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The Counterfactual to Investing Abroad: An Endogenous Treatment Approach of Foreign Affiliate Activity

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Abstract

In comparing investment behavior at the domestic location between pure exporters and multinational firms, one has to take into account that multinational firms do not arise randomly. There is self-selection, which requires an endogenous treatment approach for assessing the impact of being a multinational on domestic investment. Based on a simple model, we derive theoretical perdictions of the counterfactual investment behaviour, where multinationals are exogenously restricted to serve foreign markets by exports exclusively. Employing several procedures to estimate this endogenous treatment effect, we provide robust evidence that in our sample of Austrian manufacturing firms, multinational activity does not harm domestic investment in intangible assets, while it very likely raises investment in tangibles.

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1 Introduction

The home country effects of multinational activity have been subject to a lively debate in economic policy during recent years. Policy makers on the one hand fear the loss of jobs, if firms invest abroad. But on the other hand, they are concerned about the loss in competitiveness, if firms in their jurisdiction are not able to expand internationally. In the scientific discussion, theoretical research on the home country effects of multinational activity mainly concentrates on wages (Markusen and Venables, 1997; Wong, 2002) and on welfare (Markusen, 1997, 2002), whereas empirical work focuses on employment (Blomström et al., 1997; Braconier and Ekholm, 2000; Kravis and Lipsey, 1988), wages (Slaughter, 2000) and productivity (Pfaffermayr, 1999). However, there is much less research on the consequences of foreign activity of multinational enterprises (MNEs) on domestic investment in tangible (physical capital) and intangible assets (research and development, R&D). Stevens and Lipsey (1992) study the interdependence between a multinational's domestic and foreign fixed investment through the finance side in a partial adjustment model. Using long time-series data of seven US corporations, they find (ibid., pp. 58-59) that "more favorable investment opportunities in one area tend to reduce investment in the other ... . On the other hand, insofar as demand changes in the two locations are positively correlated, the positive correlation between [domestic and foreign] investment levels may be increased." Using a share model, Belderbos (1992, p. 554) provides evidence that "if the Netherlands as an investment site becomes less advantageous relative to foreign locations, Dutch MNEs allocate more capital abroad and invest less domestically and vice versa." Fors and Svensson (2002), analyze the relationship between foreign sales of Swedish MNEs and their domestic R&D. Following Caves (1996) and Cohen and Klepper

(1996), they highlight a two-way relationship: "Firms with higher R&D outlays should ... be more successful in foreign markets. At the same time, an expansion of sales should ... facilitate further R&D investments ..." (Fors and Svensson, 2002, pp. 95-96).

This paper compares the investment behavior of MNEs and purely exporting enterprises (NEs) with respect to both tangible and intangible assets.[1] Thereby, we account for the fact that in a population of firms, MNEs do not arise randomly. Rather, successful firms in the possession of firm specific assets are more likely to invest abroad and become a MNE. Hence, there is self-selection and to infer the impact of foreign activities on the domestic location, like the propensity to invest in equipment or R&D, any comparison between MNEs and NEs should account for this type of endogeneity. In econometric terms, an endogenous treatment approach is the proper framework to compare MNEs and NEs. In this way, one is able to calculate the hypothetical tangible and intangible investment with firms being counterfactually not allowed to invest abroad.[2] Hence, it is possible to gain insights in the domestic investment behavior of a MNE, if it had not invested abroad, or the other way round, if an NE would have set up foreign affiliates.

To derive theoretical predictions of the counterfactual, we present a simple static model, where firms invest in R&D to reduce unit costs (in both the home and foreign plants) and decide between exporting and producing abroad. If operating a foreign affiliate is profit maximizing, but a firm is exogenously restricted to export (i.e., to be a NE), the model implies both a

[1] Fors and Svensson (2002, p. 97, footnote 5) mention that such an investigation should account for both MNEs and NEs, with the latter forming the control group. However, they were unable to do so for reasons of data availability.

[2] See Markusen (2002) for similar counterfactual scenarios, in a theoretical treatment of the consequences of multinational activity on factor rewards and welfare.

lower R&D to sales ratio and a lower fixed investment to sales ratio at the domestic location. Using a sample of Austrian manufacturing firms and several endogenous treatment approaches, the empirical estimates confirm the first hypothesis. However, the tangible investment to sales ratio at the domestic location is found to be (insignificantly) smaller, if a firm goes multinational.

2 The theoretical framework

In order to illustrate the main hypotheses, consider two segmented markets, home (H) and foreign (F), where each is served by N_i firms, $i = H, F$. In any market, firm j supplies s_{ji}, $j = 1, ..., N_i$, units of a homogeneous good. For simplicity, demand is linear $p(S_i) = A_i - S_i$ with $S_i = \sum_{j=1}^{N_i} s_{ji}$ being the total quantity sold at market i. We focus on an equilibrium with simultaneous quantity and R&D competition. This assumption simplifies the analysis considerably, but nevertheless captures the main features of the empirical exercise. Specifically, consider a particular firm (to avoid index cluttering, we skip the firm index j), which invests in physical capital (K_i) both at home and abroad, and in R&D (R), which is only pursued (in the headquarter) at the domestic location. The firm is also assumed to be vertically integrated across borders. To keep things simple, the technology comprises two intermediates.

Intermediate 1 (q_{1i}) can be produced at either location and we assume constant unit costs for both the home and the foreign plant, $c_{1i} = \alpha^{-\alpha}\beta^{-\beta}w_i^{\alpha}r_i^{\beta} - R$, where w_i denotes the wage rate and r_i costs for a unit of capital. Concerning *production*, i indicates the country of production, which is not necessarily the same country, where the final product is sold. Following d'Aspremont and Jacquemin (1988) and Sanna-Randaccio (2001), firms incur R&D expenditures R to reduce marginal costs. R&D investment is only undertaken domestically (see Markusen, 2002) and, in line with the theory of MNEs, it reduces marginal costs both at the home and the foreign location simultaneously. This implies that R&D exhibits a public good characteristics within the firm and there is technology transfer in the sense that foreign production pays off more, if R&D expenditures are high. The corresponding fixed costs of R&D are quadratic, as in most other studies ($\frac{R^2}{2k}$). k is an efficiency parameter, with higher k implying lower fixed R&D costs at given R.

Intermediate 2 (q_{2i}) is entirely produced domestically (in the headquarter), and unit costs (c_2) are likewise constant. The two intermediates are combined in fixed proportions to produce the final product, i.e., $q_i = \min[q_{1i}, \frac{1}{\gamma} q_{2i}]$. Hence, $q_{1H}+q_{1F} = (q_{2H} + q_{2F})/\gamma = (q_H + q_F) = (s_H + s_F)$. Exports in intermediates are $y = \gamma s_F$. In any case, there are always exports of intermediate 2, if a foreign affiliate exists. We envisage increasing marginal transportation costs of intra-firm trade in intermediate goods ($t_y y$).

There are final goods exports if $x = s_F - q_F > 0$, and imports if $x < 0$. Domestic production of the final product is given by $q_H = s_H + x$ and foreign production for the foreign market by $q_{1F} = q_F = s_F - x$. In line with our data set (see below), we further assume that domestic production of final products is always positive: $q_H > 0$. Similarly to intermediate goods trade, there are increasing marginal transportation costs of trade in final goods ($t_x x$). As a result, a firm only establishes a foreign plant, if the foreign market is big enough. Noteworthy and in contrast to the literature on horizontal MNEs, this approach explains FDI into both high-cost *and* low-cost countries. We would observe exports of the final product, if costs are higher abroad and imports, if they are lower (Buckley and Casson, 1982, Pfaffermayr, 1997).

Given these assumptions, profit maximization of the considered firm is based on:

$$\max_{s_H,\, s_F,\, R,\, q_F} p(S_H)\, s_H + p(S_F)\, s_F - (c_{1H} - R)(s_H + s_F - q_F) - (c_{1F} - R)\, q_F$$
$$-c_2\gamma (s_H + s_F) - \frac{R^2}{2k} - t_x \frac{(s_F - q_F)^2}{2} - t_y \frac{(\gamma q_F)^2}{2},\ st.\ q_F \geq 0.$$

The first order conditions read:

$$\frac{\partial L}{\partial s_H} = A_H - S_H^- - 2s_H - c_{1H} + R - c_2\gamma = 0 \tag{1}$$
$$\frac{\partial L}{\partial s_F} = A_F - S_F^- - 2s_F - c_{1H} + R - c_2\gamma - t_x (s_F - q_F) = 0 \tag{2}$$
$$\frac{\partial L}{\partial R} = s_H + s_F - \frac{R}{k} = 0 \tag{3}$$
$$\frac{\partial L}{\partial q_F} = c_{1H} - c_{1F} + t_x (s_F - q_F) - t_y \gamma^2 q_F + \lambda = 0 \tag{4}$$
$$\frac{\partial L}{\partial \lambda} = q_F \geq 0,\ \ \lambda \geq 0 \text{ with complementary slackness,} \tag{5}$$

where S_i^- denotes the supply of the remaining firms, which is taken as given by the considered firm. We have to distinguish two cases. In *Case 1, the firm only exports* (superscript E): $q_F^E = 0$ and $\lambda = c_{1F} - c_{1H} - t_x s_F^E > 0$:

$$\begin{aligned} R^E &= k\left(s_H^E + s_F^E\right) \\ q_F^E &= 0 \text{ and } x_F^E = s_F^E < \tfrac{1}{t_x}(c_{1F} - c_{1H}). \end{aligned}$$

Hence, after inserting for R^E, the cost function reads

$$C^E(.) = (c_{1H} + c_2\gamma)\left(s_H^E + s_F^E\right) - \frac{k\left(s_H^E + s_F^E\right)^2}{2} + t_x \frac{\left(s_F^E\right)^2}{2}.$$

Using Shepard's Lemma, it follows immediately:

$$\begin{aligned} K_H^E &= \frac{\partial C(.)}{\partial r_H} = \frac{\partial C}{\partial c_{1H}} \frac{\partial c_{1H}}{\partial r_H} \\ &= \tfrac{\beta}{r_H} c_{1H}\left(s_H^E + s_F^E\right). \end{aligned}$$

In *Case 2, the firm both exports or imports, and runs a foreign plant* (superscript M): $q_F > 0$, implying $x < s_F$ with $\lambda = 0$.

$$\begin{aligned}
R^M &= k\left(s_H^M + s_F^M\right) \\
q_F^M &= s_F^M - x_F^M = \tfrac{c_{1H} - c_{1F} + t_x s_F}{t_x + \gamma^2 t_y} \\
C^M(.) &= c_{1H}\left(s_H^M + s_F^M - q_F\right) + c_{1F} q_F + c_2\gamma\left(s_H^M + s_F^M\right) \\
&\quad - \frac{k\left(s_H^M + s_F^M\right)^2}{2} - t_x \tfrac{\left(s_F^M - q_F\right)^2}{2} + t_y \tfrac{(\gamma q_F)^2}{2}.
\end{aligned}$$

Again, using Shepard's Lemma, we have

$$\begin{aligned}
K_H^M &= \frac{\partial C(.)}{\partial r_H} = \frac{\partial C}{\partial c_{1H}} \frac{\partial c_{1H}}{\partial r_H} \\
&= \left(s_H^M + s_F^M - q_F\right) \frac{\partial c_H}{\partial r_H} = \tfrac{\beta}{r_H}\left(s_H^M + s_F^M - q_F\right) c_{1H}.
\end{aligned}$$

Now, assume Case 2 is the relevant one, but the MNE is exogenously restricted to Case 1 (see Markusen, 2002, for similar counterfactual experiments in a general equilibrium model), so that $\lambda = c_{1H} - c_{1F} + t_x s_F^E > 0$. Define $u_H^E = p_H s_H^E + p_F s_F^E$ and $u_H^M = p_H s_H^M + (p_F - c_2)\, x^M + c_2 s_F^M = p_H s_H^M + p_F s_F^M - p_F q_F$, and approximate around $q_F = 0$, ignoring (4) and (5) to obtain (see the Appendix):

$$i^E = \frac{r_H K_H^E}{u_H^E} = \frac{\beta c_{1H}\left(s_H^E + s_F^E\right)}{u_H^E} \tag{6}$$

$$\begin{aligned}
i^M &= \frac{r K_H^M}{u_H^M} = \frac{\beta c_{1H}\left(s_H^M + s_F^M - q_F\right)}{u_H^M} \\
&\approx i^E + \left[\frac{\beta c_{1H}\left(\frac{\partial s_H^M}{\partial q_F} + \frac{\partial s_F^M}{\partial q_F} - 1\right)}{u_H^E} - \frac{\beta c_{1H}\left(s_H^E + s_F^E\right)}{\left(u_H^E\right)^2} \frac{\partial u_H^M}{\partial q_F}\right] q_F \\
&= i^E + \beta c_{1H} \phi \left(\frac{p_F - d_F^E}{p_F} + \frac{t_x s_F^E}{p_F} \frac{k}{2}\right) q_F = i^E + T_i q_F, \qquad (7)
\end{aligned}$$

where $\phi = \frac{2t_x}{2(2+t_x) - k(4+t_x)}$, $d_H^E = c_{1H} + c_2\gamma - R^E$ and $d_F^E = c_{1H} + c_2\gamma + t_x s_F^E - R^E$. It is clear that T_i is positive, as long as the foreign market can be profitably served by exports. If this is not the case, the effect may, however, be negative.

Concerning the R&D to sales ratio, we have

$$m^E = \frac{R^E}{u_H^E} = \frac{k\left(s_H^E + s_F^E\right)}{u_H^E} \tag{8}$$

$$\begin{aligned} m^M &= \frac{k\left(s_H^M + s_F^M\right)}{u_H^M} \approx m^E + \left(\frac{k\left(\frac{\partial s_H^M}{\partial q_F} + \frac{\partial s_F^M}{\partial q_F}\right)}{u_H^M} - \frac{k\left(s_H^E + s_F^E\right)}{\left(u_H^E\right)^2}\frac{\partial u_H^M}{\partial q_F}\right) q_F \\ &= m^E + \frac{k}{u_H^E}\left(1 + \phi\frac{2p_F - (2-k)\, d_F^E - k d_H^E}{2p_F}\right) q_F = m^E + T_m q_F. \end{aligned} \tag{9}$$

In the appendix, we demonstrate that also T_m is necessarily positive, if exporting is viable. As long as foreign production increases R&D investment and, as a result, enhances overall efficiency, the firm expands production both at home and abroad. In turn, the higher firm size induces additional R&D expenditures.

In this model, overall firm size governs investment in physical capital and R&D (see Cohen and Klepper, 1996). If a MNE is larger than it would be as an exporter, but still can profitably serve the foreign market only by exports, if it is forced to do so (Case 1), we would observe both a lower R&D to sales ratio and a lower equipment investment to sales ratio.

3 Data, econometric method and the Estimation of the counterfactual

The empirical investigation uses the Investment Surveys[3], which the Austrian Institute of Economic Research conducts annually in cooperation with the

[3] Although the Austrian Institute of Economic Research Investment Survey basically defines the establishment ("Betrieb") as its unit of measurement, most larger enterprizes prefer to respond at the corporate level. All observations referring to the establishment level, which cannot decide to set-up an affiliate abroad have been omitted. The survey asks for both realized values, which lag two years behind the survey date, and planned values. We use realized values; only the data for 2001 refer to planned values (4th plan,

EU (DG-ECFIN, see European Commission, 1997, for details). The survey is not compulsory[4] and it does not comprise a random sample of enterprises, rather it follows the development of a fixed test group of firms over the course of years. Due to the relative small number of newly founded firms in the survey, the unbalanced panel is not representative for the whole population. Instead, it mainly covers mature, medium sized and large firms.

The survey provides annual information on domestic employment (b_H), sales from domestic production (u_H), and investment in machinery (i), in R&D and in marketing expenditures. The latter two are aggregated to construct a measure of investment in intangibles (m). The exports to sales ratio ($\frac{x}{u_H}$) is available in 11 categories and valued at the middle of the corresponding interval. This design increases the response rate at the disadvantage that some information is lost. Likewise, we do not observe the scope of foreign production, rather we have to rely on a dummy variable, taking the value one, if a firm runs a foreign affiliate.

To account for the endogenous treatment due to self-selection of firms (being a MNE versus a NE), one first has to infer the determinants of this decision using a binary choice model (in most cases, a probit framework). In a second step, one estimates the impact of this treatment on investment behavior, using the prediction of the first step regression and applying a matching estimator (Rosenbaum and Rubin, 1983), the traditional Heckman (1978) estimator, or the instrumental variables procedure suggested by Wooldridge (2002).

Based on the theoretical derivations above, the probit equation can be

see European Commission, 1997).

[4] So some firms dropped out of the sample not only because of an exit or takeover, but also because they no longer wished to participate.

specified as follows:

$$\begin{aligned} P\left(q_F > 0\right) &= P(s_F^E - \tfrac{1}{t_F}\left(c_{1F} - c_{1H}\right) > \varepsilon) \\ &\approx P(\alpha_0 + \alpha_1 \ln\left(b_H\right) + \alpha_2 F + \alpha_3 \frac{x}{u_H} + \varepsilon > 0). \end{aligned}$$

The explanatory variables suggested by the model cannot be observed (s_F^E) or they are not observed for reasons of data availability $\frac{1}{t_F}\left(c_{1F} - c_{1H}\right)$, rather we have to rely on proxies thereof. We approximate s_F^E by firm size (b_H). The average exports to sales ratio $(\frac{x}{u_H})$ is used as a proxy of the cost differential. To avoid endogeneity problems, we measure these variables several years before the time span on which the averages in our cross section are based (see below for details). Additionally, the dummy F takes the value 1, if the considered firm is itself a foreign owned affiliate and is less likely to have the opportunity or the incentive to invest abroad.[5]

The treatment (T_i and T_m, respectively) is introduced as an endogenous variable in the investment equations. Concerning the right hand side variables, we also have to rely on proxies. We introduce two dummies for a medium and a high cash-flow to sales ratio ($CF1$ and $CF2$, respectively), which measure a firm‘s ability to finance investment from internal funds (confer, e.g., Kathuria and Mueller, 1995). The industry dummies (μ_k, $k = 1, ..., 12$) and 8 region dummies (ν_r, $r = 1, ..., 8$) are interpreted as exogenous determinants of unobservable counterfactual firm size.

The left hand side variables are logistically transformed, since both are defined as shares in sales from domestic production (domestic sales plus ex-

[5] We do not include the variables of the second equation (the cash-flow dummies, the industry and the region dummies), since they together proved insignificant at 5%. However, introducing them does not change the main results.

ports). Skipping the firm index i, the investment equations read:

$$\ln\left(\frac{i}{1-i}\right) = \beta_0 + \beta_1 T_i + \beta_2 CF_1 + \beta_3 CF_2 + \gamma_k + \delta_r + \varepsilon \qquad (10)$$

$$\ln\left(\frac{m}{1-m}\right) = \gamma_0 + \gamma_1 T_m + \gamma_2 CF_1 + \gamma_3 CF_2 + \zeta_k + \eta_r + \nu. \qquad (11)$$

We use three different methods to estimate the counterfactual: matching estimators, Heckman's (1978) procedure, and Wooldridge's (2002) instrumental variables approach. Additionally, we provide extensive robustness checks of our estimation results. Table 1 reports the uncorrected descriptive statistics in the first row. The tangible investment to sales ratio of MNEs is by 0.46 percentage points higher than for pure exporting firms on average. The corresponding difference for tangible investment amounts to 1.43 percentage points. The estimates of the counterfactual based on matching estimators, which use the probit equation specified above to define the matched control group obtain the *average treatment effect on the treated.* In the present case, it is the difference between the actual investment to sales ratio of a MNE and that one of an exporter with a similar probability to be selected into the MNE-group. Hence, this estimate can be interpreted as the investment to sales ratio, which would have been observed, if the MNE were counterfactually restricted to an exporting firm with the same matching characteristics. The simple one-to-one matching estimator reveals an insignificant negative effect for investment in physical capital (tangible investment) amounting to -0.15 percentage points of the logistically transformed variable. On average, this implies that the investment to sales ratio decreases by about 0.11 percentage points due to foreign affiliate activity. The estimate for intangible investment in R&D and marketing, in contrast, gives a significant effect of 0.61 percentage points, again in terms of logistically transformed values. Transforming back results in an increase by 1.19 percentage points due to foreign affiliate activity. The matching estimators based on stratified matching or on Kernel estimates lead to similar conclusions. Hence, if firms with foreign affiliates are counterfactually forced to serve foreign markets by exports, they invest marginally and insignificantly more in tangibles at the domestic location, but significantly less in intangibles.

Table 1

Table 2 presents the traditional Heckman (1978) estimator as well as the instrumental variable procedure of Wooldridge (2002, procedures 18.1, 18.2, and 18.4, pp. 623, 626 and 631, respectively) using the above formulated selection equation. With these specifications, it is possible to introduce additional controls and to derive the marginal impact of foreign affiliate activity. However, the estimated parameters of the foreign affiliate dummy now refer to the *average treatment effect*. This effect would arise, if a randomly drawn firm changes its status either from an exporter to a MNE or the other way round. In all specifications, the parameter of the foreign affiliate dummy is significantly positive. Again, it is higher in case of investment in intangibles. Overall, the average treatment effect is higher than the average treatment effect on the treated as obtained from the matching estimators. Wooldridge's procedure 18.4 (Wooldridge, 2002, p. 631) uses a control variable approach to correct for sample selection and abandons the assumption of equal variances of the error terms. In this case, we have to include two Mill's ratios. One for MNEs, which is zero for exporters and one for exporters, which is zero for MNEs. The Wald test rejects the equality of the corresponding parameters in both estimated specifications (at least at 10%), indicating that the traditional Heckman specification may be too restrictive. However, as compared to the Heckman estimates the differences are minor.

Tables 2 and 3

Calculating the average treatment effect on the treated based on the Heckman estimates, i.e., the conditional expectation for a MNE, reveals negative effects for tangible investment, and positive ones in case of intangible investment. Indeed, Table 3 shows that the impact on tangible investment is negative for all firm size classes and independent of the export propensity. Overall, the effect amounts to -0.34 percentage points, which is comparable in size to the matching estimators. On the other hand, with respect to intangibles the effect is 1.14 percentage points on average, and increasing in domestic firm size.

The Wooldridge instrumental variable estimators only provide an estimate of the average treatment effect (confer Procedure 18.1, 18.2, and 18.4). Consistent with the Heckman procedure, we observe significant positive average treatment effects in both cases. Generally, the effects are much higher than the average treatment effects on the treated. Hence, selection matters and, in our case, the errors of the selection equation and the second step regression are negatively correlated. This implies that if an exporter is counterfactually changed to a MNE, we observe a higher positive effect.

Table 4

We investigate the robustness of the estimation results extensively (Table 4). First, using firm size in 1988, several years before the trend to FDI started, leads to similar results, indicating that the introduction of the size variable in the selection equation is appropriate and robust. Again, the matching estimates lead to insignificant negative effects for tangible investment and confirm the positive effects for tangible investment. If firm size is estimated by the average firm size in the relevant 3-digit industry of small European countries[6], we likewise observe comparable effects. Lastly, we skip those firms, which do not export. Again, the estimation results prove robust.

Summing up, there is robust evidence that becoming a MNE does not harm domestic investment in tangible assets and it very likely raises investment in intangibles.

4 Conclusions

Multinationals do not arise randomly, rather larger, export oriented firms in the possession of firm specific assets invest abroad and run foreign affiliates. In assessing the consequences of going multinational for domestic investment behavior, one has to consider this type of self selection.

In a simple oligopoly model with segmented markets, counterfactually restricting multinationals to close down their foreign plants and to be pure exporters results in both lower investment in tangibles and in intangibles at the domestic location. Similar to other models, this effect is based on the positive relationship between investment and firm size.

Using data on Austrian manufacturing firms, this paper analyses the impact of multinationality on both investment in tangible and intangible assets measured in percent of sales, which are generated by domestic production. We use several endogenous treatment estimators, namely matching estimators, the Heckman approach and Wooldridge's instrumental variable estimators, to account for the endogeneity of the foreign affiliate dummy in assessing

[6] We use employment data of non-multinational firms over the period 1992-1999 from AMADEUS and, thereby, we only consider small countries: Austria, Belgium, Denmark, Finland, Ireland, Luxembourg, Netherlands, Norway, Sweden, Switzerland. To construct the European exporter firm size variable, we calculate average firm size for each NACE 3-digit industry.

the potential impact of running foreign affiliates on domestic investment behavior. In this way, it is possible to estimate the domestic investment (in terms of sales) of a multinational, if it were counterfactually forced to be a pure exporter. Our estimation results suggest that the multinational would exhibit an insignificant higher tangible investment to sales ratio, but a significant higher intangible investment to sales ratio. Hence, there are no adverse effects on domestic investment behavior, if firms go multinational.

References

Belderbos, René A., 1992, Large Multinational Enterprises Based in a Small Economy: Effects on Domestic Investment, Weltwirtschaftliches Archiv 128(3), pp. 543-557.

Blomström, Magnus, Fors, Gunnar and Robert E. Lipsey, 1997, Foreign Direct Investment and Employment: Home Country Experience in the United States and Sweden, Economic Journal, November 107(445), pp. 1787-1797.

Braconier, Henrik and Ekholm, Karolina, 2000, Swedish Multinationals and Competition from High- and Low-Wage Locations, Review of International Economics 8(3), pp. 448-461.

Buckley, Peter J., Casson, Mark, 1981, The Optimal Timing of Foreign Direct Investment, Economic Journal 91(361), pp. 75-87.

Caves, Richard E., 1996, Multinational Enterprise and Economic Analysis, 2nd ed., Cambridge Surveys of Economic Literature, Cambridge, Cambridge University Press.

Cohen, Wesley M., Klepper, Steven, 1996, A Reprise of Size and R&D, Economic Journal 106(437), pp. 925–951.

d'Aspremont Claude and Alexis Jacquemin, 1988, Cooperative and Noncooperative R&D in Duopoly with Spillovers, American Economic Review 78(5), pp. 1133-1137.

European Commission, 1997, The Joint Harmonized EU Program of Business and Consumer Surveys, European Economy, Reports and Studies 6.

Fors, Gunnar and Roger Svensson, 2002, R&D and Foreign Sales in Swedish Multinationals: A Simultaneous Relationship?, Research Policy 31(1), pp. 95-107.

Heckman, James J., 1978, Dummy Endogenous Variables in a Simultaneous Equation System; Econometrica 46(4), pp. 931-959.

Kathuria, Rajat and Dennis C. Mueller, 1995, Investment and Cash Flow: Asymmetric Information or Managerial Discretion, Empirica 22(3), pp. 211-234.

Kravis, Irving B. and Robert E. Lipsey, 1988, The Effect of Multinational Firms' Foreign Operations on Their Domestic Employment, NBER Working Paper No. 2760.

Markusen, James R., 1997, Trade and Investment Liberalization, NBER Working Paper No. 6231.

Markusen, James R., 2002, Multinational Firms and the Theory of International Trade, MIT Press, Cambridge, MA.

Markusen, James R. and Anthony Venables, 1997, The Role of Multinational Firms in the Wage-Gap Debate, Review of International Economics 5(4), pp. 435-451.

Pfaffermayr, Michael, 1997, Multinationals, Production Externalities, and Complementarity between Domestic and Foreign Activities?, Swiss Journal of Economics and Statistics 133(4), pp. 473-690.

Pfaffermayr, Michael, 1999, Ownership Advantages, Foreign Production and Productivity - Evidence from Austrian Manufacturing, The Review of Industrial Organization 15(4), pp. 379-396.

Sanna-Randaccio, Francesca, 2002, The Impact of Foreign Direct Investment on Home and Host Countries with Endogenous R&D, Review of International Economics 10(2), pp. 278-298.

Rosenbaum, Paul R. and Donald B. Rubin, 1983, The Central Role of the Propensity Score in Observational Studies for Causal Effects, Biometrika 70(1), pp. 41–55.

Slaughter, Matthew J., 2000, Production Transfer within Multinational Enterprises and American Wages, Journal of International Economics 50(2), pp. 449-472.

Stevens Guy V. and Robert E, Lipsey, 1992, Interactions between Domestic and Foreign Investment, Journal of International Money and Finance 11(1), pp. 40-62.

Wong, Kar-yiu, 2002, Direct Investment Liberalization, Commodity Trade and Income Distribution: What Can the WTO Do? Pacific Economic Review 7(2), pp. 377-400.

Wooldridge Jeffrey M., 2002, Econometric Analysis of Cross Section and Panel Data, MIT-Press, Cambridge MA.

5 Appendix:

Solving (1)-(3) gives

$$\begin{aligned}\frac{ds_H}{dq_F} &= \frac{kt_F}{2(2+t_F)-k(4+t_F)}\\ \frac{ds_F}{dq_F} &= \frac{(2-k)\,t_F}{2(2+t_F)-k(4+t_F)}\\ \frac{dR}{dq_F} &= \frac{2kt_F}{2(2+t_F)-k(4+t_F)}\end{aligned}$$

Define $\left(\frac{\partial s_H^M}{\partial q_F}+\frac{\partial s_F^M}{\partial q_F}\right)=\frac{2t_F}{2(2+t_F)-k(4+t_F)}=\phi>0$, since $k<1$ has to hold to fulfill the second order conditions, $d_H^E=c_{1H}+c_2\gamma-R^E$, $d_F^E=c_{1H}+c_2\gamma+t_x s_F^E-R^E$ and use $\frac{\partial u_H^M}{\partial q_F}|_{q_F=0}=-p_F\left(1-\frac{d_F^E}{p_F^E}\left(\frac{\partial s_H^M}{\partial q_F}+\frac{\partial s_F^M}{\partial q_F}\right)+\frac{d_F^E-d_H^E}{p_F^E}\frac{\partial s_H^M}{\partial q_F}\right)$. Now, $\frac{\partial}{\partial q_F}\left(\frac{\beta c_{1H}\left(s_H^M+s_F^M-q_F\right)}{p_H^M s_H^M+p_F^M s_F^M-p_F q_F}\right)|_{q_F=0}=\frac{\beta c_{1H}\Psi}{\left(u_H^E\right)^2}$ with $\Psi=u_H^E\left(\frac{\partial s_H^M}{\partial q_F}+\frac{\partial s_F^M}{\partial q_F}-1\right)+\left(s_H^E+s_F^E\right)p_F^E\left(1-\frac{d_F^E}{p_F^E}\left(\frac{\partial s_H^M}{\partial q_F}+\frac{\partial s_F^M}{\partial q_F}\right)+\frac{d_F^E-d_H^E}{p_F^E}\frac{\partial s_H^M}{\partial q_F}\right)=u_H^E(\phi-1+1-\frac{d_F^E}{p_F^E}\phi+\frac{d_F^E-d_H^E}{p_F^E}\phi\left(\frac{k}{2}\right))=u_H^E\phi\left(\frac{p_F^E-d_F^E}{p_F^E}+\frac{t_F s_F^E}{p_F^E}\frac{k}{2}\right)$. Using the first order condition under the assumption that foreign production is forbidden: $p_F\left(S_F^-,s_F^E\right)-s_F^E-d_F^E>p_F\left(S_F^-,s_F^E\right)-s_F^E-d_F^E$. Hence, as long as $s_F^E>0$, $p_F\left(S_F^-,s_F^E\right)-d_F^E>0$ holds and $\frac{\partial}{\partial q_F}\left(\frac{\beta c_{1H}\left(s_H^M+s_F^M-q_F\right)}{p_H s_H^M+p_F s_F^M-p_F q_F}\right)|_{q_F=0}=\frac{\beta c_H\Psi}{\left(u_H^E\right)^2}>0$. Summing up, if the foreign market can also profitably be served by exports, we observe a positive effect T_i.

Concerning the R&D to sales ratio we have:

$m^M = \frac{k\left(s_H^M + s_F^M\right)}{u_H^M} \approx m^E + \left(\frac{k\left(\frac{\partial s_H^M}{\partial q_F} + \frac{\partial s_F^M}{\partial q_F}\right)}{u_H^E} - \frac{k\left(s_H^E + s_F^E\right)}{\left(u_H^E\right)^2} \frac{\partial u_H^M}{\partial q_F} \right) q_F$. Now define $\Phi = u_H^E \left(\frac{\partial s_H^M}{\partial q_F} + \frac{\partial s_F^M}{\partial q_F} \right) + \left(s_H^E + s_F^E\right) p_F^E \left(1 - \frac{d_F^E}{p_F^E} \left(\frac{\partial s_H^M}{\partial q_F} + \frac{\partial s_F^M}{\partial q_F} \right) - \frac{d_H^E - d_F^E}{p_F^E} \frac{\partial s_H^M}{\partial q_F} \right) = u_H^E (\phi + 1 - \frac{d_F^E}{p_F^E} \phi + \frac{k t_x s_F^E}{2 p_F^E} \phi) = u_H^E \left(1 + \phi \frac{2\left(p_F^E - d_F^E\right) + k t_x s_F^E}{2 p_F^E}\right)$, so that $\frac{\partial}{\partial q_F} \left(\frac{k\left(s_H^M + s_F^M\right)}{p_H^E s_H^M + p_F^E s_F^M - p_F^E q_F} \right) |_{q_F = 0} = \frac{k \Phi}{\left(u_H^E\right)^2}$. Hence, $\Phi > u_H^E \left(1 + \phi \frac{2\left(p_F^E - d_F^E\right) + k t_x s_F^E}{2 p_F^E}\right) > u_H^E p_F^E \left(1 + \phi \frac{2 - (2-k) - k}{2 p_F^E}\right) = u_H^E > 0$ If $p_F > d_F^E$ and the foreign market can profitably served by exports, Therefore, $\frac{\partial}{\partial q_F} \left(\frac{k\left(s_H^E + s_F^E\right)}{u_H^E} \right) = \frac{k}{\left(u_H^E\right)^2} \Phi > 0$.

Table 1: The impact of foreign production on investment behavior at the domestic location
(Average treatment effect on the treated)

	Investment in			
	Tangible assets		Intangible Assets	
	Estd. effect	% point change	Estd. effect	% point change
Uncorrected estimates	0.11	0.46	0.80	1.43
One-to-one matching	-0.15	-0.71	0.61 **	1.19
Standard error	0.13		0.25	
Stratified matching (block-by-block)	-0.13	-0.62	0.55 **	1.09
Standard error (bootstrap based on normal distribution)	0.10		0.23	
Kernel estimate	-0.12	-0.58	0.58 **	1.14
Standard error (bootstrap based on normal distribution)	0.10		0.20	

Note: the tangible and intangible investment to sales ratios are logistically transformed; the selection probit equation includes firm size in terms of employment in 1993, the foreign ownership dummy and the average exports to sales ratio 1997-1998. Tangible and intangible investment is measured in percent of sales and averaged over the periods 1999-2001. ** significant at 5%.

Table 2: The impact of foreign production on investment behaviour at the domestic location

Explanatory variables:	Heckman (1978) Investment in		Wooldrige (2002, Proc. 18.1) Investment in		Wooldrige (2002, Proc. 18.2) Investment in		Wooldrige (2002, Proc. 18.4) Investment in	
	Tangibles	Intangibles	Tangibles	Intangibles	Tangibles	Intangibles	Tangibles	Intangibles
Foreign affiliate dummy (1)	0.69 ***	1.80 ***	0.73 **	2.15 ***	0.78 **	2.31 ***	0.60 **	1.97 ***
	3.82	*5.07*	*2.71*	*5.08*	*2.54*	*4.49*	*2.52*	*4.97*
Medium cash-flow to sales ratio (2)	0.40 ***	0.39 **	0.35 ***	0.31	0.56	-0.74	0.29 **	0.26
	3.98	*2.22*	*2.98*	*1.51*	*1.61*	*-1.02*	*2.07*	*1.06*
High cash-flow to sales ratio (3)	0.66 ***	0.46 **	0.61 ***	0.26	1.10 ***	0.35	0.63	0.68 **
	5.89	*2.24*	*4.90*	*0.97*	*4.37*	*0.60*	*3.95* ***	*2.19*
Medium cash-flow to sales ratio*Foreign affiliate dummy (4)	-	-	-	-	-0.55	2.36	0.21	0.15
	-	-	-	-	*0.78*	*1.50*	*1.08*	*0.43*
Medium cash-flow to sales ratio*Foreign affiliate dummy (5)	-	-	-	-	-1.23 **	0.06	0.14	-0.45
	-	-	-	-	*-2.23*	*0.06*	*0.62*	*-1.01*
λ_1	-	-	-	-	-	-	-0.12	-0.64 *
	-	-	-	-	-	-	*-0.53*	*-1.69*
λ_2	-	-	-	-	-	-	-0.81 ***	-1.34 ***
	-	-	-	-	-	-	*-3.91*	*-3.54*
ρ	-0.52	-0.57	-	-	-	-	-	
σ	0.89	1.46	0.92	1.57	0.96	1.71	0.85	1.35
Number of Observations	386	334	386	334	386	334	386	334
Wald-tests and F-tests:								
Cash-flow dummies: (2), (3);$\chi^2(2)$	37.26 ***	7.36 **	12.27 ***	1.27	9.54 ***	0.84	1.89	3.07 *
	(0.00)	(0.03)	(0.00)	(0.28)	(0.00)	(0.43)	(0.15)	(0.05)
Cash-flow dummies: (4), (5);$\chi^2(2)$	-	-	-	-	2.56 *	1.20	1.18	2.34 *
	-	-	-	-	(0.08)	(0.30)	(0.31)	(0.10)
Industry dummies,$\chi^2(11)$	37.05 ***	64.98 ***	2.88 ***	2.30 ***	2.57 ***	1.74 *	8.01 ***	13.70 ***
	(0.00)	(0.00)	(0.00)	(0.01)	(0.00)	(0.06)	(0.00)	(0.00)
Regional dummies,$\chi^2(8)$	23.98 ***	15.65 **	2.49 ***	1.60	2.35 **	1.47	3.95 ***	4.65 ***
	(0.01)	(0.04)	(0.01)	(0.12)	(0.02)	(0.17)	(0.00)	(0.00)
$\rho=0$, $\chi^2(1)$	15.02 ***	8.79 ***	-	-	-	-	-	-
	(0.00)	(0.00)	-	-	-	-	-	-
$\lambda_1=\lambda_2$, F(1,358) and F(1,306), resp.	-	-	-	-	-	-	9.97 ***	2.79 *
	-	-	-	-	-	-	(0.00)	(0.10)

Note: the tangible and intangible investment to sales ratios are logistically transformed; industry and region dummies are not reported. The probit selection equation includes firm size in terms of employment in 1993, the foreign ownership dummy and the average exports to sales ratio 1997-1998. Tangible and intangible investment is measured in percent of sales and averaged over the periods 1999-2001. *** significant at 1%; ** significant at 5%; * significant at 10%.

Table 3: Estimated counterfactuals, Heckman procedure
(Average treatment effect on the treated)

	Employment	Share of firms with foreign affiliates	Average treatment effect on the treated in percentage points	
			Tangible assets	Intangible assets
Firm size				
1. Quartil	25.58	0.19	-0.36	0.70
2. Quartil	96.77	0.33	-0.35	0.91
3. Quartil	252.82	0.47	-0.27	1.12
4. Quartil	1010.38	0.64	-0.39	1.32
Export to sales ratio				
<=25%	173.20	0.30	-0.36	1.17
>25%	438.20	0.48	-0.34	1.13
Total	344.70	0.42	-0.34	1.14

Table 4: Robustness of the estimated treatment effects

	Firm size 88	Avg. Firm size in EU-3-digit industry	Only exporters
	Average treatment effect on the treated		
Tangible assets			
One-to-matching	-0.20	0.06	-0.10
Stratified matching	-0.12	0.10	-0.13
Kernel estimate	-0.07	0.11	-0.14
Heckman (1978)	-0.18	0.35	-0.43
Woolldrige (2002, p. 623, Proc. 18.4)	0.12	0.37 **	0.08
Intangible Assets			
One-to-matching	0.29	0.73 **	0.60 **
Stratified matching	0.45 **	0.71 **	0.35 *
Kernel estimate	0.49 **	0.72 **	0.53 **
Heckman (1978)	1.13	1.22	0.83
Woolldrige (2002, p. 623, Proc. 18.4)	0.50 **	0.74 **	0.40
	Average treatment effects		
Tangible assets			
Heckman (1978)	0.58 **	0.74 *	0.64 **
Woolldrige (2002, p. 623, Proc. 18.1)	0.53 **	0.43	0.63 **
Woolldrige (2002, p. 623, Proc. 18.2)	0.57	0.48	0.72 **
Woolldrige (2002, p. 623, Proc. 18.4)	0.35	0.38	0.60 **
Intangible Assets			
Heckman (1978)	2.09 **	2.20 **	1.95 **
Woolldrige (2002, p. 623, Proc. 18.1)	2.59 **	1.87 **	2.14 **
Woolldrige (2002, p. 623, Proc. 18.2)	2.80 **	2.13 **	2.29 **
Woolldrige (2002, p. 623, Proc. 18.4)	2.32 **	1.63 *	1.93 **

Note: the tangible and intangible investment to sales ratios are logistically transformed; the one-to-one matching estimate, the stratified matching estimate and the kernel estimate refer to the average treatment effect on the treated, while the other estimates are average treatment effects. The standard errors of the Heckman and Wooldridge estimates of the average treatment effect on the treated are boostrapped. ** significant at 5%, * significant at 10%:

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