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Cross-Border Acquisition or Greenfield Entry: Does it Matter for Affiliate R&D?

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Cross-Border Acquisition or Greenfield Entry: Does it Matter for Affiliate R&D?*

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Abstract

This paper investigates how the entry mode of foreign direct investment (FDI) affects the affiliate R&D activities using unique data on Swedish multinational firms over a long period of time (1970 to 1998). On average, acquired affiliates are more likely to do R&D and have a higher level of R&D intensity than affiliates created by greenfield entry. This difference in observed R&D is explained by differences in parent, affiliate, industry and country characteristics as well as by different reactions to these characteristics, as predicted by the recent theoretical literature on international mergers and acquisitions (M&As). The results also suggest that M&As are, to a larger extent, motivated by asset-seeking motives than greenfield entry, especially in the 1990s.

Keywords: FDI, M&A, greenfield investment, R&D, multinational firm

JEL classification: F23, L10, L20, O30

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1 Introduction

An increasing share of foreign direct investments (FDI) is now taking place in the form of cross-border mergers and acquisitions (M&A).[1] The increase in FDI through foreign acquisitions has raised some concerns for policy-makers. Governments tend to be sceptical towards foreign takeovers of domestic firms, in particular when the acquired domestic firms are endowed with technological assets.[2] There is a fear that the innovative activity of the acquired firms will be reduced or shut down, thereby depriving the local economy of strategic technologies and technological spillovers. While many countries encourage inflows of greenfield FDI (start-ups), restrictions on foreign acquisitions of domestic firms are common (Mattoo et al., 2004). Greenfield investments are then seen as having a positive impact on host countries by, for instance, developing new research and development (R&D) capacity in the host country and creating technological spillover benefits.

Motivated by these concerns, we investigate empirically whether the choice of entry mode of FDI, that is M&A or greenfield entry, is of importance for affiliate R&D activities. To this end, we use unique data on affiliates of Swedish multinational firms collected by the Research Institute of Industrial Economics. Controlling for parent-, affiliate-, industry- and country characteristics, we first show that acquired affiliates are, on average, *more likely to do R&D* and have a *higher level of R&D intensity* than affiliates created by greenfield investments. These results persist over time and with the age of affiliates, as well as for different firm types and industries. Our findings thus suggest that discriminating against cross-border acquisitions in order to promote greenfield investments may be counter-productive for a host country aiming at increasing R&D investments through inflows of FDI.

Having found that acquired affiliates on average have both a higher propensity to

[1] M&As accounted for approximately 80% of all FDI transactions over the 1990's.

[2] For instance, the rumors about a takeover bid of the French dairy producer Danone by the American company PepsiCo provoked an outcry in the French political arena, some politicians swearing to protect this French company from any foreign take-over. A few weeks later, the French government officially proposed to shield ten "strategic" industries, including biotechnologies, secure information systems, casinos and the production of vaccines, from foreign acquisitions.

do R&D and a higher share of R&D expenditures in sales than greenfield affiliates, we proceed to explore why this is the case. By running separate regressions for the two entry modes, we discover that differences in R&D activities are partly explained by differences in parent, affiliate, industry and country characteristics but also by *different reactions* to such characteristics. M&As seem to be motivated by asset-seeking motives to a larger extent than greenfield investments, especially in the 1990s. For instance, we find that intellectual property rights protection (IPR) only increases the propensity to do R&D for the acquired affiliates. The same pattern holds for host-country R&D specialization – measured either in terms of industry-level R&D or patenting.

More generally, the statistical analysis suggests that cross-border acquisitions and greenfield entry follow different statistical models and should therefore be treated as distinct entry modes. This is in line with a new growing theoretical literature on international M&As which, in contrast to the traditional trade literature, emphasizes that FDI through greenfield investments and through cross-border acquisitions are not "perfect substitutes" as entry modes [e.g. Blonigen (1997), Mattoo, Olerreaga and Saggi (2004), Nocke and Yeaple (2006a,b) and Norbäck and Persson (2006)]. The new theory shows that systematic differences in affiliate performance can emerge between entry modes due to synergies and market power effects from acquisitions. By finding significant differences in the R&D activities of acquired and greenfield affiliates with otherwise similar characteristics, we provide some evidence for this hypothesis.

It should be noted that our results are derived from a unique database that provides two major advantages. First, it enables us to identify the two main entry modes and compare their impact on affiliate R&D over a long period of time (from 1970 to 1998). Statistical offices in most countries (with the main exceptions of USA, Japan and Argentina) do usually not record the FDI entry mode. Second, detailed information about parent and affiliate firm characteristics makes it possible to analyze the role of firm-specific assets and take the world-wide innovation strategies of MNEs into account.

The previous empirical literature has so far mainly focused on determinants of entry mode[3] and very few papers have directly examined the performance of affiliates given the

[3]In recent papers, Iranzo (2004), Nocke and Yeaple (2006a,b) and Raff, Ryan and Stähler (2005)

entry mode.[4] There are virtually no empirical papers comparing M&As and greenfield investments with respect to R&D.[5] Earlier empirical studies on the relationship between affiliate R&D and entry mode have treated R&D capabilities as one of the main determinants of the choice between acquisitions, joint ventures and wholly owned greenfield entry [e.g. Hennart, 1991, Hennart and Park, 1993, Gomes Cassares, 1989].[6] In this context, we contribute to the previous literature by providing new empirical evidence on the impact of entry mode on affiliate R&D. We do not only examine how entry mode and firm characteristics affect a firm's choice of doing affiliate R&D, but we also examine if these characteristics have differential effects on the level of affiliate R&D given the entry mode.

The link between entry mode and affiliate R&D also deserves a deeper analysis considering the large increase in the overseas R&D of multinational firms; between 1991 and 2001 affiliate R&D expenditures increased by more than 50 percent in the OECD area (OECD, 2005). This increasing internationalization of R&D activities might reflect a change in firms' overseas R&D strategies. The role of affiliate R&D activities has shifted from primarily supporting the local production units and adjusting products to the local market to knowledge creation. As a result, an increasing number of overseas R&D laboratories source local technological knowledge and develop new technologies to be part of firms'

find that firm characteristics affect the entry mode choice, confirming that cross-border acquisition and greenfield entry are not substitutes, but rather chosen for specific reasons.

[4]See the business literature, e.g. Shaver (1998) who analyzes the exit behavior of acquired and greenfield affiliates; Woodcock et al. (1994) and Slangen and Hennart (2005) who compare the overall performance of affiliates.

[5]An exception is Belderbos (2003) who in a cross-section of manufacturing affiliates of Japanese firms finds that the R&D intensity of acquired affiliates substantially exceeds that of wholly owned greenfield affiliates, while the R&D intensity of minority owned ventures is higher if the Japanese parent firms lack strong R&D capabilities at home. The effects of cross-border M&As on the R&D activities of a host country are, to the best of our knowledge, only examined in the study by Bertrand and Zuniga (2005).

[6]For instance, Hennart and Park (1993) find that Japanese firms prefer greenfield investment as an entry mode in the U.S. market when they possess strong sources of competitive advantage and opt for M&As when they possess weak sources of competitive advantage. These findings suggest that technology sourcing could represent an important determinant of cross-border M&As as an entry mode, consistent with the logic of asset-seeking FDI (Dunning, 1993). This is also a building block in the new theoretical literature on cross-border acquisitions.

core knowledge capital. Since R&D investments are a source of strategic technologies and competitiveness and, more generally, a major determinant of economic growth, it is particularly relevant for a host country to explore whether the entry mode has an impact on affiliate R&D and, if it does, how.

The paper proceeds as follows: Section 2 presents a review of the literature. Section 3 provides a preliminary analysis of the data. Section 4 reports the econometric model and the variables used in the regressions. Section 5 discusses the empirical findings and Section 6 concludes.

2 Theoretical background

In the theoretical literature of FDI, there is usually no distinction between the entry modes of FDI. A small but growing theoretical literature has therefore started to examine the driving forces behind MNEs' choice of entry mode and how this affects the welfare of host countries.[7] A central idea in this new theoretical literature is that FDI through greenfield investments and through cross-border acquisitions, respectively, are distinct entry modes, and that systematic differences in affiliate performance may therefore emerge.

For instance, Mattoo et al. (2004) show how restrictions on cross-border acquisitions may be warranted in order to increase technology transfers. They first note that the market power coming from monopolizing foreign acquisitions may increase foreign technology transfers. However, forcing the MNE to enter through greenfield investment may also give rise to strategic motives for transferring technology. Policy interventions may then increase the welfare of the host country if the preference of the host government with regard to the optimal entry mode differs from the MNE's choice.

Integrating recent models of firm heterogeneity in the international trade literature with ideas from the vast strategic management literature, Nocke and Yeaple (2006a, 2006b) show that cross-border M&As may arise so as to exploit complementaries when combining

[7] See, for instance, Blonigen (1997), Bjorvatn (2004), Bertrand and Zitouna (2005), Head and Ries (2006), Jovanovic and Rosseau (2002), Mattoo et al. (2004), Nocke and Yeaple (2006a, 2006b), Norbäck and Persson (2006), Iranzo (2004) and Raff, Ryan and Stähler (2005).

the firm-specific assets of the target and the acquiring firm. Greenfield entry, on the other hand, is seen as a way of more directly exploiting the MNEs' own firm-specific assets. Given the specific assumptions on the nature of MNEs' firm-specific assets and targets' assets, they show that MNEs engaging in acquisitions may be more or less efficient than MNEs undertaking greenfield investments.

Norbäck and Persson (2006) show that the welfare effects of an acquisition crucially depend on the level of complementaries generated. If an acquisition is mainly driven by market power motives, consumers are worse off. At a high level of complementaries, however, consumers gain from lower product market prices as the acquiring MNE invests aggressively to preempt its rivals in the product market. In addition, the domestic sellers are able to capture a large share of the surplus generated by the acquisition through the bidding competition among MNEs over the domestic assets. Their model also illustrates how R&D investments in an acquired affiliate can differ drastically depending on the motive of the acquisition. R&D investments by the acquiring MNE may be small if market power – rather than efficiency gains – is the dominating motive for the acquisition. On the other hand, if there are large complementaries, the acquiring MNE may have large incentives to invest in R&D in order to preempt rival MNEs in the product market. R&D investments induced by an acquisition may then not only exceed the investments conducted by the target, had no acquisition occurred, but may also exceed the investments by the acquiring MNE, had this firm been forced to enter by a greenfield investment.

Large complementaries may not always increase MNEs' investments, however. As noted by Nocke and Yeaple (2006a), acquired firm-specific assets could be transferred across borders. This link between firm-specific assets and FDI through acquisitions is also emphasized by Blonigen (1997). Using Japanese acquisitions in the US, he shows that currency depreciations make FDI through acquisitions more likely in industries with more firm-specific assets. In addition, the effect is not found for Japanese greenfield FDI, where the acquisition of firm-specific assets is not involved.

For a host country government attempting to increase FDI and MNEs' R&D investments, the new theory implies that selecting an optimal entry mode is likely to be very involved. This suggests that empirical analysis could be used to examine how the entry mode affects affiliate performance which, in turn, may give some guidance for appropriate host country policies.

3 Entry mode and affiliate R&D

As a primary data source, we use a data set from the Research Institute of Industrial Economics, based on a questionnaire sent to all Swedish MNEs every fourth year, on average, since 1970. Data on R&D expenditures for affiliates is available from five surveys: 1970, 1978, 1990, 1994 and 1998. These surveys cover almost all Swedish multinational firms in the manufacturing sector and their majority-owned affiliates abroad.

In the next sections, we first examine the pattern of entry over time, industries and regions. Then, we examine R&D activities in the affiliates, comparing acquired affiliates with affiliates started through greenfield entry.

3.1 The evolution of entry mode

Figure 1(i) shows the number of affiliates established by greenfield entry or mergers and acquisitions, respectively. As seen, affiliates established through greenfield entry were more common in the 1970's, whereas this was reversed in the 1990's. This is consistent with the international trend towards an increasing importance of cross-border M&As.

In Figure 1(ii), we examine if there are different patterns across industries, using five broader categories according to a taxonomy from OECD (1987, 1992): resource intensive, labor intensive, scale intensive industries, industries with differentiated goods and industries with science based goods. We can note that acquisitions have become more common as an entry mode in all sectors over time. Acquisitions are most dominant in resource-based industries and least common in science-based industries for most of the period. Resource-based industries may have high entry barriers, thereby making greenfield entry difficult. In science-based industries, on the other hand, greenfield may be preferred to prevent a leakage of firm-specific knowledge assets to rival firms. However, it could be pointed out that there is a sharp decrease in the share of acquisitions in resource-based industries and a parallel dramatic increase in science-based industries at the end of the period.[8]

We also examine if there is a regional pattern of cross-border acquisitions. In Figure 1(iii), we observe that a higher frequency of acquisitions is associated with the regional development level. This is evident since the share of acquisitions is higher in Europe and North America than in South America, developing countries in Asia and Africa and developed countries in Asia and Pacific. This may reflect a better supply of targets, particularly targets with complementary assets, in developed countries.

3.2 The evolution of affiliate R&D

Let us now briefly investigate if there are systematic differences in R&D activities between affiliates started through greenfield investments and affiliates joining MNEs through acquisitions of local firms. In Figure 2 (i), we first show the average affiliate R&D intensity, defined as R&D expenditures to total sales. Several interesting features arise: in contrast to what might be expected, acquired affiliates on average have a higher R&D intensity than greenfield affiliates. However, this R&D gap is decreasing over time: at the beginning of the period, the R&D intensity in acquired firms is almost twice the corresponding intensity in greenfield affiliates.

In Figure 2(ii), we show the average probability of doing R&D for each year. Note that while R&D is not conducted at all in about half of the affiliates in our sample, the probability of doing R&D is increasing over time – regardless of entry mode. It is more likely that an acquired affiliate performs R&D than a greenfield venture. The gap in the likelihood of doing R&D seems to have increased at the very end of the period. Thus, yet again we do not find that R&D in acquired affiliates is dominated by R&D in greenfield ventures.

[8] We may also note that the number of affiliates has a decreasing trend in the 1990s. This might be explained by a number of large Swedish MNEs were acquired by or merged with foreign firms during the 1990s. For instance, in 1988 Asea AB merged with Brown Boveri Ltd and therefore ASEA is no longer in the data base after 1990. Still, in terms of employees and sales, FDI from Swedish MNEs increased in the 1990s (Ekholm and Hesselman (2000)).

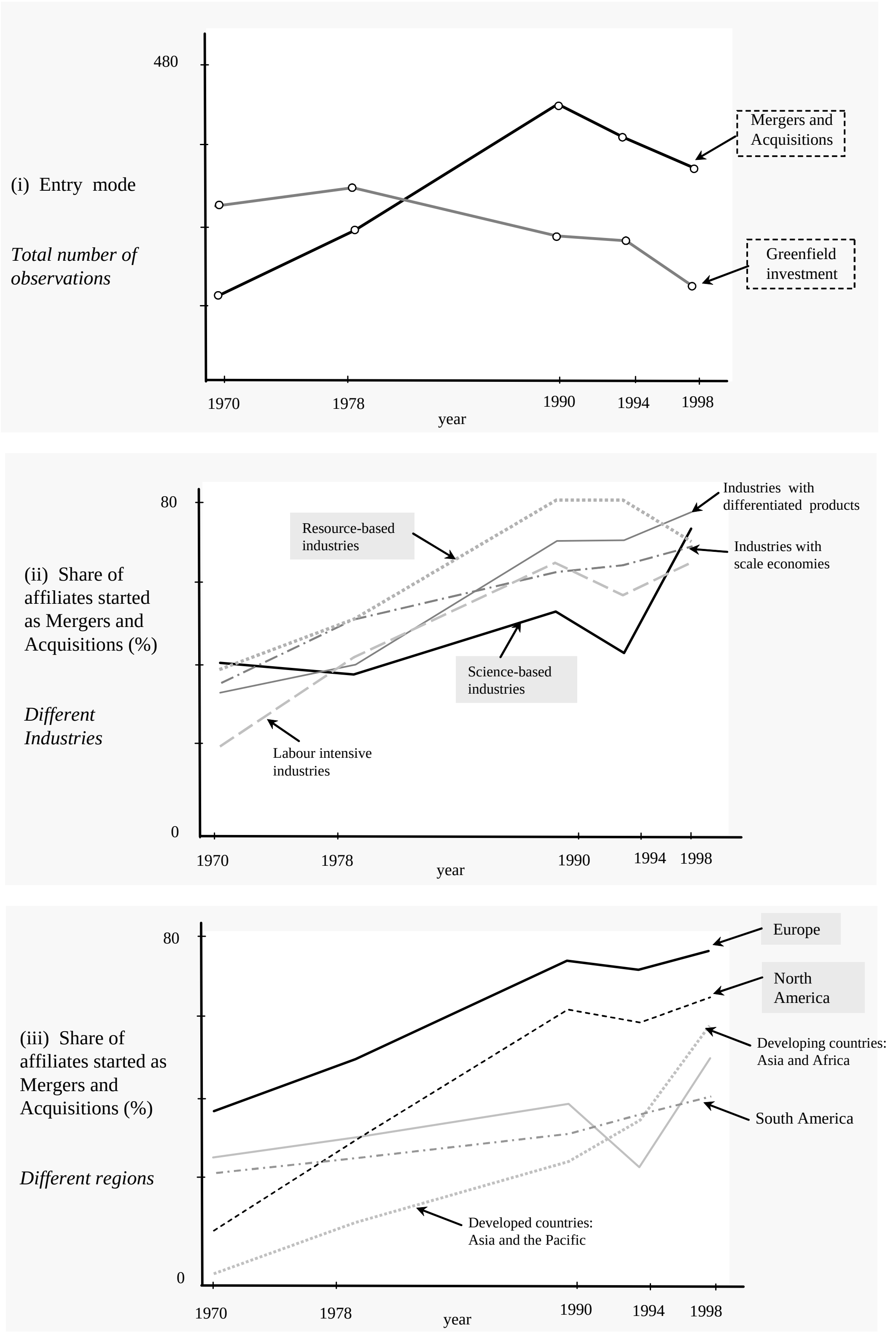

Figure 1: Mode of entry over time, industries and regions.

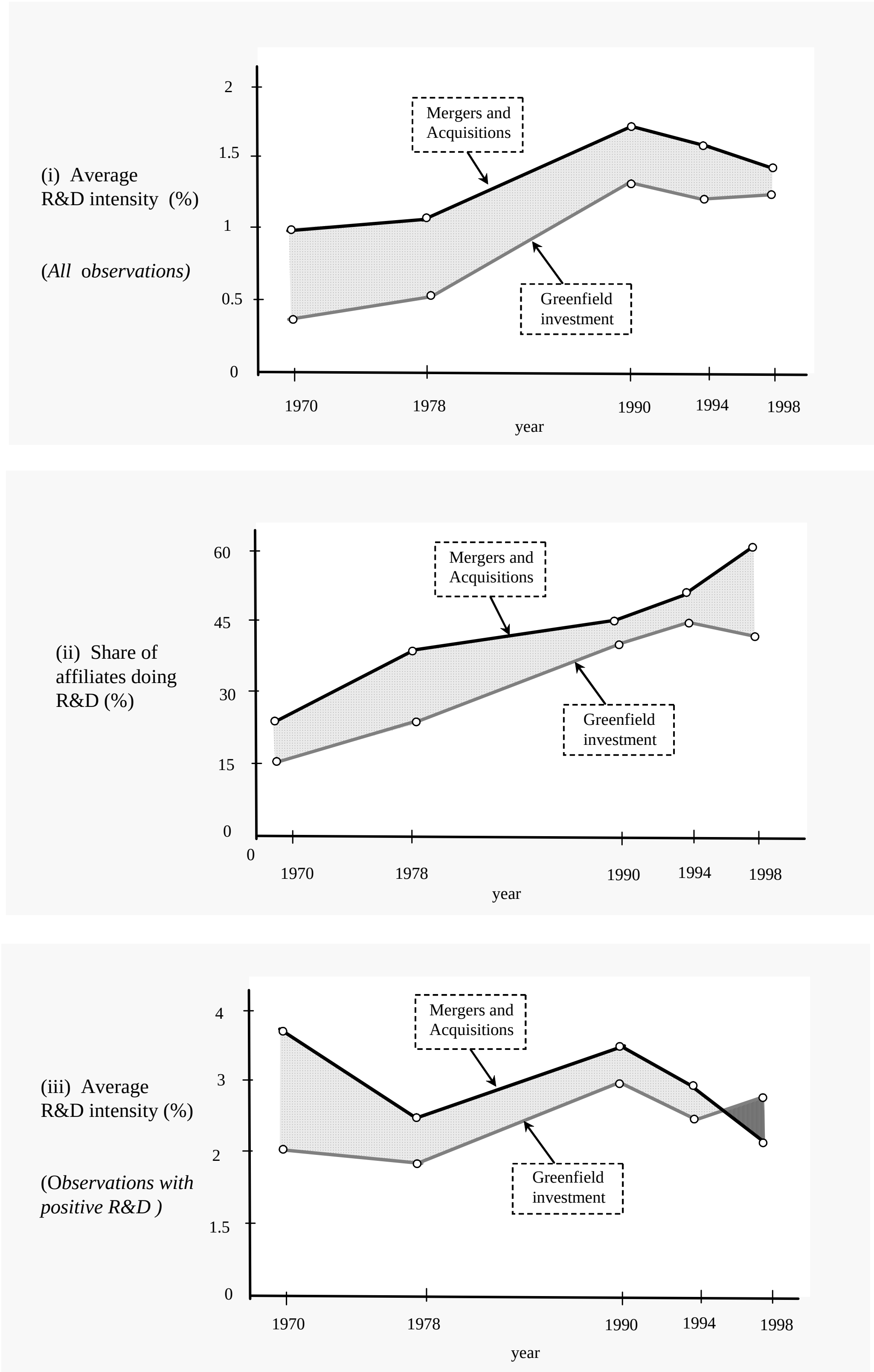

Figure 2: Affiliate R&D activities by entry mode over time.

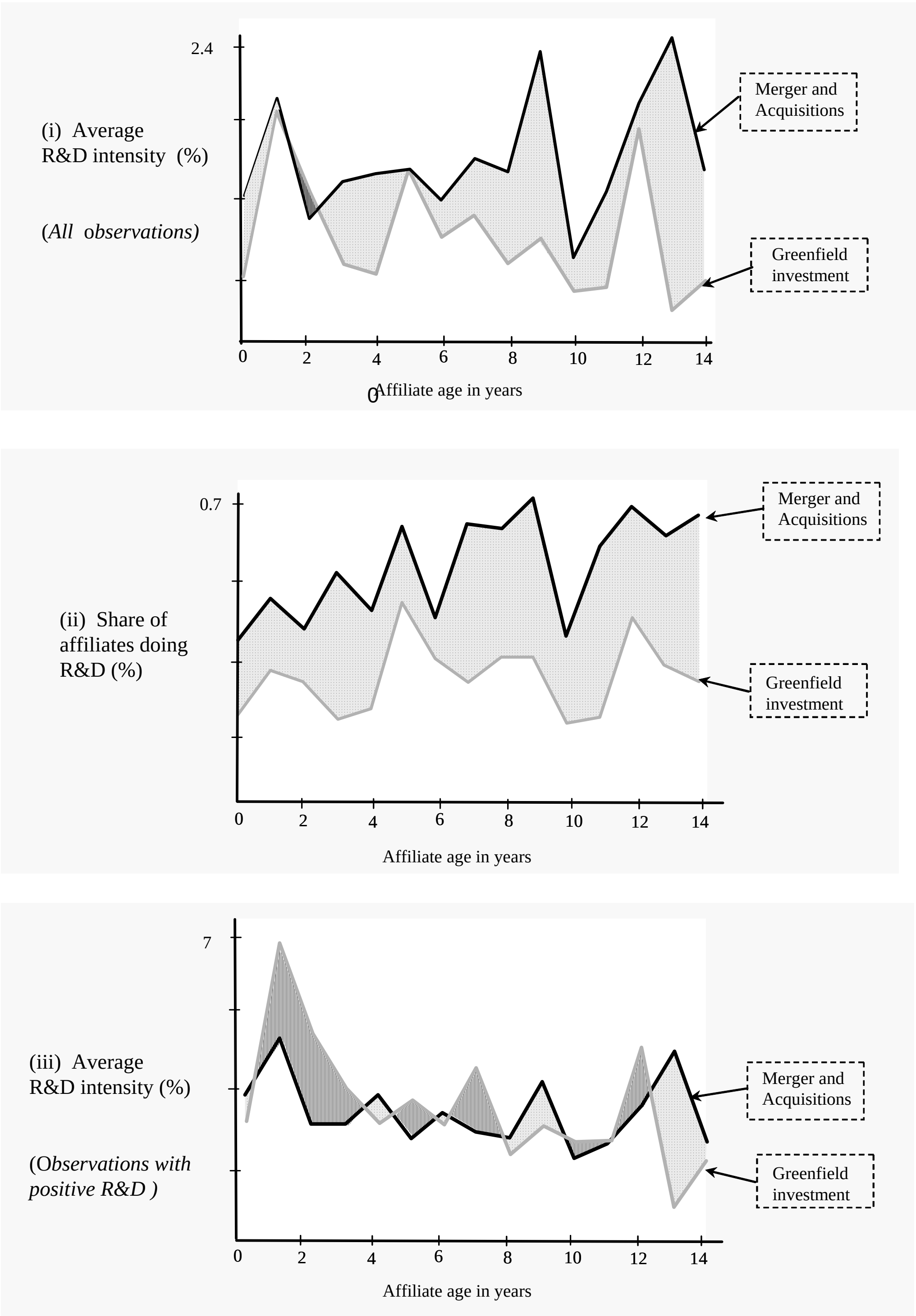

Figure 3: Affiliate R&D activities by entry mode and age.

We then turn to compare R&D expenditure in the affiliates with non-zero expenditure (Figure 2(iii)). Once more, there are several features worth noting. First, there is a much less clear pattern in the overall R&D intensity, which appears to fluctuate between surveys. The R&D gap between acquisition and greenfield affiliates seems to decrease over time, and even becomes negative in the end period.

One immediate explanation to the R&D gap between the two types of affiliates might be the age profile of the affiliates. Acquired affiliates may have R&D capabilities that they have taken over from previous owners, whereas greenfield ventures need time to build up R&D capabilities. It could then be argued that the R&D gap should decrease over the age of the affiliates. In Figure 3(i), we therefore plot the average R&D intensity as a function of affiliate age.[9] Once again, we find a persistent R&D gap in favor of acquired affiliates. This is even more accentuated when looking at the average probability of doing R&D in Figure 3(ii). When finally looking at the average R&D intensity for affiliates with positive R&D expenditure in Figure 3(iii), we do not find any clear pattern.[10]

Figures 1, 2 and 3 only illustrate the raw differences in affiliate R&D. These differences could, however, be due to differences in other characteristics of the affiliates and their parent firms. We will now further examine the sources of the R&D gap in an econometric analysis.

4 Econometric analysis

4.1 Econometric model

To measure R&D activity in the affiliates, we will use the R&D intensity of an affiliate i in time t, defined as:

$$RD_{it} = \frac{R\&D_{it}}{Sales_{it}} * 100 \quad (1)$$

[9] Age is defined as the number of years an affiliate has been part of the MNE.

[10] Again, there appears to be a decreasing trend in the 1990s. This might be partly due to a changing decomposition of the sample. Another explanation is that sales increased more than R&D expenditures, particularly in the 1990s.

where $R\&D_{it}$ is total outlays for R&D in affiliate i at time t and $Sales_{it}$ is the affiliate's corresponding total sales. Thus, we normalize R&D expenditures with total sales to control for size effects and express the intensity in percentage points. Using the intensity, we also control for omitted variables that have a similar effect on the affiliate's choice of R&D expenditures and sales.[11]

As noted in the previous section, a majority of affiliates report zero R&D and hence, the dependent variable RD_{it} contains a large number of zeros. We will take logs on the dependent variable RD_{it}, which will lead to a loss of observations with zero R&D and may result in OLS estimates on RD_{it} to be both biased and inconsistent. Therefore, we apply the Heckman (1979) two-stage model to analyze the effect of entry mode on affiliate R&D activity given by (2) and (3), below:

$$DRD_{it} = \alpha_0 + \alpha_1 MA\_GI_i + \alpha_2' Z_{it} + \alpha_3' Z_{jt} + u_{ijt} \tag{2}$$

$$\log(RD_{it}) = \beta_0 + \beta_1 MA\_GI_i + \beta_2' X_{it} + \beta_3' X_{jt} + \lambda_{it} + \varepsilon_{ijt}, \tag{3}$$

where $DRD_{it} = 1$ if $RD_{it} > 0$, $RD_{it} = 0$ otherwise. Z_i is a vector of the firm-specific variables and Z_j is a vector of the country-specific variables affecting the decision to perform R&D. X_{it} and X_{jt} are the corresponding firm-specific and country-specific variables affecting the intensity of doing R&D, u_{ij} and ε_{ijt} are the usual error terms, and $\lambda_{ijt} = \frac{\phi(\alpha' Z)}{\Phi(\alpha' Z)}$ is the error correction variable, where $\phi(.)$ and $\Phi(.)$ are respectively the normal density and cumulative distributions.[12] The explanatory variables are presented in the section below.

[11] Thus, to avoid endogeneity problems, we will not include affiliate size in the OLS regressions as one of the explanatory variables. Some other studies have included it on both sides of the equation: it results in mixed evidence of the effect of firm size on affiliate R&D intensity. For instance, Kumar (2001) and Zejan (1990) found a weakly positive effect of affiliate size on R&D intensity, while Belderbos (2003) did not find any significant effect. In our study, this variable is only introduced at the first stage of the Heckman procedure.

[12] Another alternative would be to use a Tobit approach. However, zero R&D expenditure is likely to be a consequence of binary decision-making rather than censoring, as assumed in a Tobit model. If firms first decide whether to establish a new research center, and then the exact amount of R&D expenditure, the Heckman two-stage estimation is more justified. This two-stage decision process might come from the existence of fixed sunk costs when deciding to set up a new research center abroad. Once this fixed sunk

Note that MA_GI_i is the variable of interest indicating whether an affiliate was acquired ($MA\_GI_i = 1$) or created from a greenfield investment ($MA\_GI_i = 0$).

Estimating (2) and (3) with the dummy variable MA_GI_i will give us information on whether the propensity of doing R&D and the intensity of R&D activities, on average, differ between affiliates incorporated through acquisitions and affiliates started by greenfield investments. This investigates whether the "R&D-gap" manifested in Figures 2 and 3 is robust when controlling for other characteristics that may potentially explain this difference.

Specifications (2) and (3) assume that R&D in the two types of affiliates only differs by a fixed amount (by an intercept difference) and that the impact of explanatory variables on affiliate R&D is constrained to be the same. To obtain more information, we then relax this assumption and estimate (2) and (3) separately for each entry mode. This yields:

$$DRD_{it}^{e} = \alpha_0^e + \alpha_2^{e\prime} Z_{it}^e + \alpha_3^{e\prime} Z_{jt}^e + u_{ijt}^e \tag{4}$$

$$\log(RD_{it}^{e}) = \beta_0^e + \beta_2^{e\prime} X_{it}^e + \beta_3^{e\prime} X_{jt}^e + \lambda_{it}^e + \varepsilon_{ijt}^e, \tag{5}$$

where e is an indicator for entry mode. We then test whether the R&D activities in acquired affiliates and affiliates created by greenfield investments follow different statistical relationships. The analysis serves as a test of the new theory on international acquisitions discussed in Section 2.

Finally, we consider the situation where the entry mode and the R&D decisions may be dependent on each other. If the entry choice is not a random process, but determined by unobservable firm characteristics that also influence the R&D decision [Shaver (1998), Hamilton and Nickerson (2003)] this will have an impact on our estimates. From the theory in Section 2, we know that cross-border acquisitions may emerge due to efficiency

cost has been spent, firms decide on the level of R&D expenditures. Some unobserved characteristics affecting the selection process, i.e. the decision to do zero R&D or positive R&D, could also influence the outcome. In that case, observations in the sample will differ systematically from those that are not in the sample, thereby leading to a selection bias. For comparison, we also estimated Tobit regressions. The results were qualitatively similar and are therefore not reported here.

as well as market power motives. Thus, the entry mode is likely to be endogenous and self-selected. Unfortunately, we do not have any direct measures of market power and potential synergies in our data. As a partial control, we will apply a bivariate probit model in order to control for the double selection process for the entry mode and R&D decisions [Tunali (1986), Wetzels and Zorlu (2003)].[13] The double selection model simultaneously controls for both R&D and entry mode decisions that may be related.[14]

We first add the following equation modelling the entry choice:

$$MA\_GI_i = \gamma_0 + \gamma_1' W_{it} + \gamma_2' W_{jt} + z_{ijt}, \tag{6}$$

where $MA\_GI_i = 1$ if the affiliate i is incorporated through acquisition and $MA\_GI_i = 0$ if the affiliate i is created through greenfield entry. W_{it} and W_{jt} are the corresponding firm- and country-level control variables and z_{ijt} is the error term.

We then estimate a bivariate probit model on equations (6) and (2), with the entry mode dummy MA_GI omitted in the latter, from which we calculate two error correction variables, $\lambda_{it}^{e,RD}$ and λ_{it}^{e}. These error correction terms are then included when estimating the affiliate R&D intensity in (5), which gives:

$$\log(RD_{it}^e) = \beta_0^e + \beta_2^{e\prime} X_{it}^e + \beta_3^{e\prime} X_{jt}^e + \beta_4^e \lambda_{it}^{e,RD} + \beta_5^e \lambda_{it}^e + \varepsilon_{ijt}^e \tag{7}$$

When estimating (7) for acquired affiliates ($e = MA$), the included error correction terms $\lambda_{it}^{MA,RD}$ and λ_{it}^{MA}controls for the propensity to perform R&D in acquired affiliates and the propensity to enter through acquisition, respectively. When estimating (7) for affiliates started from greenfield entry ($e = GI$), the included error correction terms $\lambda_{it}^{GI,RD}$

[13]Another way of tackling the simultaneity of these decisions is to estimate a multinominal discrete model. However, this econometric method is perfectly valid only if the assumption of independence of irrelevant alternatives is respected: error terms are supposed to be independent between all choices. It implies that the ratio of probabilities of any two alternatives is unaffected by the choice set, which seems to be unlikely in our situation.

[14]The error structure of the model depends on whether the decisions on R&D vs no R&D and M&A vs greenfield investment are made jointly or not. This issue is related to the interdependency of these two choices, and not their timing. There is a sequential decision process when one decision is only defined given a particular choice of the other decision (Maddala 1986), which is not the case in our paper.

and λ_{it}^{GI} controls for the propensity to perform R&D in affiliates entered through greenfield investment and the propensity to enter greenfield, respectively. To compute these lambda terms, we follow the procedure in Viitanen (2004).[15]

4.2 Explanatory variables

We include a set of variables at the affiliate, parent and country level to control for other determinants of affiliate R&D. Most variables are expressed in log form and all variables with monetary value are converted into US dollars in constant value of 1995 (for details, see tables A2 and A3 in the appendix for variable description and summary statistics).

At the affiliate level, we include the age of an affiliate, defined as the number of years the affiliate has been part of the MNE (*Age*). This captures the effect of time on affiliate R&D. There could be a threshold level of development which is required for a parent firm to invest in affiliate R&D, or a parent firm could also decide to reduce the R&D of acquired affiliates over time.

We also include the export intensity of the affiliate (*Export*). Previous research has found a positive effect of the export intensity of affiliates on the scale of R&D activities [Hewitt (1980), Zejan (1990) and Belderbos (2003)]. High export intensity may imply that the affiliate is used as a hub for regional or world markets in the product area, rather than just serving the local market. Such hub affiliates are more likely to function as R&D centers adapting technologies and creating new knowledge [Håkansson and Nobel (1993) and Nobel and Birkinshaw (1998)].

We examine the impact of several parent firm characteristics. In general, the relationship between the R&D intensity of the parent firm (*RD parent*) and overseas R&D is not straightforward. On the one hand, a parent firm in a high technology sector might require a high level of R&D expenditures abroad to adapt high-technology products to the local market and transfer technological knowledge. It may also be costly to protect propriety technologies from being dissipated. If such measures require large resources, the firm may concentrate R&D to the home country (Norbäck, 2001). But foreign R&D

[15] Tarja Viitanen graciously provided a STATA program in order to estimate the double-selection model.

activities may also entail localized absorption capacity for efficient technology sourcing in the host countries [Cohen and Levinthal (1989), Kamien and Zang (2000)].

The role of overseas R&D activities may be a function of corporate experience and growth. As the foreign operations become more important, the role of overseas R&D may change from supportive to creative, leading to an increase in the affiliate R&D. The proportion of overseas sales is found to have a positive effect on the proportion of overseas R&D by e.g. Lall (1979), Mansfield et al. (1979), and Hirschey and Caves (1981) for US firms and by Belderbos (1995) and Odagiri and Yasada (1996) for Japanese firms. We consider a direct measure of the internationalization of the R&D activities, defined as the share of foreign R&D in total R&D of the parent firm (*RD abroad*). A parent firm with a larger share of total R&D abroad is expected to invest more in the R&D of the affiliate.

Another R&D experience variable (*Experience*), defined as the number of years since the first overseas R&D investment of the parent firm, is used to capture the learning-by-doing process. The experience of overseas R&D is believed to promote the efficiency of R&D activities abroad and facilitate the coordination with the network of R&D centers. The implementation of an efficient decentralized management through communication and control mechanisms requires specific capabilities which are developing over time (Kogut and Zander, 1995). International experience in R&D should then have a positive impact on the decision to invest in overseas R&D [Belderbos (2001), Håkanson and Nobel (1993a), (1993b), Pearce (1989), Zejan (1990)].

Finally, we include the total size of the parent firm (*Size parent*) and the labor productivity of the parent company (*Prod parent*). A larger firm can more easily take advantage of scale and scope economies within R&D projects. Furthermore, larger firms may have greater market power and a better capacity to invest in and manage dispersed R&D systems. Larger firms may possess a greater capacity for appropriate returns to R&D because of first mover advantages, brand reputation or, for instance, distribution networks. Moreover, firm productivity has been found to be positively related to the likelihood of firms engaging in FDI (Helpman et al. 2004) and firm R&D activities in particular. It could therefore also be related to the foreign R&D activities. Firm productivity may not only reflect technological know-how but also managerial know-how advantages.

We also control for host country characteristics. A positive relation is expected between affiliate R&D and income level (*GDP cap*) or market size (*GDP*): R&D expenditures for adapting processes and products to local conditions as well as performing creative R&D are increasing with the income level of the consumers and the size of the market (Zejan, 1990). Adaptation investments are particularly relevant in large markets (UNCTAD, 2005). In a high-income country, the demand for high-quality products or/and for new technologies is more important and more R&D is conducted. It is also likely that the supply of assets with potential synergies arising from acquisitions is larger in countries with a higher development and/or a higher market size, which would in particular be important for R&D investments in acquired affiliates.[16]

We also take into account the impact of the distance between Sweden and the host country (Distance). We expect a negative effect on the R&D intensity of the affiliate. The geographical distance may obstruct technology transfers by making communication more difficult. With a greater distance, the assimilation and application of new knowledge becomes less easy as it hinders efficient supervision and control of the R&D activity abroad.

In the selection equation of the Heckman estimations, i.e (2) and (4), we add an index of property rights (*IPR*) from Ginarte and Park (1997). Multinational firms should be more reluctant to set up an R&D center when the protection for intellectual property rights is weak. Indeed, the IPR is expected to have a greater impact on the decision of whether to locate an R&D center abroad than on the level of R&D, since it constitutes one major determinant of anticipated total discounted future benefits from R&D activities. IPR may be less relevant for the R&D intensity, since improved property rights protection may increase both R&D expenditures and affiliate sales. In the selection equations, we also add affiliate size since a larger affiliate is expected be more likely to perform R&D.

[16] M&As could, in fact, be an unrealistic alternative for greenfield investments if the supply of suitable target firms is limited as in developing countries with underdeveloped asset markets. Besides, in many developing countries, foreign acquisitions are restricted. On the other hand, in some situations greenfield investment is not an alternative to M&As. For instance, during financial crises or large privatization programs, the supply of target firms overshadows the role of greenfield entry. We partly control for these last two aspects by introducing year, regional and industries dummies.

In the bivariate probit model, we need to include variables that have an impact on the trade-off between M&A and greenfield investment in (6), but not R&D spending, for identification in (4) and (5). We use two additional variables in the M&A equation (6): *Exchange rate* and *Past Number MAs*. *Exchange rate* gives the units of local currency per USD at time t related to the units of local currency per USD at $t-5$. A higher value of the variable implies a currency depreciation in the last five years and hence a lower price for acquisition objects. It is expected to increase FDI through M&As as shown by Blonigen (1997). *Past Number MAs,* defined as the number of Swedish M&As within an industry in a country over the last three years, captures both the behavior of MNEs and the supply of local targets. MNEs may first acquire to imitate each other and then to minimize their business risk (Schenk, 1996) or to obtain market power and/or prevent competitors from having an advantage in a country. It should be noted that the variable GDP also proxies the target supply: larger countries are more likely to have a higher M&A activity.

We use dummy variables for year, industry and region.[17] Our industry dummy variables are defined as five broader categories according to a taxonomy in OECD (1987, 1992): resource intensive, labor intensive, scale intensive, differentiated goods and science based goods. We use regional dummy variables defined as five main geographical areas, Europe, North America, South America, Developing Countries in Asia and Africa and Developed Countries in Asia and Pacific.

5 Empirical results

5.1 Pooled regressions

Table 1 shows the results from estimating (2) and (3), i.e the pooled sample with the entry mode dummy variable MA_GI. Columns (1) and (2) show the estimation results for the first and second stages of the Heckman two-stage procedure. In Figure 2 (ii) in Section 3, we illustrated that an acquired affiliate is more likely to undertake R&D than

[17] We also use country and/or parent firm dummies. This does not qualitatively change our conclusions. We do not report these results, but they are available upon request.

a greenfield affiliate without controlling for other characteristics and determinants. The results for the first-stage probit in column (1) show that acquired affiliates are more often associated with R&D activities, independently of affiliate age, size and other characteristics. Furthermore, the positive and significant dummy variable in the second stage of the Heckman estimation suggests that R&D activities by the acquired firms are larger than those of greenfield affiliates after taking into account unobserved characteristics affecting the selection process.[18]

The economic importance of the estimates is large. The marginal effect of the entry mode dummy MA_GI in equation (2) is 0.14. Thus, when comparing two affiliates with otherwise similar characteristics, except for the entry mode, an acquired affiliate is 12 percent more likely to perform R&D as compared to an affiliate started from greenfield entry. The corresponding effect of the entry mode dummy in equation (3) implies that the R&D intensity is on average about 46 percent higher in acquired affiliates.[19] These estimated effects are similar to the raw differences observed in Figures 2 (ii) and (iii).

In Table 1, we analyze the implications of affiliate age in more detail by estimating the effects for affiliates aged less than eight years and those aged between eight and twenty years. The time horizon is important since there could be a threshold level of development which is required for a parent firm to invest in the affiliate R&D. If a greenfield affiliate starting from scratch requires a longer time to invest in R&D activities or if an acquiring firm reduces (or closes down) the R&D activities of the target some time after the acquisition, we would expect the effect of the entry mode dummy be different when we split the sample according to affiliate age.

Columns (3) to (6) in Table 1 show the results for Heckman estimations. It appears that in both sub-samples, acquired affiliates are more likely to do R&D and have a higher level of R&D than greenfield ones which is consistent with Figure 2 in Section 3. The

[18]This result is consistent with Belderbos (2003). In his paper, acquired affiliates of Japanese MNEs are shown to have a higher R&D intensity than affiliates created as greenfield investments in Tobit estimations. The Tobit method gives qualitative the same results for our sample.

[19]The estimate of β_1 in equation (3) is $\hat{\beta}_1 = 0.376$. From (3), it follows that $\frac{\widehat{RD}^{MA} - \widehat{RD}^{GI}}{\widehat{RD}^{GI}} = e^{\hat{\beta}_1} - 1 = 0.4564$.

coefficient differences indicate that the likelihood of having R&D is larger for the younger acquired affiliates than for the older ones, but the level of R&D is higher among the older acquired affiliates. If there is some start-up delay in the R&D activities of greenfield affiliates, it does not seem as if the greenfield affiliates catch up with the acquired ones over time and the acquired affiliates do not seem to reduce R&D over time.

The theory reviewed in section 2 suggests that the impact of cross-border acquisitions may differ between industries, since market power effects and complementarities may not be uniform between different industries. Therefore, we checked the results on a number of subsamples. As the results do not qualitatively differ from the previous ones, we only state them here and provide a brief discussion.[20]

First, we defined sub-samples based the OECD definition of industries illustrated in Figure 1 (ii). In Labour-intensive and Science-based industries, we find that acquired affiliates have both a significantly higher probability of doing R&D and – given that R&D is performed – also have a significantly higher intensity of R&D. In scale-intensive and natural resource intensive industries, the intensity of R&D is significantly higher in acquired affiliates, whereas we find that the MA_GI dummy is positive, but not significant, in the probability regression (2). In the sample with differentiated product industries, we find that the MA_GI dummy is positive, but not significant, in both the probability and the intensity equations (2) and (3). Not in any sample do we find less of R&D in acquired affiliates in terms of a negative point estimate on the MA_GI dummy, irrespective of how R&D is measured.

We also tried to isolate investments where we expect market power reasons to be more prevalent. Potentially, there may be smaller differences in R&D activities between entry modes in horizontal or market-seeking FDI, since an acquisition is likely to have a larger effect on market power in the local market which, in turn, may generate acquisitions with smaller synergies.[21] To explore this, we split the sample according to export intensity.

[20] The results are available upon request.

[21] As noted in Section 2, the model by Norbäck and Persson (2006) shows that R&D investments by the acquiring MNE may be limited if market power – rather than efficiency gains – is the dominating motive for the acquisition.

Irrespective of whether affiliates were mainly selling to the local market or to external markets, acquired affiliates had a significantly higher probability of doing R&D, as well as a significantly higher intensity in doing R&D. We also defined an additional sub-sample where the parent firm was required to be in the same industry (four-digit) as the affiliate which, on basis of the IO literature, can be argued to be closer to horizontal investments. Again, also in this narrowly defined group, acquired affiliates had a higher probability of doing R&D as well as a higher intensity of R&D.

5.2 Separate regressions

So far, we find that M&As as an entry mode, on average, imply more frequent and intensive affiliate R&D than greenfield entry, and that this difference persists over time. The pooled estimation approach, however, is less informative in explaining why this is the case, since this average difference is captured by the "black box" dummy variable MA_GI. To examine the source of differences in R&D behavior between entry modes in more detail, we now turn to estimating equations (4) and (5) where the impact of the various control variables is allowed to differ between entry modes.

We should first stress that the two types of affiliates differ significantly in terms of most variables as shown by Table A3 in the appendix. Acquired affiliates are, on average, smaller (*Size Affiliate*) but more export intensive (*Export*) and have larger (*Size parent*) and more productive parents (*Prod parent*) with a larger share of overseas R&D (*RD Abroad*). They are located in countries closer to Sweden (*Distance*). These countries have a higher income level (*GDP cap)* and a better intellectual property right protection (*IPR*). Greenfield affiliates, on the other hand, have been part of the parent firm for a longer period of time (*Age*) and have more R&D intensive parents (*RD parent*) with a longer experience of overseas R&D (*Experience*). These simple tests of means reveal differences that may come through as coefficient differences in the regressions.

In Table 2, we show the results for separate Heckman estimations and the tests for coefficient differences.[22] The Wald- and F-tests rejects both stages of the Heckman speci-

[22] Coefficient differences are tested by interacting all explanatory variables with the entry mode dummy

fication with pooled entry modes. This suggests that affiliate, parent and country characteristics impact affiliate R&D in different ways depending on the entry mode.[23] Thus, the R&D activities in acquired affiliates and affiliates created by greenfield investments, follow different statistical relationships which, in turn, shows that cross-border acquisitions and greenfield entry are not "perfect substitutes", as emphasized by the new literature on the entry mode of FDI. They are likely to be driven by different strategic motivations.

In addition, we find that neither the likelihood of doing R&D nor the intensity of R&D activities of acquired affiliates vary with time after the acquisition, as measured by the *Age* variable. We note that affiliate age has a negative effect on the likelihood of doing R&D in greenfield affiliates which is somewhat puzzling given that building up R&D capacity is expected to take time and thus, older affiliates could be more likely do R&D (UNCTAD, 2000). However, the results might mean that R&D in greenfield investments is more related to adapting to the parent firm's technology. Once more, the differences in the R&D level between greenfield and acquired affiliates do not necessarily vanish with increasing affiliate age. There is no support for the assumption that R&D in acquired affiliates tends to decline over time, while greenfield affiliates are more prompt to develop R&D activities.

The export intensity of the affiliate (*Export*) has a significant positive effect on the likelihood of doing R&D in acquired affiliates and on the level of R&D in both types of affiliates, which supports the hypothesis that R&D is concentrated to affiliates serving as hubs with several functions. There are also significant differences in the effect of some parent characteristics. A higher R&D intensity of the parent (*RD parent*) implies that R&D is more likely in both types of affiliates, but that the effect is larger for acquired affiliates. A longer experience of previous foreign R&D (*Experience*) has a positive impact on the likelihood and the level of R&D in greenfield affiliates, while it has no impact on the likelihood of R&D and a negative and significant effect on the level of R&D in acquired

variable.

[23] We also checked whether the estimated coefficients for all variables which are not binary in (4) and (5) where jointly significant. Again by applying separate Wald- and F-tests for each stage, this showed that the slope coefficients, in both stages, differ signficantly between entry modes.

affiliates. The latter results provide some evidence that MNEs with less international R&D experience actively use acquisitions to strengthen their own firm-specific assets with acquired ones.

The productivity of parents (*Prod parent*) has a positive impact on the propensity of a greenfield affiliate to do R&D and the level of R&D, but no significant impact on the R&D of acquired affiliates. The result is interesting to put in the context of Nocke's and Yeaple's (2005b) model which predicts that more efficient firms are more likely to engage in greenfield FDI, since building a plant is worthwhile only if the gains are sufficiently large.

Parent size (*Size*) does not seem to capture the same aspects of parent characteristics as parent productivity (*Prod parent*) since it has a negative impact on the level of R&D and the likelihood that an affiliate has R&D for both types of affiliates, while this negative effect is significantly weaker for acquired affiliates.

It is interesting to note that intellectual property rights protection (*IPR*) has a positive and significant effect only on the acquired affiliates. A plausible explanation is that acquisitions are motivated by technology sourcing and assets synergies and therefore, they are more sensitive to intellectual property rights protection. On the contrary, greenfield investments could involve transfers of less specific and more common technological knowledge from the parent to the affiliate. Once more, this might be the case if the objective of affiliate R&D is rather to adapt the home product to local market conditions than to source technology and stimulate knowledge creation.

We can also note the asymmetry in the effects of per capita income. A higher development level as measured by income per capita is positively related to the R&D intensity in acquired affiliates, while it is negatively related to the R&D intensity in greenfield affiliates. This may indeed reflect that acquisitions occur to generate synergies, whereas R&D in greenfield affiliates may be more inclined towards adaptive R&D. Developed countries are more likely to have targets with sources of synergies.

5.3 Comparing the 1970's to the 1990's

As illustrated in Figure 1, both the number of cross-border acquisitions and foreign R&D activities of multinational firms have increased since the 1970's. We explore whether important changes in the effects of entry mode on affiliate R&D have taken place by splitting the full sample into the 1970's and 1990's samples. It should be pointed out that in some cases, the sub-samples become small, which could influence the significance of the results.

Tables 3 and 4 show that the entry mode dummy in pooled estimates from (2) and (3) are again significant and positive, suggesting that acquired affiliates are more likely to do R&D and have a higher level of R&D during both sub-periods (column 1 in both tables). The Wald and F-tests of coefficient differences (columns 4 and 8 in both tables) reject the pooled specifications, however, confirming that acquired affiliates and affiliates established by greenfield entry are fundamentally different. It should be noted that the F test is only weakly significant at the second stage OLS in the 1970's.

The R&D intensity of the parent firm (*RD Parent*) has a positive impact on the likelihood of R&D for both types of affiliates in the 1990's, but the effect is only significant for the acquired affiliates in the 1970's. In the 1970's, less productive parent firms (*Prod parent*) are less likely to have R&D activities in the acquired affiliates. This variable has no effect on greenfield affiliates. In the 1990's, it only has an impact on the likelihood of R&D in acquired affiliates. Comparing the results in the 1970s' and 1990's for the respective entry modes provides an additional insight into the intellectual property right protection (*IPR*). *IPR* has a positive effect on the likelihood of R&D only in the acquired affiliates in the 1990's. It is possible that cross-border acquisitions motivated by technology sourcing have become more common in the latter sub-period and thereby, the importance of IPR has increased.

In the 1990's, the experience of the parent firm from previous R&D has a negative impact on the level of R&D in the acquired affiliates, but no significant impact on greenfield affiliates. Since we do not find this difference in the 1970's sample, it seems that it has become more important for less experienced parents to catch-up by acquisitions. We should point out that there seem to be industry-specific differences during the 1990's. At the second stage, R&D intensity in acquired affiliates is higher in all industries, with significant differences in all industries except science-based industries.

The results for the 1990's suggest that technology sourcing has become a more important motive for entry through acquisitions. To further scrutinize this, we add another variable capturing a country's industry-level specialization in R&D activities. We define this variable as a revealed comparative advantage measure originally used on commodity exports:

$$RCA_{hjt} = \frac{RD_{hjt}}{\sum_j RD_{hjt}} \left[\frac{\sum_h RD_{hjt}}{\sum_h \sum_j RD_{hjt}} \right]^{-1},$$

where t is the time index, j is the country index, h is the industry index and where the specialization is matched to affiliates based on the industry codes. This measure reveals R&D specialization if country i's share of "world" R&D in a certain industry j is greater than the country's share of "world" R&D in all industries.[24]

Table 5 shows the results for Heckman estimations with an RCA variable. In both stages, the RCA variable is significant and positive for acquired affiliates, but insignificant for greenfield affiliates. The result provides further support for the hypothesis that technology sourcing has become a more important motive for acquisitions in the 1990s, but not for greenfield entry. The results for the other variables are to a large extent as in Table 4.[25] The inclusion of RCA reduces the significance of the *GDP cap* variable, indicating that a country's income level partly captures the same effect as RCA.

Finally, we may investigate if we can derive some additional information on the source of the "R&D-gap" displayed in Figure 2 from the separate regressions. We noted statistically significant mean differences in characteristics for the acquired and greenfield affiliates in Table A3. The significant Wald and F-tests in tables 2-5 also revealed that affiliate, parent,

[24] Due to data limitations, the measure can only be computed for the 1990's sample. We define the specialization measure in terms of patents but since the results do not differ qualitatively, we only report the results for R&D expenditures.

[25] Some differences may occur partly because including RCA reduces the sample to about 63 percent of the total sample size for the 1990's.

industry and country characteristics impact affiliate R&D in different ways depending on the entry mode. This suggests that the observed differences in R&D performance between acquired and greenfield affiliates could be explained by (i) *differences in parent, affiliate, industry and country characteristics,* but also by *(ii) different reactions to these characteristics.* As we pointed out previously, this latter aspect is emphasized by the emerging literature on cross-border acquisitions.

To quantify these effects, we use a simple Blinder-Oaxaca decomposition, which is derived in Appendix B and shown in detail in the table B1. This exercise shows that the different reactions of acquired and greenfield affiliates to given characteristics explains about 50 percent of the difference in probability of doing R&D, and that this effect is statistically significant. When separating the 1970s and the 1990s, the fact that acquired affiliates and greenfield affiliates follow different statistical models explains 92 percent of the "gap" in the propensity to perform R&D in the latter period. When applying the Blinder-Oaxaca decomposition for the R&D-intensity in equation (5), this provided less precise estimates, but a similar pattern.

5.4 Double selection

We have so far assumed that the entry mode is exogenous. Since the entry mode and the R&D decisions may be dependent on each other, we use a biprobit estimation as previously described in Section 4.[26] The biprobit estimation also provides us with valuable information about the determinants of the entry mode choice. However, there are limitations to this analysis. Since the trade-off between these two different entry modes is only performed at the birth date, we are obliged to reduce our sample to include new affiliates only. We therefore include affiliates which are at the maximum five years old in the main estimation.[27] Yet another problem is that the biprobit assumes a pooled estimation for

[26] It should be underlined that considering observable differences between acquired and greenfield affiliates as we do in previous separate estimations is also a way of reducing the potential bias (Hamilton and Nickerson, 2003).

[27] We also checked the robustness of the results by varying the age limit. This exercise did not qualitatively change our results.

the R&D decision, which was rejected in the previous analysis.

The results for the biprobit estimation are displayed in Table 6. The results for entry mode choice in column (1) are worth discussing separately. For instance, the negative effect of parent productivity *Prod parent* confirms the earlier interpretation that acquisitions are asset-seeking by MNEs with weaker sources of competitive advantage. The positive impact of *Size Parent* suggests that larger firms, on the other hand, are more likely to make acquisitions. A reason could be that a larger firm is more likely to have complementary assets or more financial resources to expand through cross-border acquisitions. Among the additional variables only affecting the entry mode choice (see Section 4.2 for definitions), *Exchange rate* is positive and significant which is consistent with Blonigen (1997) who finds that exchange rate depreciations induce entry through acquisitions in industries with more firm-specific assets. *Number MAs,* which was defined as the number of Swedish M&As within an industry in a country over the last three years, is positive and significant, which suggests that acquisitions occur where there is a supply of local targets.

Turning back to the double selection issue, the Wald test indicates that the correlation between the error terms of the two probit equations is significantly different from zero. This suggests that the model cannot be estimated with two independent probit equations and that the decision of doing R&D may be biased by an endogenous entry mode choice.

The lambda for entry mode gives an estimate for the propensity to choose M&A or greenfield entry, accounting for the endogeneity of the R&D decision. These are not significant suggesting that there is no selection among acquired nor greenfield affiliates such that the affiliates of one type had a significantly higher or lower R&D intensity than the average. The lambda for R&D choice is significant for acquired affiliates. Thus, there is some evidence of selection such that acquired affiliates choosing to do R&D had a higher R&D intensity as compared to the average in the case where all acquired affiliates had chosen to do R&D. Finally, we find that the F-test rejects a pooled model, which again suggests that M&As and greenfield entry should be seen as distinct choices made by firms.

6 Conclusions

Using unique data on Swedish multinational firms, we investigate the R&D activities of affiliates created by greenfield investments and those incorporated by the acquisition of local firms during the period 1970 to 1998. In contrast to the concerns of many policy-makers, we find that acquired affiliates are more likely to do R&D and have a higher level of R&D intensity than greenfield affiliates. There is no evidence that R&D in acquired affiliates is terminated, or to a higher degree reduced over time than in affiliates created through greenfield entry. In terms of policy implications, these results show that restricting cross-border acquisitions in order to favor greenfield investments may lead to a reduction in MNEs' technology transfers to the host countries.

Another main finding is that the gap in affiliate R&D performance between the entry modes is explained by differences in parent, affiliate and country characteristics, but also by the fact that affiliate R&D performance reacts differently to these characteristics. In fact, we find that R&D activities of acquired and greenfield affiliates follow different statistical relationships. The latter result provides support for the new and fast-growing literature on cross-border acquisitions, emphasizing that greenfield entry and cross-border acquisitions are likely to be driven by different strategic motives.

In particular, cross-border acquisitions are likely to occur in order to seek assets and generate R&D synergies, and that this motivation becomes more prevalent in 1990s. For instance, we find that R&D is sensitive to intellectual property right protection only in acquired affiliates, which suggests that synergies in firm-specific knowledge from asset acquisitions require more rigorous protection. Our results also indicate that the degree of host country specialization in R&D has a positive effect on affiliate R&D, but again only in the acquired affiliates.

Some limitations to our analysis should also be discussed. The nature of our data with affiliates to Swedish firms does not allow us to analyze the development of affiliate R&D activities before and after an ownership change. Thus, we investigate the post-acquisition performance which is compared to the "post-entry" behavior of affiliates created by green-field entry. If the higher propensity of doing R&D in acquired affiliates, as compared to affiliates created from greenfield entry, is mainly due to complementaries or synergies emerging from the acquisition, we would expect cross-border acquisitions to increase R&D also when compared to the R&D performed in the target firm before an acquisition. Such an analysis would provide a interesting comparison to our study. This is, however, left to future research and would require other data sources.

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A Additional tables

Table A1. Entry mode of FDI.

Year	MA	GI	Total Number	Share in Total
1970	100	228	328	0.15
1978	154	227	381	0.18
1990	306	189	495	0.23
1994	346	202	548	0.25
1998	290	129	419	0.19
Total	1196	975	2171	1.00
Region				
Europe	916	565	1481	0.68
North America	178	181	359	0.17
South America	53	118	171	0.08
Other Developing Countries	26	61	87	0.04
Other Developed Countries	23	50	73	0.03
Total	1196	975	2171	1.00
Industry				
Resource-intensive	173	91	264	0.12
Labor-intensive	211	227	438	0.20
Scale-intensive	369	282	651	0.30
Differentiated Goods	350	260	610	0.28
Science Based	88	112	200	0.09
Total	1191	972	2163	1.00

B The Oaxaca decomposition[28]

We follow Bergman et al. (2006) who generalize the linear Oaxaca decomposition to a non-linear probit model. Let y denote the dependent variable and let x denote the independent variables in (4) and (5). Then let $E[y]$ denote the unconditional mean of y and let $E[y|x]$ be the conditional mean of y given x. Noting that $E[y] = \int E[y|x]f(x)dx$, where $f(x)$ is the marginal probability of x, we can write the difference in unconditional means between acquired affiliates and greenfield affiliates, $E_{MA}[y] - E_{GI}[y]$, as:

$$\begin{aligned} E_{MA}[y] - E_{GI}[y] &= \int E_{MA}[y|x]f_{MA}(x)dx - \int E_{MA}[y|x]f_{GI}(x)dx + \\ &\quad \int E_{MA}[y|x]f_{GI}(x)dx - \int E_{GI}[y|x]f_{GI}(x)dx \\ &= \underbrace{\int E_{MA}[y|x](f_{MA}(x) - f_{GI}(x))dx}_{\text{"Explained part"}} + \\ &\quad \underbrace{\int (E_{MA}[y|x] - E_{GI}[y|x])f_{GI}(x)dx}_{\text{"Unexplained part"}} \end{aligned} \tag{8}$$

Thus, the difference in unconditional means between acquired affiliates and greenfield affiliates, $E_{MA}[y] - E_{GI}[y]$ can be decomposed into an "*explained part*" and a "*unexplained part*". The first "*explained part*" is the part of the difference that can be explained by the two entry modes having different distributions of the explanatory variables x. The second "*unexplained part*" is the part of the difference that can be explained two entry modes having different conditional expectation functions, so that the underlying parameters in the model that explains R&D performance differs between the entry modes.

It is convenient to write (8) as:

$$\begin{aligned} \underbrace{E_{MA}[y] - E_{GI}[y]}_{\text{Difference}} &= \underbrace{E_{MA}[y] - \int E_{MA}[y|x]f_{GI}(x)dx}_{\text{"Explained part"}} + \\ &\quad \underbrace{\int E_{MA}[y|x]f_{GI}(x)dx - E_{GI}[y]}_{\text{"Unexplained part"}} \end{aligned} \tag{9}$$

[28] See Blinder (1973) and Oaxaca (1973).

Noting that $y_i = DRD_i$ in (4) and assuming that the zero conditional mean assumption $E[u|\mathbf{Z}] = 0$ holds, the sample analog of (9) for the probability of doing R&D can be written:

$$\underbrace{\overline{DRD}^{MA} - \overline{DRD}^{GI}}_{\text{"Raw gap"}} = \underbrace{\overline{DRD}^{MA} - (1/N^{GI}) \sum_{i \in GI} \Phi\left(\mathbf{Z}_i^{GI} \hat{\alpha}^{MA}\right)}_{\text{"Explained part"}} + \underbrace{(1/N^{GI}) \sum_{i \in GI} \Phi\left(\mathbf{Z}_i^{GI} \hat{\alpha}^{MA}\right) - \overline{DRD}^{GI}}_{\text{"Unexplained part"}} \quad (10)$$

where $\overline{DRD}^{MA} = (1/N^{MA}) \sum_{i \in MA} DRD_i$ and $\overline{DRD}^{GI} = (1/N^{GI}) \sum_{i \in GI} DRD_i$, where N^{MA} and N^{GI} are the number of observations of affiliates of each type and $\Phi(\cdot)$ is the cumulative normal distrubution.

Moreover, noting that $y_i = \log RD_i$ in (5) and assuming that the zero conditional mean assumption $E[\varepsilon|\mathbf{X}] = 0$ holds, the sample analog of (9) for the R&D intensity can be written:

$$\underbrace{\frac{\overline{RD}^{MA} - \overline{RD}^{GI}}{\overline{RD}^{GI}}}_{\text{"Raw (proportionate) gap"}} \approx \underbrace{\overline{\log RD}^{MA} - \overline{\mathbf{X}}^{GI} \hat{\beta}^{MA}}_{\text{"Explained part"}} + \underbrace{\overline{\mathbf{X}}^{GI} \hat{\beta}^{MA} - \overline{\log RD}^{GI}}_{\text{"Unexplained part"}} \quad (11)$$

where $\overline{RD}^{MA} = (\Pi_{i \in MA} RD_i))^{\frac{1}{N^{MA}}}$ and $\overline{RD}^{GI} = (\Pi_{i \in GI} RD_i)^{\frac{1}{N^{GI}}}$ are the geometric means in R&D intensity for acquired affiliates and greenfield affiliates, respectively. Note that $\frac{\overline{RD}^{MA} - \overline{RD}^{GI}}{\overline{RD}^{GI}} * 100$ is the percentage difference in geometric mean between acquired affiliates and affiliates started from greenfield entry.

The Oaxaca decomposition based on the differences in the R&D intensity (11), as well as differences in the probability of doing R&D (10), over different time periods are shown in table B1. The estimates are shown together with bootstrapped standard errors derived from 1000 repetitions. We also performed the decomposition (10) when using a linear probability model to estimate (4). In addition, we did a comparison of results when using greenfield affiliates, rather than acquired affiliates, as base group. Results from these extensions did not qualitatively differ from the ones in Table B1.

C Main tables

Table A2. Variable description.

Variable name	Definition	Source
Age	ln(the number of years the affiliate has been part of the corporation)	IUI
Export	affiliate exports to sales	IUI
Size Affiliate	ln(affiliate sales)	IUI
Size Parent	ln(total corporate sales)	IUI
Prod Parent	$\ln(\frac{total\ sales}{total\ number\ of\ employees} * 100)$	IUI
RD Parent	$\ln(\frac{R\&D}{total\ sales} * 100)$	IUI
RD Abroad	$\frac{(total\ parent\ R\&D - parent\ R\&D\ in\ Sweden)}{total\ parent\ R\&D}$	IUI
Experience	ln(the number of years since the first R&D investment abroad)	IUI
Distance	ln(the greater circle distance between capitals)	Penn World Tables
GDP cap	ln(GDP per capita)	WDI, World Bank
GDP	ln(GDP)	WDI, World Bank
IPR	Index of intellectual property rights	Ginarte and Park (1997)
Exchange rate	$\frac{local\,currency\,per\,USD_t}{local\,currency\,per\,USD_{t-5}}$	Penn World Tables
Past number of MAs	The number of M&As in the country over the last three years within the industry	IUI
RCA	$RCA_{hjt} = \frac{RD_{hjt}}{\sum_j RD_{hjt}} \left[\frac{\sum_h RD_{hjt}}{\sum_h \sum_j RD_{hjt}}\right]^{-1}$ where t is the time index, j is the country index, h is the industry index	ANBERD, OECD

Table A3. Means of variables and test of equality of means.

		Full Sample	
Variable	MA	GI	Difference
Age	10.235	25.614	-15.379***
Export	0.361	0.247	0.115***
Size Parent	5467.51	3927.66	1539.85***
Prod Parent	13.659	12.619	1.041**
RD Parent	2.722	3.930	-1.208***
RD Abroad	0.462	0.327	0.134***
Experience	21.949	31.925	-9.976***
Distance	2344.03	4117.30	-1773.27***
GDP	2.01e+12	1.98e+12	2.95e+10
GDP cap	25123.88	21289.88	3834.00***
IPR	4.044	3.734	0.309***
Size Affiliate	109.77	165.51	-55.74***
Number of obs.	560	314	

Note: Robust standard errors in parenthesis. *** significant at the one,** at the five and * at the ten percent level.

Table B1. The Oaxaca decomposition.

Probability of doing R&D using (4):				
Component	Expression	Full sample	1970s	1990s
"Explained"	$\overline{DRD}^{MA} - (1/N^{GI})\sum_{i\in GI}\Phi\left(\mathbf{Z}_i^{GI}\hat{\alpha}^{MA}\right)$	0.073*** (0.024)	0.013 (0.041)	0.008 (0.029)
"Unexplained"	$(1/N^{GI})\sum_{i\in GI}\Phi\left(\mathbf{Z}_i^{GI}\hat{\alpha}^{MA}\right) - \overline{DRD}^{GI}$	0.077*** (0.025)	0.107**** (0.041)	0.078** (0.036)
Difference	$\overline{DRD}^{MA} - \overline{DRD}^{GI}$	0.150*** (0.021)	0.121*** (0.036)	0.086*** (0.028)
Obs MA		1135	242	893
Obs GI		928	436	492

R&D intensity using (5):				
Component	Expression:	Full sample	1970s	1990s
"Explained"	$\overline{\log RD}^{MA} - \overline{\mathbf{X}}^{GI}\hat{\beta}^{MA}$	0.111 (0.133)	0.380 (0.362)	-0.016 (0.155)
"Unexplained"	$\overline{\mathbf{X}}^{GI}\hat{\beta}^{MA} - \overline{\log RD^{GI}}$	0.172 (0.132)	0.317 (0.365)	0.117 (0.104)
Difference	$\dfrac{\overline{RD}^{MA} - \overline{RD}^{GI}}{\overline{RD}^{GI}}$	0.287*** (0.094)	0.697*** (0.204)	0.118 (0.104)
Obs MA		551	95	469
Obs GI		311	82	216

Note: Standard errors in parenthesis. *** significant at the one,** at the five and * at the ten percent level. The standard errors are obtained from a bootstrap with 1000 repetitions. Components may not sum to the total difference due to rounding errors.

Table 1. Pooled Heckman estimations.

	First stage	Second stage	First Stage Probit		Second Stage OLS	
Dependent Variable	Probit	OLS	Age≤8	8<Age≤20	Age≤8	8<Age≤20
MA_GI	0.347*** (0.077)	0.376*** (0.091)	0.410*** (0.127)	0.316** (0.136)	0.334** (0.164)	0.537*** (0.165)
Age	-0.006** (0.003)	-2.3E-04 (0.003)	-0.001 (0.024)	-0.004 (0.016)	-0.004 (0.027)	-0.001 (0.016)
Export	0.371*** (0.124)	0.951*** (0.141)	0.539*** (0.180)	0.488* (0.231)	0.718*** (0.206)	1.198*** (0.236)
Size Parent	-0.247*** (0.026)	-0.109*** (0.021)	-0.245*** (0.038)	-0.151*** (0.048)	-0.098*** (0.029)	-0.045 (0.037)
Prod Parent	0.171 (0.125)	0.267* (0.143)	0.345* (0.182)	-0.048 (0.260)	0.507** (0.196)	-0.180 (0.262)
RD Parent	0.414*** (0.047)	0.728*** (0.866)	0.491*** (0.064)	0.379*** (0.085)	0.827*** (0.085)	0.874*** (0.132)
RD Abroad	1.201*** (0.149)	1.491*** (0.196)	1.583*** (0.220)	0.636** (0.285)	2.136*** (0.278)	0.973*** (0.317)
Experience	0.017*** (0.002)	0.003 (0.002)	0.005* (0.003)	0.012*** (0.004)	-0.007** (0.003)	0.008** (0.003)
Distance	-0.235*** (0.088)	-0.404*** (0.107)	-0.465*** (0.152)	0.070 (0.215)	-0.424*** (0.158)	-0.162 (0.217)
GDP	-0.035 (0.038)	0.181 (0.042)	-0.047 (0.058)	-0.090 (0.075)	0.144** (0.064)	0.060 (0.073)
GDP cap	-0.063 (0.131)	-0.023** (0.172)	-0.112 (0.246)	0.142 (0.407)	-0.131 (0.246)	0.446 (0.345)
IPR	0.250** (0.101)		0.369** (0.167)	0.135 (0.199)		
Size Affiliate	0.412*** (0.033)		0.420*** (0.049)	0.372*** (0.060)		
Labor intensive	0.030 (0.129)	0.256* (0.145)	0.114 (0.192)	-0.001 (0.247)	0.067 (0.200)	0.590* (0.288)
Scale intensive	-0.109 (0.116)	0.074 (0.140)	-0.090 (0.160)	0.127 (0.235)	0.102 (0.176)	0.739*** (0.276)
Differentiated goods	0.286** (0.22)	0.745*** (0.143)	0.509*** (0.172)	0.341 (0.237)	0.733*** (0.188)	1.403*** (0.284)
Science based	-0.054 (0.168)	1.003*** (0.184)	-0.082 (0.266)	0.293 (0.309)	0.663*** (0.252)	1.679*** (0.656)
Constant	1.076 (1.610)	-4.494 (2.009)	0.100 (2.886)	-1.663 (4.424)	-4.823 (3.054)	-9.280** (4.094)
Lambda		1.442*** (0.160)			1.243*** (0.208)	2.061*** (0.333)
No. obs	2063	862	970	595	370	272
Pseudo R2/R2	0.30	0.37	0.34	0.26	0.41	0.43

Note: Standard errors in parenthesis. *** significant at the one,** at the five and * at the ten percent level. Time and region dummies are included.

Table 2. Separate Heckman estimations.

	First Stage Probit				Second Stage OLS		
Dependent Variable	MA	GI	Difference	.	MA	GI	Difference
Age	-0.007 (0.004)	-0.015*** (0.005)	0.008 (0.007)		-0.003 (0.004)	-0.002 (0.006)	3.3E-05 (0.007)
Export	0.478*** (0.)	0.072 (0.866)	0.406 (0.260)		0.920*** (0.160)	0.899*** (0.286)	0.021 (0.325)
Size Parent	-0.197*** (0.035)	-0.303*** (0.045)	0.106* (0.058)		-0.051** (0.022)	-0.198*** (0.050)	0.147*** (0.054)
Prod Parent	-0.164 (0.199)	0.413** (0.168)	-0.578* (0.260)		-0.098 (0.156)	0.549** (0.279)	-0.647** (0.317)
RD Parent	0.553*** (0.065)	0.260*** (0.073)	0.293*** (0.098)		0.808*** (0.081)	0.732*** (0.115)	0.076 (0.140)
RD Abroad	1.016*** (0.195)	1.365*** (0.247)	-0.350 (0.314)		1.387*** (0.199)	1.356*** (0.416)	0.031 (0.458)
Experience	0.004 (0.002)	0.034*** (0.005)	-0.030*** (0.005)		-0.004* (0.002)	0.013* (0.007)	-0.017** (0.007)
Distance	-0.357** (0.146)	-0.080 (0.133)	-0.276 (0.197)		-0.196 (0.123)	-0.341* (0.187)	0.145 (0.222)
GDP	0.031 (0.054)	-0.086 (0.059)	0.117 (0.080)		0.111** (0.048)	0.242*** (0.072)	-0.131 (0.086)
GDP cap	0.027 (0.261)	-0.073 (0.159)	0.100 (0.305)		0.652*** (0.211)	-0.370* (0.223)	1.022*** (0.306)
IPR	0.447*** (0.163)	0.138 (0.152)	0.309 (0.223)				
Size Affiliate	0.448*** (0.045)	0.403*** (0.060)	0.045 (0.074)				
Labor intensive	0.211 (0.183)	-0.265 (0.194)	0.475* (0.267)		0.464*** (0.175)	-0.031 (0.251)	0.495 (0.304)
Scale intensive	-0.100 (0.154)	-0.172 (0.182)	0.072 (0.238)		0.285* (0.162)	-0.252 (0.262)	0.538* (0.306)
Differentiated goods	0.432*** (0.166)	0.046 (0.190)	0.385 (0.252)		0.938*** (0.171)	0.436 (0.268)	0.502 (0.316)
Science based	-0.024 (0.245)	-0.123 (0.254)	0.099 (0.353)		1.159*** (0.225)	0.816*** (0.309)	0.343 (0.380)
Lambda					1.494*** (0.177)	1.409*** (0.312)	-0.152 (0.357)
Constant	-1.336 (2.976)	2.212 (2.288)	-3.549 (3.753)		-10.230*** (2.595)	-2.700 (2.928)	-7.530* (3.899)
No. obs	1135	928			551	311	
Pseudo R2/R2	0.31	0.35			0.38	0.40	
Wald-test/F test			71.53***				2.16***

Note: Standard errors in parenthesis. *** significant at the one,** at the five and * at the ten percent level. Time and region dummies are included.

Table 3. Separate Heckman estimations for the 1970's.

Dependent	First Stage Probit				Second Stage OLS			
Variable	Pooled	MA	GI	Diff.	Pooled	MA	GI	Diff.
MA_GI	0.457*** (0.154)				0.730*** (0.210)			
Age	-0.006 (0.004)	2.30E-04 (0.008)	-0.012* (0.007)	0.013 (0.011)	-0.003 (0.006)	-0.009** (0.010)	-0.004 (0.008)	-0.005 (0.013)
Export	0.230 (0.279)	0.008 (0.494)	7.35E-04 (0.358)	0.007 (0.610)	1.502*** (0.338)	1.638*** (0.545)	1.161* (0.662)	0.478 (0.858)
Size Parent	-0.438*** (0.070)	-0.453*** (0.137)	-0.479*** (0.109)	0.026 (0.175)	-0.334*** (0.077)	-0.172 (0.127)	-0.443*** (0.109)	0.270 (0.167)
Prod Parent	0.096 (0.225)	-1.046** (0.435)	0.276 (0.286)	-1.322** (0.520)	-0.785** (0.377)	-1.460** (0.559)	-0.520 (0.510)	-0.940 (0.756)
RD Parent	0.208** (0.082)	0.574*** (0.161)	0.047 (0.102)	0.527*** (0.191)	0.316* (0.164)	0.494 (0.339)	0.269 (0.244)	0.225 (0.417)
RD Abroad	2.356*** (0.383)	3.138*** (0.673)	2.800*** (0.693)	0.339 (0.965)	2.209*** (0.548)	1.470 (0.961)	2.487*** (0.781)	-1.016 (1.237)
Experience	0.026*** (0.005)	0.002 (0.006)	0.037*** (0.007)	-0.035*** (0.010)	0.015** (0.006)	0.005 (0.010)	0.022** (0.009)	-0.017 (0.013)
Distance	0.258 (0.205)	0.432 (0.425)	0.187 (0.256)	0.245 (0.496)	-0.786*** (0.286)	-0.203 (0.483)	-0.991** (0.417)	0.788 (0.637)
GDP	-0.185 (0.089)	0.098 (0.148)	-0.309** (0.123)	0.407** (0.192)	0.174* (0.092)	0.080 (0.146)	0.190 (0.128)	-0.111 (0.194)
GDP cap	0.546* (0.290)	1.366** (0.660)	0.319 (0.326)	1.047 (0.736)	-0.886* (0.459)	-0.047 (0.915)	-1.082** (0.539)	1.035 (1.060)
IPR	0.119 (0.217)	-0.402 (0.399)	0.396 (0.287)	-0.799 (0.491)				
Size Affiliate	0.489*** (0.079)	0.646*** (0.141)	0.500*** (0.129)	0.147 (0.191)				
Labor int.	0.230 (0.260)	0.954* (0.499)	-0.041 (0.337)	0.995* (0.602)	0.880* (0.436)	0.784 (0.456)	1.068 (0.680)	0.284 (0.819)
Scale int.	0.016 (0.234)	0.224 (0.375)	-0.105 (0.292)	0.329 (0.475)	0.230 (0.378)	0.807 (0.548)	-0.073 (0.591)	0.880 (0.806)
Differentiat.	0.824*** (0.226)	1.568*** (0.405)	0.602** (0.300)	0.966* (0.503)	1.821*** (0.401)	1.641*** (0.561)	1.750*** (0.623)	-0.109 (0.839)
Science	0.516** (0.294)	0.995* (0.523)	0.432 (0.402)	0.564 (0.659)	2.183*** (0.530)	1.770*** (0.656)	2.478*** (0.927)	-0.708 (1.131)
Lambda					0.921*** (0.251)	0.652** (0.323)	1.087*** (0.360)	-0.436 (0.484)
Constant	-3.288 (3.501)	-18.249** (8.313)	2.185 (4.247)	-20.435** (9.324)	-8.378 (5.294)	-0.722 (11.694)	11.571 (5.997)	-12.293 (13.113)
No. obs	678	236	436	672	177	82	95	177
Pseudo R2/R2	0.37	0.42	0.41	0.42	0.52	0.50	0.54	0.55
Wald test/F test				55.40***				1.50*

Note: Robust standard errors in parenthesis. *** significant at the one,** at the five and * at the ten percent level. Time and region dummies are included.

Table 4. Separate Heckman estimations for the 1990's.

Dependent	First Stage Probit				Second Stage OLS			
Variable	Pooled	MA	GI	Diff.	Pooled	MA	GI	Diff.
MA_GI	0.304***				0.288***			
	(0.096)				(0.099)			
Age	-0.009**	-0.009*	-0.019***	-0.010	-0.004	-0.003	-0.008	0.005
	(0.004)	(0.005)	(0.007)	(0.009)	(0.004)	(0.004)	(0.007)	(0.008)
Export	0.413***	0.567***	0.098	0.468	0.790***	0.794***	0.913**	-0.118
	(0.142)	(0.188)	(0.238)	(0.303)	(0.152)	(0.174)	(0.352)	(0.387)
Size Parent	-0.206***	-0.187***	-0.251***	0.063	-0.077***	-0.052**	-0.123**	0.071
	(0.028)	(0.036)	(0.055)	(0.066)	(0.020)	(0.023)	(0.053)	(0.057)
Prod Parent	0.111	-0.020**	0.348	-0.368	0.335**	0.113	-0.524*	-0.411
	(0.163)	(0.235)	(0.236)	(0.333)	(0.146)	(0.163)	(0.297)	(0.334)
RD Parent	0.472***	0.573***	0.355***	0.219*	0.886***	0.911***	0.861***	0.050
	(0.057)	(0.075)	(0.105)	(0.128)	(0.067)	(0.085)	(0.123)	(0.121)
RD Abroad	1.025***	0.858***	1.217***	-0.359	1.506***	1.426***	1.348***	0.078
	(0.167)	(0.210)	(0.289)	(0.357)	(0.188)	(0.209)	(0.407)	(0.451)
Experience	0.013***	0.003	0.032***	-0.030***	1.67E-04	-0.006**	0.012	-0.017**
	(0.002)	(0.003)	(0.007)	(0.007)	(0.002)	(0.002)	(0.008)	(0.008)
Distance	-0.410***	-0.413***	-0.208	-0.205	-0.391***	-0.191	-0.257	0.065
	(0.106)	(0.159)	(0.180)	(0.240)	(0.105)	(0.130)	(0.213)	(0.247)
GDP	0.011	0.025	-0.011	0.036	0.191***	0.105**	0.342***	-0.237**
	(0.044)	(0.062)	(0.073)	(0.095)	(0.044)	(0.051)	(0.085)	(0.098)
GDP cap	0.286*	-0.102	-0.336	0.234	0.161	0.717***	-0.320*	1.037***
	(0.161)	(0.287)	(0.205)	(0.353)	(0.143)	(0.212)	(0.188)	(0.185)
IPR	0.356***	0.582***	0.175	0.407				
	(0.124)	(0.182)	(0.197)	(0.268)				
Size Affiliate	0.419***	0.430***	0.407***	0.022				
	(0.039)	(0.049)	(0.077)	(0.091)				
Labor int.	0.058	0.185	-0.333	0.517	0.296**	0.414**	-0.159	0.573*
	(0.158)	(0.210)	(0.265)	(0.337)	(0.148)	(0.188)	(0.243)	(0.305)
Scale int.	0.143	-0.151	-0.290	0.139	0.013	0.142	-0.389	0.531*
	(0.140)	(0.177)	(0.246)	(0.303)	(0.142)	(0.175)	(0.255)	(0.250)
Differentiat.	0.215	0.394**	-0.240	0.633*	0.663***	0.831***	0.001	0.830**
	(0.152)	(0.193)	(0.269)	(0.331)	(0.149)	(0.187)	(0.278)	(0.332)
Science	0.186	-0.187	-0.428	0.241	0.885***	0.979***	0.513	0.466
	(0.211)	(0.296)	(0.341)	(0.451)	(0.191)	(0.242)	(0.324)	(0.401)
Lambda					1.635***	1.593**	1.950***	-0.358
					(0.167)	(0.197)	(0.361)	(0.405)
Constant	2.784	0.193	3.093	-2.900	-7.043***	-10.971***	-7.338	-3.634
	(2.045)	(3.310)	(3.050)	(4.499)	(1932.)	(2.701)	(3.30)	(4.228)
No. obs	1385	893	436	1385	685	469	216	685
Pseudo R2/R2	0.27	0.30	0.31	0.30	0.40	0.38	0.46	0.41
Wald test/F test				77.53***				1.71**

Note: Robust standard errors in parenthesis. *** significant at the one,** at the five and * at the ten percent level. Time and region dummies are included.

Table 5. Separate Heckman estimations for the 1990's controlling RCA in RD.

	First Stage Probit			.	Second Stage OLS		
Dependent Variable	MA	GI	Difference		MA	GI	Difference
Age	-0.005 (0.007)	-0.017** (0.008)	0.012 (0.011)		0.001 (0.005)	-0.008 (0.009)	0.010 (0.010)
Export	0.437* (0.260)	0.0146 (0.339)	0.291 (0.427)		0.789*** (0.253)	0.445 (0.508)	0.343 (0.554)
Size Parent	-0.159*** (0.046)	-0.290*** (0.074)	0.131 (0.087)		-0.012 (0.031)	-0.152** (0.070)	0.139* (0.075)
Prod Parent	-0.143 (0.287)	0.545 (0.341)	-0.687 (0.446)		0.287 (0.232)	0.768* (0.400)	-0.481 (0.452)
RD Parent	0.658*** (0.108)	0.487*** (0.129)	0.171 (0.168)		0.919*** (0.128)	1.016*** (0.159)	-0.096 (0.201)
RD Abroad	0.980*** (0.273)	1.269*** (0.383)	-0.289 (0.470)		1.479*** (0.278)	1.798*** (0.476)	-0.320 (0.540)
Experience	0.001 (0.003)	0.026*** (0.007)	-0.026*** (0.007)		-0.006** (0.003)	0.008 (0.009)	-0.014 (0.009)
Distance	-0.198 (0.312)	-0.442 (0.413)	-0.244 (0.517)		-0.123 (0.275)	-0.106 (0.472)	-0.016 (0.534)
GDP	0.014 (0.124)	-0.012 (0.157)	0.026 (0.201)		0.111 (0.125)	0.204 (0.177)	-0.093 (0.212)
GDP cap	0.449 (0.553)	-1.151 (0.844)	1.600 (1.008)		0.993** (0.444)	-0.267 (0.846)	1.260 (0.934)
IPR	0.635** (0.261)	0.303 (0.293)	0.332 (0.392)				
RCA	0.089*** (0.030)	-0.005 (0.005)	0.095*** (0.030)		0.006** (0.003)	-0.002 (0.112)	0.007 (0.012)
Size Affiliate	0.412*** (0.058)	0.420*** (0.106)	-0.008 (0.121)				
Labor intensive	0.288 (0.269)	-0.484 (0.323)	0.772* (0.420)		0.166 (0.261)	-0.208 (0.264)	0.374 (0.367)
Scale intensive	-0.004 (0.227)	-0.433 (0.314)	0.429 (0.387)		0.113 (0.242)	-0.655 (0.296)	0.543 (0.377)
Differentiated goods	0.469** (0.237)	-0.400 (0.325)	0.870** (0.403)		0.431* (0.256)	-0.332 (0.296)	0.743* (0.387)
Science based	-0.102 (0.379	-0.527 (0.446)	0.425 (0.585)		0.748** (0.320)	0.219 (0.364)	0.529 (0.479)
Lambda					1.560*** (0.252)	1.797*** (0.409)	-0.237 (0.470)
Constant	-6.788 (5.902)	12.270 (9.091)	-19.058* (10.829)		-14.807*** (4.954)	-5.594 (9.277)	-9.540 (10.293)
No. obs	556	276			298	133	
R2/Pseudo R2	0.27	0.30			0.38	0.50	
Wald-test/F-test			40.79***				1.47*

Note: Standard errors in parenthesis. *** significant at the one,** at the five and * at the ten percent level. Time and region dummies are included.

Table 6. Biprobit estimations.

Dependent	First Stage Biprobit		Second Stage OLS		
Variable	MA_G1	RD	MA	GI	Diff
Age	-0.135***	-0.051	-0.039	0.263	-0.302
	(0.034)	(0.035)	(0.044)	(0.232)	(0.193)
Export	-0.184	0.519***	0.561**	0.336	0.236
	(0.212)	(0.193)	(0.263)	(0.635)	(0.594)
Size Parent	0.213***	-0.224***	-0.066	-0.439	0.371
	(0.034)	(0.041)	(0.055)	(0.281)	(0.241)
Prod Parent	-0.809***	0.294	0.408	2.480**	-2.133**
	(0.193)	(0.203)	(0.314)	(1.005)	(0.895)
RD Parent	-0.186***	0.554***	0.801***	1.738***	-0.735*
	(0.069)	(0.072)	(0.119)	(0.482)	(0.419)
RD Abroad	0.612**	1.732***	1.980***	1.313	0.684
	(0.248)	(0.248)	(0.384)	(0.885)	(0.835)
Experience	-0.004	0.002	-0.108***	-0.007	-0.003
	(0.003)	(0.003)	(0.003)	(0.016)	(0.014)
Distance	-0.067	-0.467***	-0.235	-0.699	0.499
	(0.140)	(0.170)	(0.183)	(0.729)	(0.636)
GDP	-0.022	0.036	0.051	0.220	-0.178
	(0.059)	(0.064)	(0.070)	(0.273)	(0.238)
GDP cap	0.006	0.036	0.323	-1.062	1.236*
	(0.169)	(0.278)	(0.262)	(0.769)	(0.705)
IPR		0.318*			
		(0.185)			
Size Affiliate		0.447***			
		(0.054)			
Exchange rate	9.34e-06***				
	(2.48e-06)				
Past MA	0.019**				
	(0.010)				
Lambda MA/GI			-0.138	-2.804	
			(0.598)	(1.788)	
Lambda R&D			1.069***	0.634	
			(0.273)	(0.620)	
Constant	0.503	-0.643	-4.408***	4.750	
	(2.091)	(3.321)	(3.344)	(10.000)	
No. obs	796		241	57	298
R2			0.45	0.50	0.46
Wald test of rho=0	Prob >chi2 = 0.0006				
F test					2.60****

Note: Robust standard errors in parenthesis. *** significant at the one,** at the five and * at the ten percent level. Time-, industry and region dummies are included.