LIVE AND LET DIE:
A SURVIVAL ANALYSIS OF FOREIGN R&D UNITS IN SWEDISH MNCS

Abstract

This paper develops and tests as set of hypotheses regarding factors that influence the longevity of foreign R&D units in Swedish MNEs 1992-2012. The results obtained points to a hitherto underexplored aspect of the internationalization of R&D – the quite considerable volatility of R&D activities undertaken abroad. Over the 20 year period, 42 per cent of the R&D units had been closed down. As hypothesized, the hazard for closure declines with age and is greater for R&D units added through mergers and acquisitions than for greenfield establishments, but was smaller for strongly locally embedded units and units with R&D directed towards global markets. Contrary to expectations, the hazard of closure was greater for units strongly integrated with the rest of the MNE.

1. Introduction

Multinational enterprises (MNEs) control between one half and two thirds of the world's business research and development (R&D). A substantial share of these resources is deployed in affiliates outside their countries-of-origin (UNCTAD, 2005). This fact has attracted growing scholarly and political interest, as over time more empirical information has become available about its scope and significance.

Analyses of foreign R&D are hampered by the fact that most national statistical offices collect data only on phenomena occurring inside their respective territories. In consequence, the most comprehensive statistics on the internationalization of R&D available refer to R&D undertaken in the foreign affiliates of MNEs. Collected nationally under the auspices of the OECD, these measure R&D inputs in terms of manpower and costs (OECD 2010, 2011). Other sources include surveys undertaken by individual researchers (Ambos, 2002, 2005; Håkanson and Nobel, 1993; Pearce, 1989; von Zedtwitz and Gassmann, 2002) and analyses of patent applications which provide data not only on the name and nationality of the company filing the patent but also on the name(s) and address(es) of the inventor(s), thereby giving an indication of where the relevant development work was undertaken (Cantwell and Janne, 2000; Zander, 1994.).

Over the last few decades, these efforts have provided new and valuable aggregate information about the extent and growing significance of foreign R&D (Hall, 2011). However, on the micro level of individual R&D laboratories little systematic evidence is available. This is unfortunate, as evidence suggests that R&D activities undertaken in foreign locations may be subject to significant change and volatility, at least over the medium term. Already Ronstadt's (1977, 1978) pioneering study drew attention to the fact that, if successful, foreign R&D units tend to evolve over time. In his sample, around half of the units originally established to support technology transfer from the parent organization later engaged in generic R&D, a change associated with growth both in size and in their geographical market responsibilities. Similar evolutionary patterns have been found in subsequent studies (Asakawa, 2001; Hegde and Hicks, 2008; van Egeraat & Breathnach, 2012; von Zedtwitz, 2003; von Zedtwitz and Gassmann, 2002).

Ronstadt (1977, 1978) also noted that about a quarter of the R&D establishments in his study had not been established deliberately but were incidental consequences of mergers and acquisitions undertaken for reasons unrelated to R&D. Later studies have confirmed this pattern, with surveys indicating that a substantial proportion of foreign R&D laboratories have been added through mergers rather than set up as greenfield establishments (Håkanson & Nobel, 1993; von Zedtwitz and Gassmann, 2002). In such cases, there is a clear possibility – especially in the case of horizontal mergers between market-related-firms – that duplication of R&D competences may lead to restructuring, downsizing and closures of acquired R&D labs (Cassiman and Colombo, 2006; Cassiman, Colombo, Garrone and Veuglers, 2005; Gerybadze and Reger, 1999; von Zedtwitz and Gassmann, 2002). However, in other situations, synergetic combinations of technologies may lead the buyer invest in and expand acquired R&D capabilities (Håkanson, 1995). In either case, the consequences of foreign take-overs on indigenous R&D capabilities are often of both economic and political significance, a fact reflected in the debate regarding the desirability of such take-overs and the role of multinationals in the global economy.

Against this background, this paper develops and tests as set of hypotheses regarding factors that may influence the longevity of foreign R&D units. The analysis is based on detailed questionnaire data on a 1992 cohort of R&D establishments in major Swedish multinationals and a follow up telephone survey in 2013.With this twenty year time frame, the objective is both to descriptively analyze the medium-term evolution of the sampled R&D units and to explore to what extent their characteristics at the beginning of the period can predict the hazard of their early closure.

Drawing on the available literature, the following section outlines a set of hypotheses as to possible determinants of the longevity of foreign R&D units. Section 3 describes the sample, the nature of the data and the methodologies employed to test the hypotheses. The results of the statistical analyses are presented in section 4, followed by a summary conclusion and discussion.

2. Longevity of Foreign R&D Units

Absent dedicated studies on the longevity of foreign R&D units, the hypotheses developed in this section draw on two separate streams of literature. One of these focuses on the general effect of mergers and acquisitions on R&D in affected companies, typically in a domestic context. A second

line of relevant research identifies structural and other characteristics affecting the performance of foreign R&D units. The hypotheses outlined below are based on the assumption that (1) the determinants of the effects on R&D of mergers and acquisitions are similar in domestic and international contexts (Gugler, Mueller, Yurtoglu and Zulehner, 2003; Cassiman and Colombo, 2006) and (2) that characteristics of foreign R&D units associated with high performance are also conducive to their longevity.

2.1 Establishment mode

Most of the early evidence of the effects of mergers on R&D refers to U.S. companies (Hall, 1990; Hitt, Hoskisson, Ireland and Harrison, 1991; Hitt, Hoskisson, Johnson and Moesel, 1996). The findings, like those of Stiebale and Reize (2010) on German firms suggest that, on average, mergers and acquisitions have a negative effect on overall R&D, as measured by R&D inputs and/or patents before and after the merger, but that there are great variations between individual cases. Investigating one plausible contingency, Ahuja and Katil (2001) found for 'technological acquisitions' – "acquisitions that provide technological inputs to the acquiring firm" – a curve-linear relationship between the technological relatedness between buyers and acquired firms and subsequent innovation output, with mergers between moderately related firms performing significantly better than mergers between both highly related and strongly unrelated ones. However, Cassiman and Colombo (2006) could find no evidence of positive technological synergies in mergers between technologically complementary firms, where effects on R&D inputs, outputs and productivity were, at best, neutral. In their study, most of the effects were found to negative, especially in the case of horizontal mergers between firms active in the same markets and having overlapping R&D portfolios. In addition to the effects of rationalizations to prevent duplication of effort, the generally negative effects on R&D by mergers and acquisitions are associated also with the difficulties commonly encountered in post-merger integration (Håkanson, 1995; Birkinshaw, Bresman and Håkanson, 2000; Ernst and Vitt, 2000). As Cassiman and Colombo (2006: 160) put it: "R&D rationalization is a source of organizational turmoil leading to disruption of organizational routines, the demoralization of R&D personnel and the loss of key researchers."

Even in cases where the acquiring firm believes it to be in its best interest to close down the R&D activities in an acquired company, this is unlikely to happen immediately after the merger. Such

closures are often associated with strongly negative reactions not only from local governments, trade unions and media but can have negative effects also on the post-merger integration process involving personnel in other functions, who may see the dismantling of local R&D as a threat to the unit's competitive ness and long-term survival. A common approach is therefore to shrink local R&D capabilities in a more gradual manner, not replacing engineers who decide to seek employment elsewhere and redirecting activities towards technical support of customers and/or local manufacturing operations while scaling down generic development of new products and processes. However, in the medium to long term, it appears likely that acquired units, on average, have poorer survival chances than greenfield R&D establishments:

Hypothesis 1. The hazard of closure is higher for acquired R&D units than for greenfield R&D establishments.

2.2 R&D unit age

If successful, foreign R&D units tend over time to acquire larger mandates and enhanced technical capabilities (Ronstadt, 1978; Birkinshaw and Hood, 1998; Pearce, 1989; Håkanson and Nobel, 1993). Having overcome an initial 'liability of newness' (Stinchcombe, 1965; Freeman, Carroll and Hannan, 1983), the contributions of successful foreign R&D units are likely to become increasingly recognized, enhancing their legitimacy and political clout in the MNE. Such recognition can be expected to create certain 'inertia'; in case the unit subsequently encounters problems in meeting headquarters expectations, these are unlikely to lead to immediate closure. Recognizing the value of the unit's technical capabilities, the potential of which has been proven in the past, ways to improve its performance are likely to be attempted before an outright closure is considered.

Conversely, both newly established and recently acquired R&D units that are not seen to provide a unique contribution will face increasing difficulties to obtain sufficient budgetary and other support. In the case of greenfield establishments, such judgments will not be immediate but will have to await some reasonable build-up period; in the case of acquired units, decisions may be tempered by political and other considerations already discussed. In either case, however, such units are unlikely to become very old.

Hypothesis 2. The hazard of closure declines with the age of a foreign R&D unit.

2.3 Integration

However, in order to obtain recognition for innovativeness and technical excellence (Andersson and Forsgren, 2000), a foreign R&D unit must also be integrated into the MNE organization (Denrell, Arvidsson and Zander, 2004; Monteiro, Arvidsson and Birkinshaw, 2008; Håkanson and Nobel, 2001; Tallman and Chacar, 2011) and attain the 'attention' of headquarters managers (Bouquet & Birkinshaw, 2008; Ambos and Birkinshaw, 2010). Foreign subsidiaries and R&D units that are isolated from the corporate network will find it difficult both to provide technological inputs to other units and to profit from technological advances obtained elsewhere in the group. This will make it more difficult for them to contribute to the MNEs overall technological competitiveness and to obtain recognition for both potential and actual such contributions. In consequence, they may be viewed as 'expendable' by headquarters managers, making them vulnerable to closure, especially in times of low profitability when cost savings are implemented.

Hypotheses 3. The hazard of closure declines with the foreign R&D unit's degree of integration with the rest of the MNE.

2.4 Local embeddedness

There is a broad consensus in the literature that a foreign subsidiary's 'local embeddedness' – the quality and intensity of its interaction within local networks of customers, suppliers, competitors and other relevant organizations – is of prime importance for its performance and significance within the MNE – especially in terms of R&D and technical development (Ambos, 2005; Anderssson, Forsgren and Pedersen, 2001; Andersson, Forsgren and Holm, 2001; Gassler and Nones 2008; Kramer and Revilla Diez 2012; Meyer, Mudambi and Narula, 2011; Song, Asakawa and Chu, 2011; Yamin and Andersson, 2011). For a foreign R&D unit, strong and frequent contacts with local partners can provide both access to new technical knowledge, for example in cooperative projects with local universities or local suppliers, and valuable insights into evolving customer needs and requirements.

For a newly established R&D laboratory, the creation of valuable local ties requires the creation of strong local technical capabilities and of trust – potential local partners need to be convinced both of the unit's ability to provide competent technical solutions and of its readiness to reciprocate in technical exchanges (Hofer and Håkanson, 2003). The establishment of local technical capability and

building reputation for trustworthiness take time and the local embeddedness of newly established greenfield R&D units requires investment of effort and money to establish. In acquired R&D units that may have been locally well embedded before the ownership change, initial mistrust of new owners, often aggravated by the loss personnel, re-establishment of trust and re-building of local ties involve similar challenges and investments (Håkanson and Nobel, 2001).

A locally well-connected R&D unit therefore represents a valuable asset, sometimes one that it has taken many years to set up. Both in view of its potential value and of the sunk costs that has gone into its establishment, locally well embedded R&D units appear less likely to be closed down than ones that focus on internal technical service and support.

Hypotheses 4. The hazard of closure declines with the foreign R&D unit's degree of local embeddedness.

2.5 Development mandate

Although they often evolve over time, the missions and capabilities of foreign R&D units vary (Behrman and Fischer, 1980; Chiesa, 1996; Håkanson and Nobel, 1993; Kuemmerle, 1999; Pearce, 1990; Ronstadt, 1978). These range from, one the one extreme, small R&D teams performing technical service to local manufacturing operations and minor adaptations of parent company technology to local customer requirements to, on the other, large R&D departments entrusted with research and development for new products and processes for worldwide markets.

Technical support units may be in possession of detailed knowledge about the eccentricities of individual customers and markets, but technical adaptation of products and processes is often a rather 'routine' task that can be undertaken without the benefit of physical proximity and close interaction. Such units may therefore be liable to closure when MNEs consolidate and rationalize their international R&D operations in order to reduce coordination costs and avoid redundancies (Gerybadze and Reger, 1999). In contrast, R&D laboratories engaged in generic research and product development for global markets often possess technical capabilities that are unique to the group and difficult to replicate or replace. They are therefore likely to have good survival chances also in times of rationalization and consolidation; in fact, some may as a consequence of such consolidation be granted extended mandates and additional resources (Birkinshaw and Hood, 1998).

Hypotheses 5. The hazard of closure declines with the relative importance of the foreign R&D units' work that is directed at global markets.

2.6 Autonomy

Foreign R&D units' relative autonomy is related to the proximity of their technologies to those of the parent corporation. Foreign R&D units that enjoy a high degree of autonomy can develop technological capabilities independently of those pursued at headquarters or elsewhere in the group (Asakawa, 2001; Cantwell and Mudambi, 2005; Mudambi, Mudambi and Navarra, 2007). For entrepreneurial managers active in technologically demanding markets, this may present an opportunity to develop products and technical solutions that are unique to the group and that may be possible to exploit internationally (Blomkvist, Kappen and Zander, 2012). Successful such initiatives create novel and valuable technological capabilities not available elsewhere in the group. This is likely to strengthen their autonomy both because of the difficulty of making decisions from afar in areas with which headquarters managers are unfamiliar and because there will be less perceived need for coordination and control.

Conversely, when the technologies of the parent company and those of the foreign unit overlap or are closely related, there is usually a higher need for coordination and control in order to exploit synergies and avoid wasteful duplication of effort. Moreover, because of the understanding at headquarters of the technologies in question, central managers will feel more confident in taking decisions regarding activities in the foreign unit, reducing its autonomy. This, in turn, makes it less likely that the unit will develop new and unique technological capabilities and increases the likelihood that its activities be transferred to larger units in order to reap scale benefits and reduce coordination costs (Mudambi, 2011).

Hypotheses 6. The hazard of closure declines with the foreign R&D units' relative decision-making autonomy.

3. Method

3.1 Sample

The empirical analysis is based on a sample of 75 foreign R&D units, responding to a 1992 questionnaire survey directed to 20 of Sweden's at the time largest MNEs. At the time, these together

accounted for about three quarters of all industrial R&D in Sweden and an even higher proportion of R&D performed outside the country by Swedish firms (Håkanson and Nobel, 1993). Analyses of the survey data, including data on 35 domestic R&D units, have been reported by Nobel and Birkinshaw (1998), Birkinshaw, Nobel and Ridderstråle (2002). Håkanson and Nobel (2000, 2001), likewise utilized the questionnaire data, but like the present one, their analyses only concerned the foreign units in the original sample. In adherence to good scientific practice, the reported results – like those of Håkanson and Nobel – are based on a data file that has been proof read against the actual questionnaires, excludes items with minimal response rates, and respects the anonymity promised the respondents.

3.2 Measuring survival

The basis for the present paper is a 2012 follow-up to the original questionnaire, with the aim to determine which of the original units were still operative after 20 years and, when this was not the case, in what year they had been shut down. The follow-up was conducted through a combination of telephone interviews and e-mail correspondence, partly with the corporate communications departments of the companies concerned, partly in direct contact the units in question. Of course, in the two decades since the original questionnaire a number of ownership and organizational changes had taken place, but with the help of Internet research, it was possible to establish the fate of all but one of the 75 units in the original sample (the variable STATUS = 1 for units still alive in 2012, 0 for closed units). (For one closed R&D unit it proved impossible to establish the year of its termination.)

The remaining 74 units provide the observations for the analysis. Of these, only 43 (58 %) were still operative in 2012; the remainder had been closed down. As indicated in Figure 1, the survival rates of acquired and greenfield establishments are parallel for about the first ten years after the original survey; thereafter, acquired units display a somewhat higher hazard of being closed down. (The difference between the survival curves are statistically significant, but not strongly so.) While providing partial support for Hypothesis 1, the shape of the survival curves suggest that, perhaps for the 'political' reasons suggested above, acquired R&D units tended – at least in Swedish MNEs in this period – to be retained for a relatively long time, also in cases where they were finally disbanded.

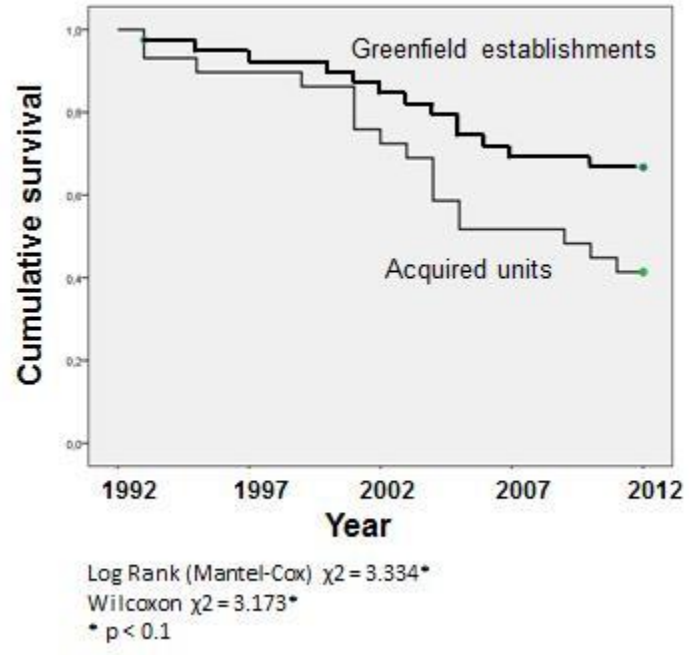

Figure 1

Survival curves for greenfield and acquired foreign R&D units (n=74)

3.3 Independent variables

Establishment mode. The information on establishment mode (MODE) comes from the original questionnaire. It enters here as a dichotomous variable taking the value '1' for R&D establishments that were added to the MNE through acquisitions, '0' for units that were added as greenfield operations.

R&D unit age. The age of the R&D units (R&D AGE) is calculated from the year of their establishment or acquisition until the year of their closure or, in the case of surviving units, in 2012.

Integration. Following Håkanson and Nobel (2001), the organizational integration of the foreign R&D units (INTEGRATION) is measured through the intensity of personal interaction with the rest of the group in 1992. The measure is based on the average of the standardized frequencies of face-to-face contacts with other R&D units (Table 1). A Cronbach's alpha of .805 supports the reliability of the index.

Table 1

INTEGRATION: Intra-group personal contacts

Number of Swedish nationals employed by R&D unit
Number of R&D personnel taking part in company rotation programs
Number of R&D personnel taking part in company training programs
Yearly number of visits to other company R&D units
Yearly number of visits from other company R&D units

Cronbach's alpha: 0.805

Local embeddedness. As in Håkanson and Nobel (2001), the level of local embeddedness (EMBEDDENESS) was measured by a composite index, calculated as the average of the standardized frequencies of (1) personal, face-to-face meetings, (2) other types of contacts, and (3) the number of on-going cooperative projects with local partners (local universities, local customers and local suppliers, respectively) (Table 2). The Cronbach's alpha of .721 is within the generally recommended range.

Table 2

EMBEDDEDNESS: Frequency of contacts and number of cooperative projects with local partners

(1) Frequency of face-to-face contacts
(2) Frequency of other types of contacts (letter, phone, data link, etc.)
(3) Number of ongoing cooperative projects
with:
Local universities and research institutions
Customers in local market
Suppliers in local market

Cronbach's alpha: 0.721 (9 items)

Global development. The degree to which foreign units engaged in development aimed for global markets – as opposed to adaptation of products and processes to local conditions – was measured by questionnaire respondents' estimates of the proportion of the R&D effort that had global relevance (GLOBAL R&D). Around one fifth of the respondents reported that less than ten per cent of their R&D effort in 1992 was directed towards global markets, about one third that more than 90 per cent was, with the remaining half indicating percentages in between these extremes.

Autonomy. R&D units' decision-making autonomy (AUTONOMY) was measured utilizing a scale originally developed by Hedlund (1980), asking respondents about the influence of the local subsidiary on decisions regarding five key R&D-related areas (Table 3). Cronbach's alpha of .855 indicates a high degree of reliability.

Table 3

AUTONOMY: Average degree of autonomy in key decision areas

The R&D budget

The overall direction of the R&D unit's efforts

Which new R&D projects to pursue

Cooperation with other R&D units in the company

Scale:

(1) Decided by HQ or division

(2) Decided by HQ or division after consultation with subsidiary

(3) Decided by subsidiary, but subject to approval by HQ/division

(4) Decided by subsidiary, after consultation with HQ/division

(5) Decided independently by subsidiary

Cronbach's alpha: 0.863 (6 items)

3.4 Analytical model

The hypothesized influences of the longevity of foreign R&D units were tested by means of event history analysis, examining the effect of a set of the independent variables on the conditional

probability (hazard rate) that a specific unit be closed down (Kleinbaum and Klein, 2005). The hazard rate of being closed down at time *t*, is defined as:

$$h(t\ \ \boldsymbol{X}) = \lim_{\Delta t \to 0} \left(\frac{P(t \leq T < t + \Delta t \mid T \geq t}{\Delta t} \right) \quad (1)$$

where *h* is the conditional probability that a unit will exit in the time period between *t* and *t+Δt*, given that that the survival time is greater than *t* (and the unit therefore at risk at time t), and **X** is a set of covariates (independent variables) in the estimation. Time is measured in years after 1992 and R&D units are considered to be at risk in each time period until closed down or the observations are censored in 2012.

The hazard rates were estimated using the Cox proportional hazards model, a robust semi-parametric model; based on the observed order of events, it has the advantage that it requires no assumption as to the shape of the baseline hazard rate and the distribution of the outcome variable (time to event). However, on evaluation, one of the covariates, R&D AGE, was found to be time-dependent and not meet the proportional hazards assumption[1]. The hypotheses were therefore tested by means of an extended Cox model, including an interaction term, T_COV, the product of time and R&D AGE (Kleinbaum and Klein, 2005).

4. Results

Descriptive statistics of the variables employed are presented in Table 4. Of the R&D units in the original sample 58 per cent were still alive and enter the analysis as censored observations (STATUS = 1 for units still in existence in 2012, 0 for units that were closed down during the study period). About 40 per cent of the units in the sample had been added as a consequence of mergers and acquisitions (MODE = 1 for acquired units, 0 for greenfield establishments). The correlations between the variables are low and do not indicate problems of collinearity.

Table 4

[1] The proportional hazard assumption was tested by computing the correlations between time and the Schoenfeld residuals for the covariates (the value for each covariate at closure minus its average value for all units at risk at that time). With the exception of *R&D unit* age, the correlations were not significant.

Descriptives and correlations

Variable name	Mean	S.D.	1	2	3	4	5	6	7
1 Status (0, 1)	.58	--	--						
2 Mode (0,1)	.41	--	-.223	--					
3 R&D age	28.3	14.58	.286*	-.145	--				
4 Integration	.000	.749	-.092	-.373**	.112	--			
5 Embeddedness	.000	.707	.189	.230*	.167	.123	--		
6 Global R&D	50.3	39.35	.176	-.268*	-.026	.175	-0.35	--	
7 Autonomy	3.6	.939	.184	.305**	.119	-.256*	.045	-.161	--

* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$
Two-tailed significance tests.

The hypotheses are tested in the Cox regression reported in Table 5. In interpreting the results, it is important to remember that over the 20 year period, the MNEs in the original sample have evolved not only through organic growth (and, in some cases decline) but also through mergers, acquisitions and divestments. These changes, which in some cases have been quite considerable, are not captured by the research design, although they help to explain the quite considerable 'churn' of foreign R&D units observed. The hypotheses tested focuses on individual R&D units and their 'resilience' towards external changes. Clearly, these (unobserved) external changes will have affected some of the units in the sample more directly than others. Unfortunately, the number of observations did not permit dummy control variables for individual MNEs, a way to capture at least some of these effects. Since this was not possible, the model estimates are biased against their true effects, thereby strengthening the confidence in the significance of the statistical results obtained. In spite of this bias, the regression estimates support four of the six hypotheses.

As expected, the hazard of closure is higher for R&D units added through mergers and acquisitions than for laboratories set up in existing subsidiaries (greenfield establishments). The finding adds to the evidence already cited that mergers and acquisitions tend to negatively affect R&D and innovation in acquired companies. In an international context, of course, this takes on additional

political significance, suggesting that host country governments may in some circumstances be well advised to restrict foreign acquisitions of domestic R&D performers by foreign multinationals, a famously contentious issue in regard to host country effects of foreign direct investment. In cases where this is not possible or desirable, host governments should encourage and facilitate entrepreneurship and new firm formation based on the talent, skills and knowledge of disgruntled or laid-off R&D engineers.

Table 5

Cox regression of foreign R&D unit closure 1992-2012

Variables	
Mode (greenfield=0, acquired =1)	.939** (.480)
R&D age	-.191*** (.057)
T_COV (time * R&D age)	.012*** (.004)
Integration	.564** (.265)
Embeddedness	-.761* (.463)
Global R&D	-.010** (.005)
Autonomy	-.298 (200)
-2 Log likelihood χ^2	217.991 24.935***

* p < 0.1; ** p < 0.05; *** p < 0.01
Two-tailed significance tests.
Standard errors in parenthesis.

In line with Hypothesis 2, the hazard of closure declines with the age of a foreign R&D unit, supporting the expectation that over time R&D units tend to accumulate both valuable technical capabilities and political 'clout' within the organization. Interestingly, the positive effect of age on survival tends to decline over time (as indicated by the coefficient for the interaction term T_COV). This probably reflects the phenomenon, already commented on, that the relatively higher hazard of closure for acquired R&D units seems to set in only after almost ten years[2].

Contrary to expectations, the findings indicate that an R&D unit's degree of integration with the rest of the group tends to significantly *increase* the hazard of closure. The results is surprising and stands in opposition to much of the literature on the topic, which tends to emphasize that integration between headquarters helps to facilitate both the detection of opportunities for valuable 'reverse technology transfer' and the implementation of such transfer, both factors that could be expected to enhance the perceived value of the R&D undertaken in the foreign subsidiary.

Two complementary observations offer potential explanations. First, along the lines of Granovetter's (1973) classical argument, foreign R&D units that are too closely integrated with the rest of the MNE are likely to possess technological capabilities and pursue technological opportunities similar to that of the parent and sister subsidiaries. This redundancy diminishes the probability that they provide radically new innovative products and processes (Ambos and Reitsperger, 2004; Mudambi, 2011) – ideas for such breakthroughs being more likely from units with R&D capabilities less similar to that of the rest of the group. Second, headquarters managers' knowledge about the R&D activities in closely integrated units is likely to be better, making it easier to detect and close down redundant laboratories to avoid potential duplication of effort.

Although not strongly significant, the regression results support the hypothesis that local embeddedness diminishes the hazard of early closure. To the extent that embeddedness is associated with access to unique local knowledge, such as customer problems of relevance to large markets or technologically leading local suppliers, whose advances can be incorporated into new designs or process improvements, the explanation parallels that advanced regarding 'integration'. By means of such access, foreign R&D units can provide unique and difficult to replace technological capabilities

[2] The supposition is supported by the fact that in Cox regressions computed separately for acquired and greenfield units (not here reported), the interaction variable is significant only for the former.

which will enhance their value and survival probabilities as the structure and strategy of the MNE evolves (Meyer, et al., 2011).

This interpretation is in line with the support obtained for Hypothesis 5. The hazard of closure diminishes with the share of the foreign R&D unit's activities that is of relevance for global markets. By implication, R&D units primarily devoted to serving the needs of local customers and manufacturing operations are more liable to be closed down. The finding suggests that, over time, the perceived value of R&D units focusing on the adaptation of products and processes tends to decline. There are several potential explanations. Whether correctly or not, headquarters R&D may perceive local adaptations as less important or of a nature that can more efficiently be performed centrally. In other cases, the size of the local market may be considered too small to warrant local adaptations, perhaps because with 'globalization' the nature of demand has tended to become more homogenous across countries.

The regression provides no support for Hypothesis 6. The hazard of closure does not significantly decline with the foreign R&D unit's decision-making autonomy. The corresponding coefficient is in the expected direction but does not reach statistical significance. This is somewhat surprising, especially in view of the (unexpected) finding that less well integrated units seem to have better survival chances than more closely integrated ones. Perhaps as a result of the rather small number of observations and the limited power of the test, the analysis is inconclusive in regard to the role of autonomy – an issue worthy of further research, also because the relationship is likely to depend on a complex array of contingencies that are currently not well understood.

5. Conclusions

The results obtained points to a hitherto underexplored aspect of the internationalization of R&D – the quite considerable volatility of R&D activities undertaken abroad. As already emphasized, the development of the R&D units in the sample over the 20 year period examined takes place against an unobserved background of structural and strategic changes, changes in ownership and technological developments, and a myriad of other aspects in the wake of 'globalization'. In view of these changes, the observed 'churn' in foreign R&D should come as no surprise – but it is an aspect of international R&D management that has attracted very little, if any, attention in the literature. For MNE managers,

the turnover in R&D establishment raises the question of how to 'phase out' foreign R&D activities in a way that minimizes loss of valuable technical capabilities, potential disruption among foreign subsidiary employees and potential reputational damages. In spite of the negative connotations attached it, the problem of 'how to best close down a foreign R&D unit' is a topic well worthy of study.

From the point of view of government policy, the results confirm that concerns regarding the effects on local R&D and technical development by foreign take-overs may often be warranted. However, on the basis of the limited evidence presented here, the implications are far from obvious. The negative effects associated with the loss of employment opportunities for skilled R&D engineers may well be compensated for by benefits, for example, in terms of improved efficiency and competitiveness of acquired firms. Perhaps a more far-sighted policy-response would be to secure fruitful alternative employment of R&D personnel and other resources made redundant. Since closures of acquired R&D units do not often occur immediately following an acquisition, implementation of such policies would require a (possibly unrealistic) longer time perspective than is common. In either case, research on the micro-level effects on the mobility of local R&D personnel induced by foreign acquisitions presents an attractive starting point to shed more light on these processes

The findings also sow doubt as to the realism of notions of the MNE that emphasize the role of foreign subsidiaries as important innovators and contributors of new knowledge, and depict MNE headquarters as benign orchestrators of world-wide innovation and knowledge diffusion. They simultaneously question the validity of popular conceptualizations of the MNE that see the allocation of R&D and other strategic resources as the outcome of political power games, largely devoid of economic rationality. Both views tend to ignore the dynamic aspects of MNE evolution in favor of overly static analyses of cross-sectional observations. Although not easily compatible with the short-sighted preferences of most funding agencies and the emphasis on rapid top tier journal publications that increasingly governs academic career patterns, detailed longitudinal studies are needed in order to advance our understanding of the managerial challenges facing modern day MNEs and to provide recommendations as to appropriate policy responses, especially in regard to R&D, innovation and technical development, areas where MNEs have come to play increasingly dominant roles.

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