast to previous models (Brainard, 1993; Markusen, Venables, 1998), in which the decisions to export or to establish plants abroad are considered as exclusive options, MNEs in the present setting may do both. The motivation is that significant diseconomies of scale at the plant level or rising marginal transportation costs may induce firms to operate more than one plant. Often, they do not

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[1] According to data limitations both are treated as one country since their separation. Data on wages refer to the Czech Republic only.

[2] Since the analysis is based on a bilateral framework of production. The home market or exports to other third markets are not considered. Thus only the number of workers required to produce exports in the host countries is taken into account at the bilateral level.

[3] See Brainard, Riker (1997A) for a similar approach.

completely give up exporting. In the present setting, this behaviour implies that exports and foreign production are imperfect substitutes. Therefore, the higher transportation costs are, the more MNEs rely on local production, even if marginal costs are higher abroad. On the other hand, with low transportation costs and a high elasticity of substitution between locally produced goods and traded goods, it pays more to concentrate production in the lower cost plant, the larger economies of scale are. The simplest way to represent this relationship is to impose for total demand abroad $s_F = \left(q_F^{-t} + (Tx)^{-t}\right)^{-\frac{r}{t}}$ with $t > -1$ and $T \geq 1$ as an additional iceberg-transportation cost parameter. Corner solutions are ruled out for the moment, but are considered below. The MNE chooses q_F, x to minimise total variable costs given by

(1) $\quad \min_{x, q_F} c_H(x) + c_F(q_F) \quad s.t : \left(q_F^{-t} + (Tx)^{-t}\right)^{-\frac{r}{t}} = s_F$

Denoting the Lagrange multiplier with $\mathbf{1}$, differentiating and using $c_i' = a_i w_i$, $i = H, F$ gives relative labour demand for the horizontal activities[4]:

(2.1) $\quad c_H' - \mathbf{1}\left(-\frac{r}{t}\right)\left(q_F^{-t} + (xT)^{-t}\right)^{-\frac{r}{t}-1}(-t)x^{-t-1}T^{-t} = 0$

(2.2) $\quad c_F' - \mathbf{1}\left(-\frac{r}{t}\right)\left(q_F^{-t} + (xT)^{-t}\right)^{-\frac{r}{t}-1}(-t)q_F^{-t-1} = 0$

or

(2.3) $\quad \dfrac{q_F}{x} = T^{\frac{t}{1+t}}\left[\dfrac{c_H'}{c_F'}\right]^{\frac{1}{1+t}}$

For $x > 0$ the assumption of fixed labour input coefficients in both plants allows to state (2.3) in terms of labour inputs (L_i^q, $i = H, F$). In particular, the amount of domestic labour necessary to produce the exports can easily be calculated from the total industry employment times the export share (x_q).

(2.4) $\quad \dfrac{L_F^q}{L_H x_q} = \dfrac{a_F q_F}{a_H x} = \left[\dfrac{a_H}{a_F}\right]^{\frac{t}{1+t}}\left[\dfrac{w_H}{w_F}\right]^{\frac{1}{1+t}} T^{\frac{t}{1+t}}$ with $x_q = \dfrac{x}{q_H}$

The second component of the demand for labour by foreign affiliates comprises vertical downstream activities such as services and distribution, which cannot be traded and (in the

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[4] Sufficient for the second order condition to hold is $t > -1$, see Chiang (1984).

extreme case) depend solely on the size of the market they serve. The simplest assumption regarding labour demand for these activities is:

$$(3) \quad L_F^z = ds_F^f$$

In order to derive the total labour demand of the foreign affiliate, (2.4) and (3) are added using a linear approximation of the log of the labour figure around $\boldsymbol{f}_o = \left(ln\, L_F^q - ln\, d\right)/\, ln\, s_F$ which implies $L_F^q = ds_F^{f_o}$, i.e. for given wages labour is allocated to horizontal and vertical activities in equal proportions. Note that it is not possible to identify the relative magnitude of the two components; instead, their significance and a proper estimate of the elasticity of substitution implied by (2.4) are investigated empirically.

$$(4) \quad ln\left[L_F^q + L_F^z\right] = ln\left[L_F^q + ds_F^f\right] \approx ln\left[L_F^q + ds_F^{f_o}\right] + \frac{ln\, s_F}{2}\left(\boldsymbol{f} - \boldsymbol{f}_o\right) = \tfrac{1}{2}\, ln\, L_F^q + \tfrac{f}{2}\, ln\, s_F + ln\left[2\sqrt{d}\right]$$

Subtracting $0.5 lnL_H x_q$ from (4) using (2.4) results in the basic econometric specification of the bilateral relative labour demand equation which will be estimated below:

$$(5) \quad ln\left[\frac{L_F^q + L_F^z}{0.5 x_q L_H}\right] \approx \tfrac{1}{2}\, ln\, L_F^q - \tfrac{1}{2}\, ln\left(x_q L_H\right) + \tfrac{f}{2}\, ln\, s_F + ln\left[2\sqrt{d}\right] =$$

$$= -\frac{t}{2(1+t)}\, ln\left(\frac{a_H}{a_F}\right) + \frac{1}{2(1+t)}\, ln\left(\frac{w_H}{w_F}\right) + \frac{t}{2(1+t)}\, ln\, T + \frac{f}{2}\, ln s_F + ln\left[2\sqrt{d}\right]$$

Equation (5) relates relative labour demand to relative wage rates, relative productivity and the size of demand in the foreign market. Thus this simple - and therefore to a certain extent restrictive specification - is able to capture both the horizontal and vertical components of the activities of foreign affiliates. It provides a direct estimate of the elasticity of substitution between workers employed in the home and foreign plants. In principle, a third component of relative labour demand should also be included. This would be based on the production of intermediates in each location, which are assembled to an end-product for a third market (i.e. international fragmentation of production according to the factor intensity of the intermediates and the comparative advantage of the locations). In this case, domestic employment and that in the foreign affiliates tend to complement each other. As long as they are combined by a limitational technology with labour in fixed proportions, relative labour demand is captured by the fixed industry and country effects of the econometric specification. However, there is no information in the data which allows a more direct approach to capturing this third component.

The present specification can be generalised to multiple host countries in an obvious way and it will be estimated below at the bilateral country-industry level (ignoring the problem of aggregation

over firms). It holds only for industry-host country pairs with foreign production and the analysis is confined to these cases[5]. Augmenting (5) with fixed time, industry and country effects (the index i refers to the host country, j to the industry and t to time) the empirical model reads:

$$(6) \quad ln\left(\frac{L_{ijt}}{\tilde{L}_{Hjt}}\right) = b_0 + \beta_1 \, ln\left(\frac{pr_{ijt}}{pr_{Hjt}}\right) + \beta_2 \, ln\left(\frac{w_{Hjt}}{w_{ijt}}\right) + b_3 \, ln \, s_{ijt} + k_i + m_j + l_t + e_{ijt}$$

$\tilde{L}_{Hjt} = 0.5 L_{Hjt} * \left(\frac{x_{jt}}{q_{Hjt}}\right)$, $e_{ijt} \sim N(0, s_e)$. k_i, m_j, l_t, denote the fixed country, industry and time effects, respectively. Relative efficiency, $\frac{a_H}{a_F}$, is approximated by relative plant-specific labour productivity, $\frac{pr_{ijt}}{pr_{Hjt}}$. The transportation cost parameter, T_i, is subsumed to the country fixed effects. As mentioned above, β_2 (β_1) gives a direct estimate of the elasticity of substitution between employment abroad and at home, with respect to relative wages (productivity).

To identify the labour demand equation either a simulations equation framework has to be estimated or an identifying assumption on the labour supply must be made. In line with Slaughter (1997) and Hamermesh (1993), this paper follows the second strategy, assuming a perfectly elastic supply at the sectoral level. This assumption is justified, since manufacturing accounts for the smaller part of the economy (and very likely takes wages as given in determining employment). Secondly, employment in Austrian affiliates abroad only amounts to a very small fraction of total employment in the corresponding host-country sector. Furthermore, there are no plausible instruments in the data set which would merit an instrumental variable approach.

III Data and estimation results

The available data are far from ideal. There is information on employment and sales of the foreign affiliates from the Austrian National Bank. The other variables are supplied by various sources, including STAN from the OECD and the WIFO and WIIW-databases[6]. Detailed definitions are included in the Appendix. Table 1 provides a descriptive overview of the data, an unbalanced

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[5] The decision to serve a foreign market exclusively with exports (and to rely on a foreign owned firm to provide upstream-services) could easily be included if fixed set-up costs for foreign plants were added. There will be production abroad if the total costs of home and foreign production including fixed plant-set up costs are lower than for exports alone. Below, it is tested whether there is a bias due to a sample selection from excluding this possibility.

[6] Wages for the Eastern European countries were calculated from the average monthly labour costs per employee*14 (Source: WIIW), whereas wages for all other countries were taken from STAN (Source: OECD) and calculated as total labour compensation/number of employees. Since the data sources are not fully compatible, we tested for differences in the parameter estimates below. As far as the differences remain constant over time, they are however controlled by the fixed country effects.

three-way panel, aggregated over industries to 4 country groups and averaged over time. There are a few important stylised facts: First, starting from a very low level, Austrian manufacturing firms increased their activities abroad through the expansion of existing plants, greenfield investments and acquisitions at an average rate of 13.7% p.a. in terms of employment relative to corresponding figures for Austria, and by 14.6% p.a. in terms of relative production. Austrian based MNEs have rapidly reoriented their foreign activities to the neighbouring transition economies of Hungary, the Czech Republic and the Slovak Republic, since the opening of these markets in 1989. Relative employment, as well as relative demand, have grown fastest in these Eastern European countries. Affiliates in the northern regions of the EU (FRG, UK, Netherlands, Belgium) and in Switzerland have, in contrast, developed less dynamically, although they do hold a much larger share of total affiliate sales. Wages and plant specific productivity are particularly low in Eastern European countries, with wages averaging 8.7% and plant specific productivity 38.8% of the corresponding Austrian figure. However, a certain degree of underestimation can be attributed to the fact that the Eastern European countries calculate their wage figures according to a different definition than is used in the EU. In the other countries, productivity is considerably higher than in Austria, probably because distribution and services are important components of foreign affiliate activity.

Table 1: Descriptive Statistics on multinational activities in Austrian manufacturing

	1990-1996			$\varnothing$ 1990-1996					
	Number of observations with l_j >0 out of total	employment in foreign plants	sales of foreign plants	l_j / l_H *100	Share of exports in total sales abroad	Rel. wages *100	Rel. productivity *100	growth of l_j / l_H *100	Growth of affiliate production relative to domestic production*100
			Share in %						
Eastern Europe a)	85/98	51.7	18.8	17.2	74.9	8.7	38.8	46.6	43.7
EU-North a), Switzerland	125/225	30.9	63.3	9.6	86.5	93.6	247.4	16.3	9.6
EU-South c)	37/81	13.3	11.3	3.8	86.0	61.8	108.3	-9.6	3.5
US	35/47	4.0	6.6	1.2	78.8	106.4	204.0	1.5	1.6
Total	282/451	100.0	100.0	8.0	81.5	67.6	149.6	13.7	14.6

a) Hungary, Czech Republic + Slovak Republic. Note figures on wages are not fully comparable to the other countries.
b) Germany (West), UK, Netherlands, Belgium
c) Italy, Portugal

Data on employment and sales for foreign affiliates are very volatile and are heavily affected by outliers attributable to the small number and the lumpiness of foreign direct investment projects (and maybe also from some mismeasurement of the sales figures). Furthermore, as mentioned above, wages in the Eastern European countries are not entirely comparable. However, these systematic effects are captured by the country dummies. The outlier detection procedure follows Belsley, Kuh and Welsh (1980). In the first regression, observations with studentised residuals above 2.5 or a DFITS-measure above $2*\sqrt{K/N}$ are identified as outliers. In the second

regression, it is controlled for additional outliers using somewhat less restrictive criteria (3 and $3*\sqrt{K/N}$, respectively). All in all, depending on the specification, 24 to 30 of the 277 observations were classified as extreme and were skipped. Although the standard error of the estimate, as well as that of the estimated coefficients, decreased considerably, the estimated parameters proved quite robust.

From a total of 541 observations, foreign affiliates exhibited positive labour demand and proved valid with respect to all independent variables in only 277 cases. Therefore, there are several sectors in some of the host countries in which no foreign direct investment is made by Austrian firms. If these industry/country combinations differ systematically from those with positive labour demand, the estimates suffer from a sample selection bias. Principally, several procedures exist which generalise the Heckman selectivity bias procedure (Heckman, 1974) to panels. However, as Baltagi (1995) notes, before one embarks on these complicated estimations procedures one should test whether the selection rule is ignorable. Wooldridge (1995) provides a simple variable addition test in a fixed effects framework. If the latent variable determining the selection remains unobserved (as in the present case), he proposes (Procedure 3.2, p. 123) (i) to estimate a simple probit-selection equation[7] for each time period, (ii) calculate the corresponding inverse Mills ratio and (iii) test for its significance in the fixed effects regression. Here, a serial correlation and heteroscedasticity-robust estimate is warranted unless homoscedasticity is explicitly assumed under the H_o-hypothesis. Indeed, the hypothesis that the selection rule is ignorable cannot be rejected in all three estimated specifications, so the econometric analysis can proceed with the simple OLS-dummy variable framework.

Overall, the equations of Specifications II and III, which both assume different parameters for the Eastern European transition countries, seem to be well specified. The Ramsey RESET-Test could not be rejected and the parameter estimates proved rather robust. In contrast, Specification I, which pools across all countries, provided no significant estimate of the elasticity of substitution. Comparing Specifications I and II illustrates that relative labour demand behaves significantly differently in the Eastern European transition countries and that the static cost minimisation approach (which assumes a long-run equilibrium) does not apply in this case. During the transition

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[7] To allow the industry and country effects to be correlated with the right-hand side variables in the selection equation, Wooldridge (1993) follows Chamberlain (1980) and specifies the selection equation

$$h_{it}^{*} = \boldsymbol{d}_{to} + \mathbf{x}_{i1}\boldsymbol{d}_{t1} + \ldots + \mathbf{x}_{iT}\boldsymbol{d}_{T} + v_{it}$$

with $v_{it} \sim N\left(0, \boldsymbol{s}_{t}^{2}\right)$ independent of the fixed effects and the explaining variables in the basic equation. In the present setting, the selection equation includes the same variables as the corresponding OLS equation, with two exceptions. The relative productivity terms are skipped because this variable is only observed when there are foreign affiliates in the respective sector of a host country. Furthermore, country fixed effects are not included, because for some countries they formed a perfect predictor, rendering Probit estimation impossible.

process, we observed rising wages and productivity relative to Austria and yet at the same time there were massive increases in sales and employment in the foreign affiliates. Firms did not react to the increase in relative wages given the big wage differentials between East and West, but rather directed more and more FDI into these neighbouring countries. This trend also shows up in the significantly higher fixed country effects for Hungary and the Czech and Slovak Republics. Therefore, the estimation results are sensitive to the inclusion of country effects.

Demand for labour in non-tradable vertical downstream affiliate activities, such as services and distribution, also seems less important in the transition countries. Ceteris paribus, a 1% increase in local real demand (exports+affiliate sales) increases relative labour demand by 0.4%, whereas this figure amounts to 0.8% for the other countries. This observation is consistent with casual evidence that Austrian firms more and more are splitting up production stages and relocating labour intensive ones in low wage countries. Indeed, the volume of intrafirm trade with these countries increased fastest. According to Specification III, however, this finding is not robust with respect to the pooling assumption and no firm conclusion can be drawn. Generally, the estimation results underline the importance of real foreign demand as a determinant of relative labour demand. Firms tend to rely more heavily on foreign production and they increasingly supply market related services in the foreign market even if a wage differential does not exist.

Furthermore, there is also evidence of a significant and robust impact of labour productivity in foreign plants relative to domestic plants. Consistent with economic theory, a 1% increase in relative labour productivity (Austria vs. the host country) decreases, c.p., relative labour demand by approximately 0.3%[8]. The impact differs significantly across sectors, and is highest in the stone, clay and glass sector and smallest (with a reversed sign and not significantly diffe-

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[8] The implicit restriction in (5) namely that the absolute values of the coefficients of relative wages and relative productivity sum up to 1/2 is rejected in Specifications I and II. However, in Specification II, it cannot be rejected for the Eastern European countries (where substitution at the margin does not take place). Therefore, in this respect the simple econometric set-up is too restrictive.

Table 3: Relative labour demand in manufacturing at the bilateral

country-sector level : foreign affiliates/Austria, 1990-1996

	I		II		III	
	ß	t	ß	t	ß	t
Log rel. wage rate (Austria vs. host country)	0.2	0.4	1.5	2.7 **)	1.2	2.1 **)
Log rel. wage rate, Eastern European countries	-	-	-2.9	-3.8 **)	-3.1	-3.4 **)
Difference to metals and machinery						
Electronics	-	-	-	-	-0.0	-0.1
Chemicals, oil	-	-	-	-	0.1	0.4
Paper, wood products	-	-	-	-	1.5	4.1 **)
Textiles, leather, clothing	-	-	-	-	1.8	3.1 **)
Food, beverages, tobacco	-	-	-	-	-1.5	-1.7 *)
Stone, clay, glass	-	-	-	-	0.1	0.2
Log rel. productivity (host country vs. Austria.)	-0.3	-3.5 **)	-0.3	-2.5 **)	-0.7	-7.4 **)
Log rel. productivity, Eastern European countries	-	-	0.1	0.5	0.7	5.1 **)
Log rel. productivity, difference to metals and machinery						
Electronics	-	-	-	-	0.1	0.3
Chemicals, oil	-	-	-	-	0.5	2.7 **)
Paper, wood products	-	-	-	-	1.7	3.4 **)
Textiles, leather, clothing	-	-	-	-	0.8	2.2 **)
Food, beverages, tobacco	-	-	-	-	0.3	0.6
Stone, clay, glass	-	-	-	-	-1.2	-4.1 **)
Log real demand,	0.6	4.2 **)	0.8	5.4 **)	0.5	2.0 **)
Log real demand, Eastern European countries	-	-	-0.4	-2.5 **)	0.2	0.6
Constant	-0.9	-0.6	4.5	2.2 **)	3.7	1.5
Number of nonzero observations	257		253		247	
R^2	0.81		0.82		0.89	
Root MSE	1.0		0.9		0.8	
Sample selection: Inverse Mill's ratio (t-test)	1.3		0.5		0.6	
Heteroscedasticity (Cook-Weisberg, c^2-Test)	1.8	(1)	7.4 **)	(1)	15.5 **)	(1)
Ramsey RESET (F-Test)	3.8 **)	(3,225)	0.7	(3,221)	1.5	(3,203)
Time dummies (F-Test) [a]	0.8	(6,228)	1.0	(6,224)	1.7	(6,206)
Country dummies (F-Test) [b]	24.4 **)	(9,228)	24.4 **)	(9,224)	14.9 **)	(9,206)
Industry dummies (F-Test) [c]	35.4 **)	(6,228)	37.2 **)	(6,224)	13.9 **)	(6,206)
Interaction with Eastern-European country dummy (F-Test)	-		5.1 **)	(3,224)	19.9 **)	(3,206)
Interaction of relative wages with sectors (F-Test)	-		-		6.1 **)	(6,206)
Interaction of relative productivity with sectors (F-Test)	-		-		9.2 **)	(6,206)

Note: Fixed time, industry and country effects not reported. Standard errors are heteroscedasticity consistent using the White-procedure. Degrees of freedom are given in parentheses.
a) relative to 1989
b) relative to Hungry
c) relative to metals and machinery
**) significant at 5%
*) significant at 10%

rent from 0) in the paper and wood sector. The findings on the direct impact of relative wages in Specifications II and III indicate that once controlled for the differences with respect to the Eastern European host countries, elastic substitution exists between employment at home and in

foreign affiliates at the margin. In the developed host countries, a 1% increase in relative wages (Austria vs. foreign) results in an increase of approximately 1.5% in the labour demand of foreign affiliates relative to Austria. According to Specification III, this elasticity of substitution varies significantly across industries. It is significantly more elastic in the paper and wood industry and in textiles, leather and clothing, while it is inelastic in the food sector.

The estimation results provided here are partly in line with other studies. Using a rich data set consisting of the affiliates of US-multinationals, Brainard, Riker (1997A) find that a decline in the affiliate wages in developing countries leads to an increase in affiliate employment in industrialised countries, while reducing affiliate employment in other developing countries. Therefore, there is no substitution between employment in high-wage and low-wage countries at the margin; rather their observations point to specialisation in complementary stages. Applying a translog approach, Brainard, Riker (1997B) find that labour abroad substitutes on an approximately one-to-one basis for parent labour, a somewhat lower value than the present estimate. However, the substitution elasticity is markedly higher between employment in affiliates located in high-wage and low-wage countries, suggesting that activities in the foreign affiliates are more similar than those in the parent firm and the affiliates.

IV Conclusions

For a high wage country like Austria, it is commonly expected that growing employment in foreign affiliates substitutes for jobs at home. This paper provides a simple framework for estimating the determinants of relative labour demand (abroad in relation to that at home) bilaterally. It is based on the relationship of (dis)economies and transportation costs under the hypothesis that goods trade is an imperfect substitute for foreign production in the case of horizontal investments, while with respect to vertical investments, goods trade is solely dependent on relative market size. The esimates are based on bilateral, industry level data on foreign affiliates and the domestic activities of Austrian manufacturing firms, covering the period 1990-1996, the 10 most important host countries and 7 industrial sectors.

Within a simple econometric framework, elastic substitution between employment in domestic and foreign plants by Austrian firms at the margin can be detected as a response to changes in relative wages in several industries. Therefore, relative labour demand is responsive to relative labour costs. Consistent with Brainard, Riker (1997A), this does not hold true for low-wage transition countries. Industries in the these countries may well reveal high relative labour demand and they can be expected to do so, even if low foreign wages rise faster than domestic ones, especially during the transition phase. Productivity differences, as well as demand, are also important determinants of relative labour demand. We have to bear in mind, however, that the estimates are

conditioned on given foreign demand. In a richer model, which also takes competition in the product market into account, we may well find that firms with investments abroad gain market shares, which in turn generates growth in labour demand both at home and abroad. Therefore, the degree of substitution is likely to be overestimated with the present cost based approach. With richer data sets, future research should attempt to provide a more detailed analysis of the world-wide technology of multinational firms. The effects on the skill composition in the various locations of multinational production and the division of labour among the affiliates especially deserve closer investigation.

References

Baltagi, B. , 1995, Econometric Analysis of Panel Data, Wiley.

Belsley, D., Kuh, E., and Welsh, Regression Diagnostics, John Wiley, New York, 1980.

Brainard, S.L., A Simple Theory of Multinational Corporations with a Trade-off between Proximity and Concentration, *NBER-Working paper* 4269, 1993.

Brainard, S.L., Riker, D.A., U.S. Multinationals and Competition from Low Wage Countries, *NBER-Working paper* 5959, 1997A.

Brainard, S.L., Riker, D.A., Are U.S. Multinationals Exporting Jobs, *NBER-Working paper* 5958, 1997B.

Chaimberlain, G., Analysis of Covariance with Qualitative Data, *Review of Economic Studies* 47, 1980, pp. 225-238.

Chiang, A.C., Fundamental Methods of Mathematical Economics, MacGraw-Hill, 1984.

Hamermesh, D. S., Labour Demand, Princeton University Press, Princeton, 1993.

Heckman, J., Shadow Prices, Market Wages, and Labour Supply, *Econometrica* 42, 1974, pp. 679-694.

Horst, T., The Theory of the Multinational Firm: Optimal Behaviour under Different Tariff and Tax Rates, *Journal of Political Economy*, 79(5), 1971, pp. 1059-1072.

Markusen, J. R., Venables, A. J., Multinational Firms and the New Trade Theory, *Journal of International Economics* 66(2) 1998, pp. 183 –203.

Pfaffermayr, M., Multinationals, Production Externalities, and Complementarity between Domestic and Foreign Activities?, *Swiss Journal of Economics and Statistics* 133 (4), 1997, pp. 673-690.

Slaughter, M.J., International Trade and Labour-Demand Elasticities, *NBER-Working Paper* 6262, 1997.

Wooldridge, J.M., Selection Corrections for Panel Data Models under Conditional Mean Independence Assumptions, *Journal of Econometrics* 68, 1995, pp. 115-132.

Appendix: Definitions of variables and data sources at industry-country levels :

All nominal variables are converted into $; real variables are converted into 1994 $. The data source of each variable is mentioned in parenthesis.

Variable definitions:

Rel. labour demand: employment in foreign affiliate (OENB)/(1/2*total employment in the respective Austrian industry (STAN-OECD)* export share (WIFO)).

Foreign demand: affiliate sales (OENB) + exports (WIFO) deflated by foreign value added deflator (STAN-OECD and WIIW).

Rel. productivity: Real affiliate sales/employment in foreign affiliates (using a foreign value added deflator) divided into real output/employment in Austria (STAN-OECD).

Rel. wages: Eastern European countries:14*monthly wage rate (WIIW), Switzerland: labour compensation per employee (available only for 1990-1994, statistical yearbook), other countries including Austria: labour compensation per employee (STAN-OECD).

Distance: Distance between capital cities in km.

Deflator: Eastern European countries: nominal over real production (WIIW), Switzerland: published value added deflator (statistical yearbook) and other countries (STAN-OECD): nominal over real value added. All deflators have been converted 1994.

Abbreviations:

OECD-STAN: The OECD Stan Database for Industrial Analysis, OECD 1998
OENB: Austrian National Bank
WIFO: Austrian Institute of Economic Research
WIIW: Austrian Institute of Comparative Studies

Industry definition ISIC Rev.2:

Metals, machinery: 37+38-383
Electrical machinery: 383
Chemical products: 35
Paper, wood products: 34,35
Textiles, apparel, leather: 32
Food, beverages, tobacco: 31
Stone, clay, glass: 36

Data from OENB are classified according to "Fachverbände" i.e. according to the membership in the chamber of commerce and are converted to ISIC. Export data as well as the data from WIIW are classified in 2 digit NACE and likewise have been matched to the ISIC-industries defined above. Due to the high sectoral aggregation, classification errors should be small.

Host Countries (in order of importance):

Hungary, Germany (including the 'neue Länder' beginning in 1991), Switzerland, Netherlands, Great Britain, Czech and Slovak Republics (before their separation Czechoslovakia), United States, Portugal, Belgium and Italy.