Foreign acquisition and plant survival

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Abstract

This paper analyses the effect of foreign acquisition on the survival probability using plant level data on the Swedish manufacturing industries during the period 1993-2002. The results, controlling for possible endogeneity of the acquisition dummy using an IV and propensity score matching approach, and also controlling for plant productivity and other plant and firm specific characteristics, suggest that acquisition by foreign owners increases the lifetime of the acquired plants by 15-20 percent as compared to non-acquired plants. An improvement as compared to previous studies is that we are able to separate the targeted plants into plants within Swedish MNEs, within Swedish exporting non-MNEs, and purely domestic firms before foreign takeover. The result indicates that plants of targeted Swedish exporting non-MNE have higher survival rates than non-acquired plants. However, plants of targeted Swedish MNEs and of purely domestic firms do not experience such positive survival effects.

JEL Classification: F23, L23

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1. Introduction

Foreign direct investment (FDI) is one of the main aspects of current day globalization. The total volume of FDI world-wide has increased tremendously in the last two decades. UNCTAD (2007) shows that, in 2006, total FDI flows amounted to 1.3 trillion USD, contributing to a total world-wide FDI stock of roughly 12 trillion USD – equivalent to about 25 percent of world GDP. At the same time it is well known that the majority of FDI flows are due to international mergers and acquisitions (M&A) rather than setting up new projects abroad (greenfield). Again, UNCTAD (2007) shows that in 2006 the total value of world-wide cross-border M&As was roughly 0.9 trillion USD, amounting to about 70 percent of total FDI flows (in 2005, this figure was even higher at about 76 percent).[1]

These trends have brought international mergers into the academic debate, with recent literature attempting to model these activities theoretically and providing empirical evidence on their determinants (e.g., DiGiovanni, 2005, Neary, 2007, Hijzen et al., 2008, Head and Ries, 2008). Moreover, the growing importance of M&As has given rise to policy concerns as to the impact of such cross-border mergers for domestic economies. From the point of view of the host country, a potential downside is that a foreign multinational acquiring a domestic firm may reduce employment post acquisition or even shut down the plant or part thereof completely.[2] On the positive side, however, a foreign acquisition may bring new technology and market access opportunities and, thus, strengthen the overall competitiveness and survival prospects of the takeover target.

In this paper we study in detail the implications of foreign acquisitions for the survival prospects of the target plants. We focus on such adjustment along the extensive margin as plant closures are an important aspect of industry dynamics, shaping industry productivity and forming the competitive landscape in an economy.[3] We use recent unique detailed plant level data (which also provide some information at the firm level) for Sweden to investigate survival probabilities in the context of a hazard model. We take particular account of the

[1] Striclty speaking the UNCTAD data on FDI and M&A are not fully comparable as they come from different sources. Still, they give a good indication of the importance of M&A.

[2] Recall, for example, the public debate surounding the Vodafone takeover of the German company Mannesmann in 1999 / 2000: http://www.eurofound.europa.eu/eiro/1999/11/feature/de9911220f.htm (accessed on 7 August 2008).

[3] It is also one aspect of plant outcomes that is still underresearched. By contrast, productivity, employment and wage effects of foreign acquisitions have received far higher attention in the literature. See, for example, papers by Almeida (2007), Girma and Görg (2007), Conyon et al. (2002), Harris and Robinson (2002).

potential endogeneity of the acquisition decision (for example due to "cherry picking") by implementing an instrumental variables approach. Furthermore, we check the robustness of the IV estimation with an estimation on a matched sample of firms based on propensity score matching.

Sweden is an interesting case to analyze in this context. Over the last two decades Sweden has introduced a considerable amount of liberalization reforms in order to promote foreign ownership. However, it was not until 1995, that in connection with Swedish membership in the European Union (EU) the business climate improved considerably and Swedish firms became to be more attractive targets to foreign investors. Ever since then, Sweden has witnessed a rapid increase of inward FDI, mainly through mergers and acquisitions. Well-known former Swedish owned multinational enterprises, such as Astra, Pharmacia, Volvo Car and Saab Automobile, changed ownership in the 1990s and are nowadays foreign owned. At the beginning of the 2000s, the employment share in foreign owned firms in manufacturing was among the highest in OECD.[4]

The increase in foreign ownership has given rise to mixed feelings in the Swedish public debate with growing concerns about the security of plants after the takeover and, ultimately, employment. Conceptually, a plant acquired by a foreign owner may experience a reduction or an increase in its survival probabilities. As to the former, it is frequently argued that multinationals are more "footloose" than domestic firms (e.g., Flamm, 1984), owing to their possibilities of relocating production and employment among their affiliates in different countries and, hence, their ability to respond more quickly to adverse shocks than domestic firms. It may also be the case that the foreign acquisition is used as a device to eliminate competition by taking over a rival and closing it down afterwards. However, foreign acquisition can improve the survival prospects of the target if it transfers technology, know-how or skills to the acquired firm and, hence, contributes to an improvement in the target's performance (e.g., Conyon et al., 2002).

The empirical evidence on the impact of foreign acquisitions on survival probabilities is rather limited. A few studies, e.g. Bernard and Sjöholm (2003) for Indonesia, van Beveren (2007)

[4] As compared to 21 other OECD countries in 2002, only Ireland, Luxembourg and Hungary had larger employment shares than Sweden in foreign owned firms in manufacturing. Moreover, in the service sector, where the prevalence of foreign ownership is generally lower than in manufacturing, the employment share in foreign owned firms is high in Sweden (Hansson et.al. 2007).

for Belgium and Bandick (2007) have analyzed differences in survival rates between foreign-owned and domestic plants (the latter two papers distinguishing domestic multinationals from purely domestic plants).[5] These studies indicate that the probability of shutdown is larger for plants that are part of a multinational, at least when controlling for other factors related to plant survival. As to studying the effect of a foreign acquisition on survival, one of the few papers to have looked at this is Girma and Görg (2004). They find evidence that foreign acquisition reduces the lifetime of acquired UK plants in electronics and food industries.[6]

We extend and improve upon these earlier papers in a number of ways. First, we focus on acquisitions by foreign multinationals and use econometric approaches to be able to identify the causal effect of takeovers on the exit probability of a plant. Second, using the detailed and unique data for Sweden we are able to link our empirical work to the recent literature on firm heterogeneity in international trade (e.g., Helpman et al., 2004). Specifically, we are able to categorize all domestic firms into being (i) a domestic multinational with affiliates abroad, (ii) a domestic exporter and (iii) a purely domestic firm. Theoretical heterogeneous firm models would predict that these types of plants are intrinsically different. We therefore analyse whether the extent of global engagement of the plant (multinational, exporting, none) impacts on plant survival through mediating the impact a foreign acquisition has on the target.

The quality of our data also allows further novelties in our research design. The data combines plant level with firm level information and is therefore able to control for the role of firm attributes for plant survival. Bernard and Jensen (2007) is one of the few other papers in the literature that are able to do so. Moreover, unlike some of the former studies, our data allows us to be confident that we observe true exits; these are not due to plants disappearing from the data due to mergers and acquisitions or because they drop in size below a certain cut-off level.[7]

To preview our results, we find, after controlling for the possible endogeneity of the acquisition dummy by using a matched sample of firms and instrumental variable and also controlling for plant productivity and other plant and firm specific characteristics, that plants

[5] Bernard and Jensen (2007) focus on differences in plant survival rates in US manufacturing between plants within domestic US multinationals and other plants.
[6] Bernard and Jensen (2007) look at the effect of acquisition on plant exit, but do not distinguish the takeover by a foreign firm.
[7] The former is a potential issue in Mata and Portugal (2002), while the latter problem potentially affects the study by Van Beveren (2007).

of acquired firms have 15-20 percent higher chances to survive as compared to plants of non-acquired firms. Moreover, the effect of foreign acquisition differs for targets that are domestic multinationals, exporters, or purely domestic, suggesting that there is heterogeneity in plants along the dimension of global engagement.

The remainder of the paper is structured as follows. Section 2 presents the data and illustrates the increased importance of foreign ownership in Swedish manufacturing in the 1990s. Section 3 discusses the analytical framework and section 4 presents the results of the analysis. Section 5 summarizes and concludes.

2. Foreign ownership, acquisitions and survival in Sweden

In this section we provide a first overview of foreign ownership and plant survival in Sweden. The data used in this paper are uniquely assembled and combine data from Statistic Sweden (SCB) and the Swedish Institute for Growth Policy Studies (ITPS). The data consist of three register-based datasets where information at the plant and firm-level are linked together by a unique identification code. Our period of observation covers 1993 to 2002.

Statistics Sweden provided two datasets, the Regional Labor Market Statistics (RAMS) and Financial Statistics (FC). The former contains information at the plant-level *for the population of manufacturing plants* on variables such as total employment, the number of employees with post-secondary education, and age of the plant.[8] Each plant is identified by a unique plant identifier. The appearance of a new identification number indicates necessarily that a new plant has entered, the disappearance of a previous number means that this plant has exited. If the number remains unchanged in subsequent years the plant has survived. Furthermore, RAMS reports firm and industry codes for each plant.

The firm code attached to each plant enables us to match data from Financial Statistics (FC) including information at the firm-level such as labour productivity, capital-labour ratio, exports, whether a firm is multi- or single-plant, and ownership status (foreign or domestic). Using this data we define a foreign acquisition as a change in the ownership indicator from

[8] We have access to plant-level data from 1986 onwards. For plants entering after 1986 we are able to calculate the exact plant age, while older plants are improperly assigned to enter in 1986.

domestic to foreign.[9] The firm-level variables are available from the year 1993 and onwards only for larger firms, i.e. firms with 50 employees and more.

The database provided by ITPS is a register of all Swedish firms that are multinational enterprises (MNE).[10] By merging the three databases using the firm identifier of plants, we can assign the firm level information to the plant level data. In that way we can also separate plants into plants within foreign MNEs, plants part of a Swedish MNE, plants part of an exporting (non-MNE) firm and plants that operate purely domestically. A Swedish MNE is defined as a domestically owned firm which is part of an enterprise group with affiliates abroad. In foreign-owned firms, foreigners possess more than 50 percent of the voting rights.

The clear distinction into different types of MNEs and exporting activities is a distinct advantage of our data over the previous literature. This is an important dimension to the analysis since the prospect of surviving may differ between ownership structures due to their ex-ante different characteristics as highlighted by, for example, Helpman et al. (2004). Moreover, with our data we can be confident, given that it covers the whole population of plants, that we observe true exits and do not confound them with (i) disappearance of a plant code due to mergers & acquisitions, or (ii) a plant dropping out of a sample due to size thresholds for inclusion in the sample.[11] These are problems that have plagued much of the previous literature (e.g., Mata and Portugal, 2002, Van Beveren, 2007). Furthermore, our data covers the 1990s and early 2000s, which is a particularly interesting period to study given recent increases in international merger activity.

In the 1990s, foreign direct investment in form of mergers and acquisitions increased substantially worldwide since many countries abolished or reduced their restrictions for foreigners to buy indigenous firms (Golub, 2003). During this period, Sweden also introduced a considerable amount of liberalization reforms in order to promote foreign ownership. As a result foreign ownership increased rapidly and the trend seems to have been

[9] Plants within firms that switch between domestic and foreign ownership more than once over the period are not included in the sample. Also, plants in firms that disappear from the sample one year and reappear in later years are also excluded.

[10] The first year we can distinguish Swedish MNEs from non-MNEs is 1993 and explains why our analysis begins in 1993.

[11] Our data, due to the restrictions of the FC database, only include firms with 50 employees or more. However, since we use plant-level data for the population of plants from RAMS we still can observe all the plants that are within a firm, even if that firm drops below the threshold size value. Hence, contrary to some papers in the literature, we do not mix sample exit with true exit.

more pronounced in Sweden than in other OECD countries.[12] *Table 1* shows that in the 1990s, the employment share in plants within foreign MNEs increased by almost 27 percentage points. This trend seems to have evolved at the expense of Swedish MNEs whose employment share dropped by 21 percentage points. The table also shows that over the period 1993 to 2002, the share of plants within foreign MNEs increased from 26 percent to 41 percent, whereas the share of plants within Swedish MNEs has fallen by almost 7 percentage points. The employment and plant shares for Swedish exporters remained fairly constant over the period, however.

Table 1 here

During the 1990s several large Swedish multinationals have become foreign-owned due to acquisitions by foreign MNEs, e.g. Pharmacia and Upjohn 1995, Saab Automobile and General Motors 1998, Astra and Zeneca 1999 and Ford and Volvo Car Corporation 1999. *Table 2* reports, by year, the frequencies of plant acquisitions by foreign firms. On average 33 percent of plants acquired were part of Swedish MNEs before foreign takeover, and almost 58 percent were plants of Swedish exporters. *Table 2* also shows that more than 90 percent of the employees in the takeover targets were employed in plants part of Swedish MNEs or Swedish exporters before foreign acquisition.

Table 2 here

Table 3 shows the distribution of acquisitions by plant and firm across manufacturing sectors. We can see that over the period studied, 12 percent of all manufacturing firms were acquired by foreign firms.[13] Over the same period, 7 percent of all plants were acquired. Moreover, the shares of foreign acquisitions are more pronounced in sectors with a high degree of product differentiation and high R&D intensity such as chemicals, basic metals and motor vehicles.

Table 3 here

The aim of this paper is to investigate what happened to acquired plants after acquisition in terms of their survival prospects. To get a first impression of this we compare the survival

[12] Hansson et.al. (2007) chapter 2. Other explanations put forward for the increased foreign ownership in Sweden in the 1990s are that there were more invitation to acquire Swedish firms after the EU membership, Swedish firms were cheap to buy due to the devaluation at the beginning of the 1990s and the Swedish tax system has favored foreign ownership.

[13] Recall that firm level information is only available for firms with 50 or more employees.

rates of plants within foreign acquired firms with those of non-acquired plants. To do so we calculate, separately for each type of plant, the Kaplan-Meier survival function given by

$$\hat{S}(t) = \prod_{j|t_j \le t} \left(\frac{n_j - d_j}{n_j} \right) \quad (1)$$

where *S(t)* is the probability of surviving past time *t*, n_j is the number of plants that have survived to t_j years of age and d_j is the number of plants that die at age t_j. *Table 4* shows that plants of acquired firms have higher survival ratios than plants of non-acquired firms. After five years, for instance, 51.4 percent of the plants of acquired firms survived while only 48 percent of the plants of non-acquired firms survived. However, a log-rank test does not reject the hypothesis that the survivor functions across the two groups of plants are equal.

Of course, the Kaplan-Meier survivor function only considers differences in survival unconditional on other factors. However, it is an established stylized fact that smaller and younger plants have lower probabilities of survival than larger and older plants (Geroski, 1995) and if the above cited examples are anything to go by, it is likely that takeover targets are older and larger than other plants. In this respect, *Table 5* shows that in the years before acquisition, plants within acquired firms are larger in terms of employment and are younger than plants of non-acquired firms. Moreover, the acquired firms seem to have higher skill and R&D intensity, higher labour productivity and capital-labour ratios and are more export intensive than non-acquired firms in the pre-acquisition years. Since these variables may affect the survival rate and are non-randomly distributed between plants we need to employ an estimation approach where we can control for different plant- and firm specific factors.

Table 4 here

Table 5 also provides us with some evidence of "cherry picking", i.e. that firms that perform "well" and have plants with "good" characteristics are more likely to be acquired by foreigners. Differences in characteristics and performance between acquired and non-acquired plants in the years before acquisition could bias the estimates of the causal effect of foreign acquisition. To overcome this problem, we use various methods: first, we estimate a hazard model controlling for a large number of observable plant and firm characteristics.

Second, using the same hazard model, we apply an instrumental variables approach using the predicted probability of being acquired as an instrument (see McGuckin and Nguyen, 2001). Third, as a robustness check, we estimate the hazard model on a carefully selected sample of a treated and control group, where the latter is generated using a propensity score matching approach.[14]

Table 5 here

3. Foreign acquisition and plant survival in a hazard model

To establish whether the acquisition of a plant by foreign owners changes its survival prospects compared to other plants we model the determinants of plant survival and check whether the incidence of acquisition is a statistically significant determinant of a plant's hazard of exiting. The related empirical IO literature (for example, Audretsch and Mahmood, 1995, Agarwal and Audretsch, 2001, Disney et al., 2003) generally uses a Cox proportional hazard model for this type of analysis. Given that our data are collected on a yearly basis, it is more appropriate to use a complementary log-log model (cloglog) which is equivalent to the discrete time version of the proportional hazard model.[15]

The underlying assumption of the proportional hazard model is that the hazard ratio depends only on time at risk, $\theta_0(t)$ (the so-called baseline hazard) and on explanatory variables affecting the hazard independently of time, $\exp(\beta' X)$. The hazard ratio is then given by:

$$\theta(t, X) = \theta_0(t)\exp(\beta' X) \tag{2}$$

More specifically, the discrete-time hazard function takes the following form:

$$h(j, X) = 1 - \exp\left[-\exp(\beta' X + \gamma_j)\right] \tag{3}$$

where $h(j, X)$ shows the interval hazard for the period between the beginning and the end of the j^{th} year after the first appearance of the plant and $\gamma_j = \log\int_{a_{j-1}}^{a_j} \theta_0(t)dt$ capture, within each

[14] A similar approach is used by Greenaway and Kneller (2008) in the context of modelling changes in firm performance after export market entry.

[15] The complementary log log model has the same assumptions on the coefficient vector β as in the continuous-time version of proportional hazard model (Prentice and Gloeckler, 1978).

interval, period specific effects on the hazard. The β parameters show the effects of the explanatory variables X (at the plant and firm level) on the hazard rate.

The main interest in our analysis is a dummy variable showing whether a plant is part of a Swedish firm that has been acquired by a foreign MNE (*Acquired*). The dummy switches to one in the year that the firm changes its ownership status from domestic to foreign, and is zero if ownership status is domestic.

To be able to identify the acquisition effect we need to control for other variables that are potentially correlated with it and that also affect plant survival. The literature generally finds that plant size and age are important determinants of plant survival. We, therefore, include both variables in the vector X. Size is measured as log employment size and plant age as years of operations. Furthermore, we calculate a measure of skill intensity of a plant's production process. This is defined as the percentage of employees with post-secondary education in a plant relative to the industry mean skill intensity. We also take into account a variable at the firm level, namely, whether or not a firm is a multi-plant operation. This has been shown by Bernard and Jensen (2007) as an important determinant of firm survival.

The final hazard model can then be written as:

$$h(j,X) = 1 - \exp\left[-\exp(\beta_0 + \beta_1 Acquired + \beta_2 plant\_controls + \beta_3 firm\_controls + \gamma_j)\right] \quad (4)$$

The cloglog model of equation (4) does not allow for unobserved firm heterogeneity. To do so we use the random-effects version of complementary log-log model as a robustness check. As these estimations produce results that are largely comparable with the simple cloglog model, we relegate these to the Appendix to save space.

In an extension to the base line model in equation (4) we allow the acquisition effect to differ across plants depending on whether they are within global engaged firms, i.e. Swedish MNEs and exporting non-MNEs, or purely domestic firms before foreign takeover. This accounts for an important aspect of firm heterogeneity highlighted in the recent theoretical and empirical literature, namely, that there is a clear ordering of firm types, with the "best" becoming outward investors, the next exporters, and the least equipped firms remaining in the

domestic market. This can have implications for the post-acquisition survival prospects. The ex-post performances of ownership changes are unknown due to the uncertainty of how good or bad the match between the acquired and acquiring firm is. Since foreign MNEs and purely domestic firms substantially differ in their observable and unobservable characteristics we expect the latter to be an ex-post poor match for the foreign acquirer and thus more likely to close. Moreover, since plants of globally engaged firms tend to be a priori "better" along a line of observable and (to the econometrician) unobservable characteristics they may be better matches, but also be better able to absorb technology transfers from the foreign acquirer. Hence, we expect better survival prospects in these plants after foreign acquisition compared to targets in purely domestic firms.

Before proceeding to the estimation results we need to describe in more detail our identification strategy. In equation (4) identification of the coefficient β_1 on the acquisition dummy rests on the assumption that, conditional on the plant and firm controls included, acquisition is exogenous. This is, arguably, a strong assumption. As second estimation strategy utilizes an instrumental variables approach. To do so we generate a plant's predicted value of being acquired from a probit regression of the dummy on a large number of plant and firm characteristics, and use this as an instrument for the acquisition dummy.[16] The set of instruments, and the probit regression results, are reported in the Appendix. In a third approach we use propensity score matching to establish a valid counterfactual of non-acquired firms which have similar pre-acquisition characteristics to the acquired firms. Under the matching assumption, conditional on the propensity score, acquisition is random. We then carefully construct a sample of acquired plants and matched non-acquired plants, and estimate equation (4) on this matched sample. Details of the matching procedure are in the Appendix.

4. Empirical results

To examine whether the survival prospects differs in plants within foreign acquired firms as compared to plants within non-acquired firms, we estimate different specification of the hazard model described in equation (4). We report the hazard ratios (exponentiated coefficients) which allows a straightforward interpretation of the coefficient size. For example, a coefficient β less than one on a dummy variable implies that changing the

[16] A similar approach was taken by McGuckin and Nguyen (2001) who analyse the effect of acquisitions on plant exit in the US. Hujer et al. (1999) also use this approach in a nonlinear hazard model for the analysis of the effectd of training on unemployment duration in Germany.

dummy from 0 to 1 reduces the hazard rate of exiting (or increases the probability of survival) by $(1 - \beta) * 100$ percent, *ceteris paribus*.

Table 6 presents the main estimation results. In the first three columns we report the result from estimating equation (4) for the whole sample, i.e. Swedish manufacturing plants in firms with 50 employees or more between 1993 and 2002. The result in column (i) reveals that plants of acquired firms are more likely to survive than plants of non-acquired firms. Controlling for plant and firm level characteristics, in columns (ii) and (iii) suggests that acquisition by foreign owners increases a plant's probability of survival by roughly 30 percent.

In terms of the control variables it is reassuring to note that their results are largely as expected. In line with the large IO literature on firm survival we find that older and larger firms have lower exit hazards. Our results also support the finding by Bernard and Jensen (2007) that plants that are part of a multiplant firm are less likely to exit than other plants. Furthermore, firms with higher R&D and productivity, and lower capital intensities, are more likely to survive. The latter result may indicate that firms that enter industries with high sunk costs in capital equipment (high barriers to entry) are more likely to exit due to fierce competition in these industries.

Returning to the effect of acquisition on survival, our results thus far suggest that the effect is positive. However, this may be purely due to foreign acquirers choosing targets with a priori positive characteristics, a practice known as "cherry picking", as illustrated above in Table 5. These characteristics may also account for the higher survival probabilities of such firms after acquisition. To some extent, this is already accounted for by the large number of relevant firm and plant characteristics that we include in our empirical model in column (iii). However, we also go a step further and explicitly correct for the possible endogeneity of the acquisition dummy. To this end we firstly estimate a variant of the hazard model in equation (4) which instruments for the acquisition dummy using the probability of foreign acquisition as an instrument. As an alternative we use a propensity score matching approach in column (x) and (xi).

The details of the instrumental variables approach are described in the appendix. We use alternative ways of generating the instrument. The results based on these two alternatives are

reported in columns (iv) to (ix). Unfortunately there is, to the best of our knowledge, no formal method of choosing between the standard and the IV estimation in the context of a hazard model. Hence, preference of the IV model would be predicated on the assumption of endogenous acquisitions which is, strictly speaking, not reliably testable. However, we may use a standard Hausman test to get a rough indicator of whether or not the assumption of exogeneity holds. These tests, which are reported at the bottom of Table 6 provide evidence that in all cases we can reject the assumption of exogeneity of the acquisition dummy.

Turning to the estimation results, column (iv) reveals that the probability of surviving in plants within acquired firms is almost 15 percent higher than in plants within non-acquired firms. When we control for firm level characteristics in column (v) the estimated acquisition effect is similar but is no longer statistically significant. In column (vi) we replace the productivity measure at the firm level with average wage at plant level, which we take as a proxy for plant level productivity. We find again a positive acquisition effect on survival. The results suggest that when controlling for the level of productivity at the plant, plants belonging to an acquired firm have higher survival rates than plants within non-acquired firms.

The findings in column (vii) to (ix), which are based on using an alternative definition of the instrumental variable, are similar to those reported before. We find a positive acquisition effect on plant survival controlling for plant productivity and other plant and firm specific characteristics. This indicates the robustness of our IV approach to a change in the definition of the instrument variable.

The reliability of the IV approach hinges on the relevance and validity of the instruments used. While the relevance is to some extent shown in the IV generating probit in the appendix, there is, to the best of our knowledge, no test of instrument validity in the context of this non-linear hazard estimation. Hence, our results are reliable under the assumption of instrument validity, which cannot be tested. In order to provide a further robustness check we use an approach which does not depend on such an assumption. Specifically, we implement a propensity score matching procedure to generate a sample of acquired and non-acquired (matched) firms which can serve as a valid counterfactual. We then estimate equation (4) on this matched sample of firms, similar to Greenaway and Kneller (2007). The details of the propensity score matching procedure are described in the appendix.

The results show that results do not change dramatically using this alternative estimation strategy, which underlines the robustness of results. We find that, even when we control for plant and firm specific variables, plants of acquired firms have almost 15 percent higher chances to survive as compared to plants within non-acquired firms.

Table 6 here

In *Table 2*, we observed that, on average almost 90 percent of the plants that are within foreign acquired firms were plants of globally engaged firms, i.e. Swedish MNEs and exporting non-MNEs, before acquisition. We may expect that the survival prospect after foreign takeover differs depending on whether the plants were within targeted Swedish MNEs, exporting non-MNE or purely domestic firms. The recent literature on firm level heterogeneity makes the point that these firms have, a priori, differences in their characteristics (Helpman et al., 2004). This may not only effect their likelihood of being a target for takeover but may also affect the post acquisition effects on survival. For example, globally engaged firms may find it easier to absorb the new technology brought in by the foreign firm due to, a priori, better ability to absorb this knowledge. Moreover, since the dissimilarity in characteristics between foreign and domestic firms acting in the global market are much smaller as compared to the differences between foreign MNEs and purely domestic firms we expect the latter to be ex-post poor matches for the foreign acquirer and thus more likely to close. Accordingly, we expect lower hazard ratios after takeover in plants that were within globally engaged firms as compared to plants that were within purely domestic firms.

To investigate these hypotheses, we replace our key variable *Acquired* in equation (4) with three dummies showing the ownership status before foreign takeover; *Acquired Swedish MNE*, *Acquired Swedish exporter* and *Acquired Swedish domestic*. The first dummy equals one if the plants were within Swedish MNEs before foreign takeover and zero if the plants are within non-acquired firms. The second dummy takes the value of one if the plants were within exporting non-MNEs before foreign takeover and the last dummy shows whether the plants were within purely domestic firms before foreign takeover.

Table 7 shows the results, which indicate that plants that are within targeted Swedish exporting non-MNEs have higher survival ratios after foreign takeover as compared to plants within non-acquired firms. The survival ratio in these plants improves by between 25 and 40

percent after foreign takeover, depending on the estimation strategy. There is, however, no robust evidence that acquisition impacts on the survival probabilities of either Swedish MNEs or purely domestic firms. This indicates that just looking at the acquisition effect without considering heterogeneity in the effect depending on firm characteristics may lead to biased conclusions. We show that it is only exporters which experience increases in their survival prospects.

Why do we not find any effects for acquired MNEs or purely domestic firms? The former may be quite similar to their acquirer and, hence, have little to learn in terms of new technology coming in. By contrast, purely domestic firms may be quite different from the acquirer in terms of their pre-acquisition characteristics. In fact, they may be too different to absorb the new knowledge and, hence, are not able to improve their survival chances significantly. Only exporters, which have a certain level of "absorptive capacity", are able to use the new knowledge that comes in with the foreign acquirer.

5. Conclusions

This paper has investigated the effect of foreign acquisition on plant survival in the Swedish manufacturing during the 1990s. To this end we have used a unique dataset where firm and plant are linked together. This means that we are able to use firm information, as well as characteristics at the plant level.

Controlling for possible endogeneity of the acquisition dummy by using an instrumental variable and a matched sample and also controlling for plant productivity and other plant and firm specific characteristics, the result reveals that foreign acquisition increases the lifetime of the acquired plants by almost 20 percent as compared to non-acquired plants.

An improvement as compared to the previous studies is that we are able to separate the targeted plants into plants within Swedish MNEs, exporting non-MNEs, and purely domestic firms before foreign takeover. This distinction is important since the prospect of surviving may differ between different ownership structures, in line with the recent theory on firm heterogeneity. The results indicate that this is indeed important: plants within targeted Swedish exporting non-MNEs have higher survival ratios after foreign takeover as compared

to plants within non-acquired firms. However, plants of targeted Swedish MNEs and purely domestic firms do not experience such a survival boosting acquisition effect.

There are important implications of this finding for researchers and policy makers. Firstly, foreign acquisition appears to have overall positive or neutral effects on survival of targets. Hence, strong fears as to the sustainability of domestic industry in the light of increasing foreign acquisitions appear unfounded. Secondly, when judging the magnitude of these survival effects it is important to take into account aspects of firm level heterogeneity, as not all types of firms benefit equally in terms of higher survival prospects from foreign acquisition.

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Table 1 Foreign MNEs, Swedish MNEs and exporting non-MNEs: Number of plants and employment shares 1993-2002

Year	Foreign MNEs		Swedish MNEs		Exporting non-MNEs	
	Plants (Percent)	Employment Percent	Plants (Percent)	Employment Percent	Plants (Percent)	Employment Percent
1993	1,402 (25.8)	21.5	1,722 (31.6)	53.3	1,141 (21.0)	16.1
1994	1,476 (27.4)	21.1	1,911 (35.5)	57.3	1,141 (21.2)	14.8
1995	1,534 (29.1)	22.0	1,618 (30.6)	55.1	1,156 (21.9)	15.3
1996	1,624 (31.5)	27.4	1,495 (29.0)	50.4	1,238 (24.0)	14.9
1997	1,490 (28.9)	27.8	1,761 (34.2)	51.8	1,044 (20.3)	14.7
1998	1,686 (31.8)	30.8	1,536 (29.0)	48.4	1,077 (20.3)	15.3
1999	1,774 (37.7)	34.9	1,180 (25.1)	43.6	943 (20.1)	16.1
2000	1,837 (37.3)	41.1	1,385 (28.1)	38.8	958 (19.4)	14.7
2001	2,051 (41.6)	46.8	1,216 (24.6)	32.2	954 (19.3)	16.0
2002	1,815 (40.5)	48.3	1,123 (25.1)	32.3	850 (19.0)	13.1
1993-2002	16,689 (32.9)	32.2	14,947 (29.5)	46.3	10,502 (20.7)	15.1
	Number of unique plants					
1993-2002	4,305 (29.5)		4,684 (32.1)		3,047 (20.9)	

Table 2 Frequency of foreign acquisitions: Number of plants and employment shares

Year	Swedish MNEs to foreign MNEs		Exporting non-MNEs to foreign MNEs		Non-exporting non-MNEs to foreign MNEs	
	Plants (Percent)	Employment share*	Plants (Percent)	Employment share*	Plants (Percent)	Employment share*
1994	7 (9.2)	19.4	51 (67.1)	66.7	18 (23.7)	13.9
1995	19 (20.0)	30.0	74 (77.9)	68.8	2 (2.1)	1.2
1996	161 (55.5)	72.1	123 (42.4)	26.1	6 (2.1)	1.8
1997	8 (18.2)	26.0	23 (52.3)	57.8	13 (29.5)	16.2
1998	25 (41.7)	74.8	34 (56.7)	19.4	1 (1.7)	5.9
1999	78 (72.2)	77.3	23 (21.3)	15.3	7 (6.5)	7.4
2000	20 (41.7)	88.0	14 (29.2)	10.6	14 (29.2)	1.4
2001	5 (1.9)	4.0	217 (82.8)	85.0	40 (15.3)	11.0
2002	13 (26.0)	26.9	34 (68.0)	65.8	3 (6.0)	7.3
1993-2002	336 (32.5)	46.5	593 (57.4)	46.2	104 (10.1)	7.3

Notes: * Share of total employment in plants within acquired firms

Table 3 Foreign acquisitions by sectors 1994-2002

Industry	Target firms	Number of firms*	Plants within target firms	Number of plants*	Acquisition share Percent	
					Firm	Plant
Food, beverages and tobacco	14	179	246	2,821	7.8	8.7
Textiles, apparel and leather	6	59	16	159	10.2	10.1
Wood products	19	196	60	1,469	9.7	4.1
Paper and pulp products	14	83	22	345	16.9	6.4
Printing and publishing	13	255	43	2,706	5.1	1.6
Chemicals	30	117	75	876	25.6	8.6
Rubber and plastics	14	110	34	379	12.7	9.0
Non-metallic products	13	79	166	739	16.5	22.5
Basic metals	15	63	27	180	23.8	15.0
Non-electrical machinery	31	297	52	1,017	10.4	5.1
Electrical machinery	46	354	167	1,563	13.0	10.7
Telecommunication	12	118	18	513	10.2	3.5
Professional goods	6	66	20	488	9.1	4.1
Motor vehicles	17	75	24	298	22.7	8.1
Transport equipment	23	119	36	384	19.3	9.4
and other manufacturing	15	177	27	660	8.5	4.1
Total	288	2,347	1,033	14,597	12.3	7.1

Notes: *Unique number of firms and plants during the period in each sector.

Table 4 Kaplan-Meier survival function, whole sample

Time	Whole sample	
	Acquired	Non-acquired
1	95.2 (0.011)	89.5 (0.003)
2	89.2 (0.016)	80.2 (0.004)
3	72.9 (0.021)	72.3 (0.005)
4	66.4 (0.024)	64.8 (0.005)
5	58.1 (0.026)	54.0 (0.005)
6	51.4 (0.026)	48.0 (0.005)
7	46.1 (0.027)	40.9 (0.005)
8	35.5 (0.024)	32.6 (0.005)
9	35.5 (0.024)	32.6 (0.004)
Log- rank	0.20	

Notes: Standard error is within parentheses

Table 5 Mean variable differences between acquired and non-acquired firms in the pre-acquisition period, whole sample.

Plant variables	T=0	T=-1	T=-2
Employment	22 (2.48)***	35 (3.71)***	52 (4.69)***
Age	-1.82 (9.27)***	-1.11 (5.47)***	-1.01 (4.26)***
Skill intensity	-0.07 (1.09)	-0.01 (0.16)	-0.13 (1.57)
Obs. Target/Non-target	907/28,490	808/27,411	572/26,784
Firm variables	T=0	T=-1	T=-2
Employment	170 (2.54)**	175 (2.52)**	156 (2.05)**
Skill intensity	3.1 (3.66)***	2.5 (2.93)***	2.7 (2.97)***
R&D intensity	0.7 (2.52)**	0.8 (2.98)***	0.7 (2.61)***
Capital-labor Ratio	39.6 (0.64)	75.5 (2.22)**	39.0 (1.06)
Shipment	451 (1.76)*	444 (1.90)*	389 (1.68)*
Export intensity	8.2 (3.72)***	8.1 (3.60)***	6.0 (2.48)**
Productivity	22.60 (1.32)	39.2 (2.41)**	42.0 (2.44)**
Obs. Target/Non-target	207/7,456	198/6,932	168/6,425

Table 6 Result of Cox Hazard model. Foreign acquisition of plants of all Swedish manufacturing firms.1993-2002

	Basic model			**IV-estimation**			**Alt. IV-estimation**			**Matched sample**	
	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(vii)	(ix)	(x)	(xi)
Acquired	0.836	0.699	0.680	0.860	0.895	0.823	0.889	0.855	0.793	0.849	0.868
	(4.64)***	(9.09)***	(9.30)***	(2.02)***	(1.25)	(2.03)**	(1.40)	(1.89)*	(2.61)***	(2.39)**	(1.98)**
Plant level controls											
Age		0.257	0.253	0.259	0.255	0.267	0.255	0.255	0.267	0.332	0.332
		(79.58)***	(78.00)***	(82.45)***	(76.21)***	(77.61)***	(76.52)***	(76.30)***	(76.30)***	(29.29)***	(29.04)***
Size		0.861	0.851	0.861	0.852	0.862	0.852	0.852	0.862	0.830	0.828
		(12.27)***	(12.99)***	(12.36)***	(12.60)***	(12.41)***	(13.01)***	(12.61)***	(11.49)***	(7.40)***	(7.45)***
Skill intensity		0.992	0.992	0.992	0.992	0.996	0.992	0.992	0.996	1.011	1.011
		(1.43)	(1.52)	(1.42)	(1.47)	(0.75)	(1.54)	(1.48)	(0.79)	(0.90)	(0.88)
Multiplant		0.783	0.723	0.780	0.735	0.849	0.735	0.735	0.799	1.215	1.250
		(3.23)***	(4.03)***	(3.35)***	(3.71)***	(8.57)***	(3.79)***	(3.71)***	(2.91)***	(1.25)	(1.42)
Average wage						0.799			0.849		
						(3.16)***			(8.97)***		
Firm level controls											
Capital intensity			1.073		1.058	1.027	1.059	1.060	1.029		1.006
			(7.26)***		(5.79)***	(2.95)***	(6.13)***	(5.92)***	(2.94)***		(0.29)
R&D intensity			0.434		0.459	0.332	0.456	0.464	0.332		0.067
			(2.32)**		(2.09)**	(3.15)***	(2.30)**	(2.06)**	(3.35)***		(4.32)***
Labor productivity			0.674		0.674		0.674	0.674			1.045
			(11.44)***		(11.73)***		(12.45)***	(11.73)***			(0.57)
Observation	31,051	31,051	31,051	31,051	31,051	31,051	31,051	31,051	31,051	6,985	6,985
Wald Chi Square	959	11,551	11,081	16,462	14,667	12,834	13,537	14,655	14,963	2191	2159
Hausman test (P-value)				0.000	0.002	0.034	0.015	0.001	0.000		

Notes: Estimations are stratified by industry and year. Industries are defined at the SNI92 2-digit level (22 industries). Standard errors in parentheses. In column (v) and (vi) standard errors are bootstrapped. ***, **,* indicate significance at 1, 5 and 10 percent levels, respectively. Only plants in firms with 50 employees or more are included.

Table 7 Result of Cox Hazard model. Foreign acquisition of Swedish MNE plants and plants of exporting and non-exporting firms. 1993-2002

	IV-estimation		**Alternative IV-estimation**		**Matched sample**	
	(iv)	(v)	(vi)	(vii)	(viii)	(ix)
Acquired Swedish MNE	0.724	0.807	0.937	1.011	0.865	0.951
	(2.24)**	(1.27)	(0.40)	(0.07)	(1.66)*	(0.52)
Acquired Swedish exporter	0.584 (5.22)***	0.582 (5.22)***	0.596 (5.20)***	0.611 (4.93)***	0.749 (3.26)***	0.739 (3.31)***
Acquired Swedish domestic	2.033 (1.84)*	1.009 (0.02)	1.159 (0.32)	0.241 (3.03)***	1.094 (0.78)	1.100 (0.76)
Multiplant	0.796	0.728	0.729	0.720	1.197	1.209
(plant level)	(3.12)***	(3.95)***	(3.88***	(3.90)***	(1.15)	(1.21)
Labor productivity		0.679	0.679	0.662		1.077
(Firm level)		(10.64)***	(12.15)***	(12.07)***		(0.90)
Plant controls	Yes	Yes	Yes	Yes	Yes	Yes
Firm controls	No	Yes	Yes	Yes	No	Yes
Observation	31,051	31,051	31,051	31,051	6,985	6,985
Wald Chi Square	18,351	15,128	13,451	14,737	2,184	2,163
Hausman test (P-value)	0.000	0.001	0.004	0.002		

Notes: Estimations are stratified by industry and year. Industries are defined at the SNI92 2-digit level (22 industries). Standard errors in parentheses. In column (v) and (vi) standard errors are bootstrapped. ***, **,* indicate significance at 1, 5 and 10 percent levels, respectively. Only plants in firms with 50 employees or more are included.
Results do not significantly change once we control for productivity at the plant level instead of at the firm level.

Appendix

Details on the instrumental variables approach

In order to capture the effect of a foreign takeover on plant survival we, in the first instance, include a dummy variable set equal to one once the plant has been taken over and thereafter. However, it is likely that such a dummy variable is endogenous. In this case, the stochastic dependence between the acquisition dummy and the error term may bias our estimators. In order to take account of this possible endogeneity we construct an instrumental variable as the probability of a plant being taken over by foreign owners. This instrumental variable is constructed as the predicted value of the dependent variable from a probit regression for the probability of foreign takeover, similar to McGuckin and Nguyen (2001) and Hujer et al. (1999). The probit model takes the following form

$$\Pr(A) = Y\alpha \qquad \text{(A1)}$$

where Y is a vector of plant characteristics. This vector, in the first instance, includes labour productivity in plant *i*, plant age, age-squared, current employment size (relative to the industry mean), R&D and skill intensity, export intensity, and a measure of foreign presence in the industry. The latter measure captures potential spillover effects in an industry. The results of estimating equation (A1) are reported in Table A1. The estimation results suggest that more productive, skill intensive and export oriented plants are more likely to be acquired. Furthermore, plants located in industries with higher foreign presence are more likely to become acquisitioin targets.

A note on the calculation of the hazard ratio: since the variable *Acquired* is defined as a probability and not as a dummy, the hazard ratio can be calculated as exp(β*probability). Note also that, in order to get accurate standard errors for the estimators using generated IV we compute bootstrapped standard errors.

Propensity score matching: a brief methodological overview

The idea of this method, developed by Rosenbaum and Rubin (1983), is to find, for every foreign acquired firm, a similar firm that has remained in domestic hands and from which we can approximate the non-observed counterfactual event. Thus, the matching technique able us

to construct a sample of acquired and non-acquired firms with similar pre-acquisition characteristics *X*, e.g. productivity, wages, size etc. Conditional on these characteristics we estimate the probability (or propensity score) of being acquired by foreign firm using the following probit model:

$$p(AF_{it} = 1) = F(X_{it-1}, D_j, D_t) \quad \text{(A2)}$$

where $AF_{it} = 1$ if a domestically owned firm in year $t-1$ becomes foreign owned in year *t*. X_{it-1} is a vector of relevant firm-specific characteristics in year $t-1$ which may affect the firm's probability of being acquired in year *t*. D_j and D_t control for fixed industry and time effects. Once the propensity scores are calculated, we can (using the "caliper" matching method) select the nearest control firms in which the propensity score falls within a pre-specified radius as a match for an acquired firm.[17] Moreover, we check whether the balancing condition is verified, that is each independent variable do not differ significantly between acquired and non-acquired firms.

Neither in the theoretical nor in the empirical literature is there any consensus on what causes a foreign acquisition. After evaluating different alternatives, we found the following set of explanatory variables to fulfill the balancing condition criterion; firm's export intensity (export share of production), firm's R&D intensity (R&D expenditure as a share of sales), firm's employment relative to industry mean employment, firm's labor productivity (measured by value added per employee), firm's skill intensity, firm's age and its square and the share of foreign employment at industry level (two-digit) as proxy for foreign presence.

The estimation of the probit model is shown in column (i) of *Table A1*. The result indicates that firms that are more export intensive, have higher productivity and are more skill intensive are more likely to be acquired by foreign firms. Moreover, firms in industries with a large foreign presence are more often taken over. This results support the findings in *Table 5* that foreign investors "cherry pick" firms with good performance.

Another condition that must be fulfilled in the matching procedure is the so-called common support condition. This criterion implies that at each point in time, a newly acquired firm is

[17] The procedure we utilize to match acquired and non-acquired firms is the PSMATCH2 routine in Stata version 10 described in Leuven and Sianesi (2003). In our analysis, the pre-specified radius is set to 0.01.

matched with non-acquired firms with propensity scores only slightly larger or smaller than the target firm. Note that some acquired firms may be matched with more than one non-acquired firm, while acquired firms not matched with a non-acquired firm are excluded. Eventually, we end up with a sample, henceforth denoted the matched sample, which consists of 207 acquired firms with 907 plants and 2,372 non-acquired firms with 10,776 plants.

Since the aim of the matching is to find a group of acquired and non-acquired firms with similar characteristics we once more report, in *Table A2*, mean variable differences between the two groups of firms that were successfully matched together. The matching procedure has substantially reduced the firm-level differences between acquired and non-acquired firms. Regarding to the plant-level characteristics, the differences are slightly reduced as compared to the unmatched sample in *Table 5*. However, there still are significant differences between plants of acquired firms and plants of non-acquired firms. Hence, in the estimation of the hazard model we control for variations among the plants in respect to size, age and skill intensities. Finally, from *Table A3* it is clear that the matching procedure also has been successful in constructing a sample with the same structure of ownership changes as in the unmatched sample.

Table A1 Estimation of the Probit model

Variables	Probability of foreign acquisition
Export intensity	0.296 (3.42)***
R&D intensity	0.524 (0.94)
Relative employment	0.003 (1.01)
Labor productivity	0.127 (2.11)**
Skill intensity	0.077 (1.88)*
Age	-0.077 (5.42)***
$(Age)^2$	0.002 (4.35)***
Foreign presence	0.064 (2.14)**
Year dummies	Yes
Pseudo R^2	0.050
LR chi2(16)	112.24
Observations	9.716

Notes: Z-statistics is within parenthesis. Relative employment is firm's employment relative to the industry mean employment. Apart from age and age^2, all the other variables are lagged one period. The share of foreign employment at industry level (SNI92 2-digit level) is used as proxy for foreign presence. ***, **, * indicate significance at 1, 5 and 10 percent levels, respectively.

Table A2 Mean variable differences between acquired and non-acquired firms in the pre-acquisition period, matched sample.

Plant variables	T=0	T=-1	T=-2
Employment	20 (1.83)*	33 (2.88)***	49 (3.67)***
Age	-1.40 (6.85)***	-0.7 (3.49)***	-0.61 (2.58)***
Skill intensity	-0.10 (1.55)	-0.05 (0.77)	-0.19 (2.21)**
Obs. Target/Non-target	907/10,776	808/10,387	572/10,121
Firm variables	T=0	T=-1	T=-2
Employment	78 (0.88)	76 (0.81)	46 (0.44)
Skill intensity	0.9 (0.86)	0.3 (0.32)	0.6 (0.55)
R&D intensity	0.1 (0.37)	0.2 (0.67)	0.1 (0.36)
Capital-labor Ratio	23.6 (0.68)	50.0 (1.37)	16.3 (0.43)
Shipment	285 (1.13)	252 (0.95)	172 (0.60)
Export intensity	4.3 (1.84)*	4.3 (1.82)*	2.2 (0.87)
Productivity	5.57 (0.32)	25.4 (1.52)	31.2 (1.82)*
Obs. Target/Non-target	207/2,372	198/2,240	168/2,114

Table A3 The share of total number of firm and plant acquired by foreign MNEs. Whole and matched sample

	Whole sample					
	Swedish MNEs		Exporting non-MNEs		Non-Exporting non-MNEs	
	Firms	Plants	Firms	Plants	Firms	Plants
1993-2002	30.6	31.5	56.6	56.0	12.8	12.5
	Matched sample					
	Swedish MNE		Exporter		Non-Exporter	
	Firms	Plants	Firms	Plants	Firms	Plants
1993-2002	29.6	30.3	57.5	57.0	12.9	12.7