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Multinationals and Plant Survival[*]

by

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Abstract

The aim of this paper is twofold: first, to investigate how different ownership structures affect plant survival, and second, to analyze how the presence of foreign multinational enterprises (MNEs) affects domestic plants' survival. Using a unique and detailed data set on the Swedish manufacturing sector, I am able to separate plants into those owned by foreign MNEs, domestic MNEs, exporting non-MNEs, and purely domestic firms. In line with previous findings, the result, when conditioned on other factors affecting survival, shows that foreign MNE plants have lower survival rates than non-MNE plants. However, separating the non-MNEs into exporters and non-exporters, the result shows that foreign MNE plants have higher survival rates than non-exporting non-MNEs, while the survival rates of foreign MNE plants and exporting non-MNE plants do not seem to differ. Moreover, the simple non-parametric estimates show that domestic MNE plants are more likely to exit the market than other plants, also when controlling for plant-specific differences. Finally, foreign presence in the market seems to have had a negative impact on the survival rate of plants in non-exporting non-MNEs, but not to have affected plants in exporting non-MNEs or plants in domestic MNEs.

JEL classification: C41, F23, J31

Key words: Survival, multinational enterprises, heterogeneity

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1. Introduction

The recent literature on firm heterogeneity in international trade demonstrates that globally engaged firms, that is, multinational enterprises (MNEs) and exporters, differ from purely domestic firms in many respects.[1] It has been shown that there is a clear ordering of firm types, with the best firms becoming outward investors, less well-equipped firms becoming exporters, and the least well-equipped firms remaining in the domestic market. Moreover, it is a stylized fact that MNEs tend to be larger, more capital- and skill-intensive, and not least, to be more productive and pay higher wages than non-MNEs.[2]

Another important characteristic of MNEs is that, as compared to non-MNEs, they can respond more easily to adverse shocks in one country by simply moving production to another country. This "footloose" character of MNEs means that, conditional on the superior factors that reduce the likelihood of closure, the survival rate of plants of MNEs would be expected to be lower than for plants of non-MNEs. Moreover, since foreign MNEs are less rooted in the local economy than domestic MNEs (and non-MNEs), the former may be more inclined to shift production to other countries whenever the conditions change to their disadvantage. In other words, plant survival rates are expected to be lower for foreign MNEs than for domestic MNEs.

It may well be the other way around, however. An investment in a foreign country involves a major commitment, because setting up, and to some extent also taking over a plant abroad, entails substantial sunk costs. This means that if the conditions in the host country do not deteriorate drastically, it is likely that foreign-owned plants will continue to stay on. Domestically owned MNEs that existed for a long time in their home market may, on the other hand, begin to realize that some of their production in the home country is better carried out abroad. Furthermore, recent reductions in transport and information costs have made it easier to exploit the advantages of relocating production between countries. Therefore, plant survival rates may be lower for domestic MNEs than for foreign MNEs.

[1] See, e.g., Helpman (2006) and Helpman et al. (2004).
[2] See, e.g., Doms and Jensen (1998) for the US, Lipsey and Sjöholm (2004) and Bernard and Sjöholm (2003) for Indonesia, and Bandick (2008) for Sweden.

Finally, in line with recent literature on firm heterogeneity in international trade, it could be argued that since globally engaged firms have more diversified sales profiles than non-exporting non-MNEs, they have better prospects of withstanding negative shocks such as temporary drops in the demand for some of their products. The probability of shutdown would then be lower among plants of globally engaged firms than among plants of purely domestic firms.

Apparently, it is an empirical question whether there are differences in shutdown probabilities between; i) plants of MNEs and non-MNEs, ii) plants of foreign and domestic MNEs, and iii) plants of globally engaged firms and purely domestic firms.

In this paper, I use recent, unique detailed plant data (which also provide some information at the firm level) for Sweden to investigate the survival probabilities of plants with different ownership structures. Sweden is an interesting case in this context. For a long time, Swedish manufacturing was dominated by domestically owned MNEs. Yet in the 1990s, Sweden introduced considerable liberalization reforms and as a result we observe a substantial increase in foreign ownership. This increase has sparked public concerns in Sweden about the uncertainty of foreign MNEs' impacts on plant security and, ultimately, on employment. As argued above, plants of MNEs (foreign or domestic) may experience a reduction or an increase in their survival probabilities. From a policy perspective, it is important to determine which of these two effects predominates in order to refine some of the current policies. Although this is important to analyze, the empirical evidence to date is rather limited.

One more important dimension to analyze is the interaction between foreign MNEs and local plants. The presence of foreign MNEs may affect the survival rate of indigenous plants in two different ways. On the one hand, foreign presence may increase indigenous plants' survival if there are knowledge and technological spillovers from foreign MNEs to indigenous companies. On the other hand, domestic plants, which in general are less endowed with advanced technologies, may find it hard to stay in business due to the competition imposed by foreign MNEs. Moreover, the presence of foreign MNEs may have different impacts on various types of plants depending on their ability to benefit from technology transfers (their absorptive capacity) and to withstand intensified competition. Accordantly, this paper also examines how foreign MNE presence affects the survival prospects of plants within domestic MNEs, exporting non-MNEs, and non-exporting non-MNEs.

So far, a few studies, e.g., Görg and Strobl (2003a) for Ireland and Bernard and Sjöholm (2003) for Indonesia, have analyzed differences in survival rates between foreign-owned plants and plants of indigenous firms (domestic MNEs and non-MNEs).[3] Bernard and Jensen (2007) focus on differences in plant survival rates in US manufacturing between plants of domestic (US) MNEs and plants of other firms (foreign MNEs and non-MNEs). The results of these studies, after controlling for other factors related to plant survival, such as plant age, size, and productivity, indicate that the probability of shutdown is larger for plants of MNEs. The only study, to my knowledge, that has been able to analyze the differences in survival rates between MNEs (domestic- and foreign-owned) and non-MNEs is the study by Van Beveren (2007). The result, after controlling for plant-specific differences, shows that domestic and foreign MNEs in Belgium were more "footloose" than national firms in the manufacturing sector during the period 1996-2001. As regards the effect of foreign MNE presence on domestic plant survival, Görg and Strobl (2003b) find that there are positive effects on domestic plants in Irish high-tech manufacturing industries, but no effects on domestic plants operating in low-tech industries.[4]

I extend and improve upon these earlier papers in a number of ways. First, by using the detailed and unique data for Sweden, I am able to link this work to the recent literature on firm heterogeneity in international trade. Specifically, I am able to categorize all domestic plants as part of (i) a domestic multinational firm with affiliates abroad, (ii) a domestic exporter, or (iii) a purely domestic firm. A negative shock in the domestic market will most likely hit the latter firms and their plants harder because they rely more heavily on the domestic product market. Plants of domestic MNEs and exporters have a more diversified sales profile, which means that they can resist impaired conditions better. Moreover, the impact of foreign MNE presence may differ depending on the extent of global engagement of the domestic plants (multinational, exporting, none). Second, unlike some of the former studies, I do not mix mergers and acquisitions with true exits, and my data set does not place cut-off limits on plant size. Such limits entail the ambiguity that an exit may be the result of decreased plant size below the cut-off level rather than the result of closure.[5]

[3] In contrast to Sweden, most MNEs in Ireland and Indonesia are foreign-owned.
[4] For a more detailed discussion of the related literature, I refer to Section 2.
[5] The former is a potential issue in Mata and Portugal (2002), while the latter potentially affects the study by Van Beveren (2007).

In line with previous literature, the results—conditional on controlling for other factors affecting survival—show that foreign MNE plants have lower survival rates than non-MNE plants. However, separating the non-MNEs into exporters and non-exporters, the results show that plants of foreign MNE have higher survival rates than non-exporting non-MNEs, while the survival rates of foreign MNE plants and exporting non-MNE plants do not appear to differ. Moreover, the results, unconditional or conditional on controlling for other plant-specific factors and for separating the non-MNEs into exporters and non-exporters, show that domestic MNE plants are more likely to exit the market than other plants. Finally, the increased foreign presence in Swedish manufacturing seems to have had a negative impact on the survival rate of plants in non-exporting non-MNEs, but not to have affected plants in exporting non-MNEs or plants in Swedish MNEs.

The structure of the paper is as follows. Section 2 reviews the related theoretical and empirical literature and Section 3 briefly describes the data set used. Moreover, it shows the changing importance of Swedish MNEs, foreign MNEs, and non-MNEs in Swedish manufacturing. Section 4.1 discusses the econometric modeling, and Section 4.2 presents the results of the analysis. Section 5 summarizes and concludes.

2. Theoretical and empirical overview

The determinants of plant exits have been the subject of a large number of theoretical and empirical studies. The literature focuses mainly on two lines of investigation: first, the role of plant and industry characteristics for plant survival, and second, the relationship between plant survival and the ownership structure of the plant.[6]

Papers dealing with the first strand of research in determining plant survival highlight the relevance of factors related to plant size and age (i.e., Evans, 1987; Dunne et al., 1988; and Dunne and Hughes, 1994) and to other plant and industry characteristics such as capital intensity, productivity, industry growth and concentration (i.e., Doms et al., 1995; Audretsch and Mahmood, 1995; and Mata and Portugal, 2002). These papers have emphasized that plant survival is positively related to

[6] Sutton (1997), Caves (1998), and Audretsch and Klepper (2000) summarize the main theoretical and empirical contributions to the existing literature on survival dynamics of the firms.

both plant age and size, and that plants using advanced technologies and having high productivity are more likely to adopt new production methods and hence to increase their chances of survival. As for industry characteristics, plants in growing industries are more likely to survive, while the effect of industry concentration on survival is ambiguous. On the one hand, price-cost margins are high in highly concentrated industries, which should increase the plant's probability of survival, but on the other, highly concentrated industries may be subject to aggressive behavior by rivals, which may reduce the plants survival probability.

The second strand of research dealing with plant survival analyzes how ownership structure influences the exposure to exit risk. The focus of this literature has recently turned to investigating whether the survival dynamics of the plants differ depending on whether they belong to domestic or foreign-owned firms, and whether the presence of foreign MNEs impacts domestic plants' survival.[7] Unfortunately, there is no clear theoretical evidence on the role of multinationals in plant survival prospects. On the one hand, relative to purely domestic firms, MNEs can easily re-allocate their production among their affiliates in different countries in reaction to adverse changes in alternative host countries. In other words, plants that are part of MNEs may have lower survival rates due to the "footloose" behavior of the MNEs. On the other hand, since MNEs are on average more skill- and capital- intensive than their domestic counterparts, they may face substantially higher sunk costs, which should lead to a lower exit rate among their plants.

Also, it can be argued that the reaction to adverse shocks differs between domestic and foreign MNEs. If the former are assumed to be more rooted in the local economy, then the prediction would be that plant survival rates are higher in domestic MNEs than in foreign MNEs. However, as compared to foreign MNEs, domestic MNEs would face lower sunk costs in shutting down some of their plants since they have been established in the domestic market for a long time. Moreover, if the domestic MNEs begin to realize that some of their production would be better carried out abroad, we then would expect the survival rates to be lower for domestic MNEs than for foreign MNEs.

[7] The focus has also been on whether the plants are under single- or multi-unit ownership. Disney et al. (2003) find that single establishments in UK manufacturing are unconditionally more likely to exit than group establishments. However, after controlling for other factors affecting survival, they find that singles with average group characteristics have lower exit rates than groups with the characteristics of singles. Similar results are presented by Bernard and Jensen (2007). They find, after controlling for other plant and industry characteristics, that plants of multi-unit firms and domestic multinational plants (they are not able to identify foreign MNEs in the data) have a significantly higher likelihood of exit in US manufacturing sectors.

While the theoretical prediction for the role of multinationals in plant survival is ambiguous, we have to rely on empirical evidence, which unfortunately is rather limited and the results are mixed. Bernard and Sjöholm (2003), Görg and Strobl (2003a), Mata and Portugal (2002), and Gibson and Harris (1996) provide some of the first empirical evidence on the effect of foreign ownership on plant survival in the manufacturing sector in Indonesia, Ireland, Portugal, and New Zealand, respectively. After having controlled for plant characteristics known to reduce the probability of exit, the first two papers find that foreign-owned plants are more likely to exit than their domestic counterparts. However the paper of Mata and Portugal (2002) finds no significant differences in the exit rate between domestic and foreign-owned plants, while the paper of Gibson and Harris (1996) shows that foreign-owned plants have lower exit rates than incumbent plants when conditioning on plant-specific differences.

A robustness factor that constitutes an improvement over previous studies is introduced by Van Beveren (2007), who investigates not only the role of foreign MNEs, but also the role of domestic MNEs for plant survival. Her findings show that when conditioning on firm and industry characteristics, foreign MNEs as well as domestic MNEs in Belgium's manufacturing sector are more likely to exit the market than national firms. Bernard and Jensen (2007) also control for domestic MNEs to determine the characteristics for plant survival. They do not, however, control for foreign MNEs, since they have no information about them in the data. Their results show, after controlling for various other plant- and industry-specific characteristics, that domestic MNEs are more likely to exit the market than plants owned by other firms (foreign MNEs and non-MNEs) in the US manufacturing sector.

A common shortcoming of earlier studies on this topic is the failure to adequately consider how heterogeneity of firm structure affects plant survival. More specifically, while very few papers control for the role of MNEs in survival prospects, there is no theoretical or empirical evidence on the role of domestic exporters in plant survival.[8] From the recent literature on heterogeneous firms in international trade, there is theoretical justification and empirical evidence that MNEs tend to be the most productive firms, followed by exporters who are not MNEs, and that firms without any foreign involvement are the least productive. In particular, the evidence has shown that domestic

[8] Bernard and Jensen (2007) do indeed control for the export status of the plants in their empirical estimations. However, they only include the export variable as a control and do not consider the role of exporters separately as a mutually exclusive category.

MNEs outperform exporters (Greenaway and Kneller, 2007) and are more similar to foreign MNEs (Criscuolo and Martin, 2009), while exporters are more productive than purely domestic firms (Wagner, 2007). This may have implications for the different survival patterns of different type of plants.[9]

As discussed above, the role of MNEs in plant survival, no matter whether they are domestic or foreign, is ambiguous. How then does export activity affect the survival rates of the plants? The models developed by Bernard et al. (2003) and Melitz (2003) argue that exporting firms are less likely to fail than non-exporters due to the higher productivity of the former.[10] This means that we would expect exporters to survive longer than non-exporters when productivity is not controlled for in the non-parametric analysis. What is the prediction for exporters, controlling for productivity and other variables affecting plant survival? Since exporters tend to be larger and more skill- and capital-intensive than purely domestic firms, this implies that the former may face higher sunk costs of shutting down their plants. Moreover, exporters could be less likely to exit because they have a more diversified sales profile and are hence more resilient to shocks. However, since exporting firms have already gained experience and knowledge about foreign markets, it could be argued that they have a higher exit rate than their purely domestic counterparts.[11]

As in the case of firm ownership structure, there is no clear theoretical indication as to how the presence of foreign MNEs affects domestic plant survival. The foreign MNEs' presence may have two different impacts on the survival rate of plants of indigenous firms: one resulting from technology transfers, and one from intensified competition. In the standard models of multinationals, these types of firms are generally assumed to have some sort of firm-specific asset or efficiency advantage that enables them to operate abroad successfully (Markusen, 2002; Helpman et al., 2004). The inflows of superior knowledge into an economy resulting from increased foreign ownership can also benefit the host country indigenous firms, raising their productivity and reducing their costs, and thus increasing their probability of survival. Görg and Strobl (2003b) find,

[9] Yet it should be noted that once the observed plant/firm characteristics are controlled for, these factors should not matter for the final ownership effect on survival. However, the plants may still have different survival patterns due to other unobserved (by the econometrician) ownership factors that are not controlled for, such as differences in management, organization, diversified sales profiles, and sunk costs.

[10] Esteve Pérez et al. (2004) find that exporters have greater chances of survival than domestically oriented firms in the Spanish manufacturing sector.

[11] This is especially the case when the exit is categorized as reallocation rather than bankruptcy.

for instance, that the presence of foreign MNEs has a life-enhancing effect on indigenous plants in Irish high-tech manufacturing industries.

However, intensified competition on product markets, as well as on factor markets, may have negative effects on the survival of indigenous firms' plants. More efficient foreign MNEs that produce at lower marginal costs than indigenous firms tend to increase their output at the expense of the indigenous firms. If the domestically owned rivals face fixed costs of production, their average costs will increase, reducing the probability of their plants' survival. A larger presence of foreign competitors may also drive up factor costs, leading, for example, to higher wages, which in turn may entail an increased probability of shutdowns among indigenous plants.[12]

The impact of foreign presence on plant survival should also be predicted to differ between plants owned by different types of indigenous firms. Since plants of domestic MNEs and exporting non-MNEs tend to have better observable and (to the econometrician) unobservable characteristics, they may undergo different impacts of foreign presence than plants of purely domestic firms. In particular, plants of globally engaged firms are likely to have better chances to withstand the intensified competition since they have a better ability to absorb the technology spillovers that arise with foreign MNE presence. Plants of non-exporting non-MNEs, however, which have a lower capacity to absorb technology spillovers, are less likely to survive intensified competition from the foreign MNE presence.

3. Data and description

The data set used in this paper includes all plants in Swedish manufacturing covering the period 1993--2002, and comes from Statistics Sweden (SCB) and the Swedish Institute for Growth Policy Studies (ITPS). Each plant is identified by a unique plant code. The appearance of a new identification number indicates that a new plant has entered the market; the disappearance of a previous number means that this plant has exited; and if a number remains the same, the plant has

[12] These arguments can be compared to the theoretical predictions developed by Melitz (2003) for the impact of sector-level export intensity on the competitive pressure in that sector, which also entails a crowding-out of less-efficient plants.

survived. For each plant, total employment, number of employees with post-secondary education, and firm and industry codes are reported. Plant age can be derived back to 1986.[13]

The firm code assigned to each plant makes it possible to match, for example, the firm's accounting data to the individual plant. Accordingly, firm-level data, such as labor productivity, can be linked to plants. Furthermore, Swedish manufacturing firms can be divided into Swedish-owned MNEs, foreign-owned MNEs, exporting non-MNEs, and non-exporting non-MNEs. A Swedish MNE is a domestically owned firm, which is part of an enterprise group with affiliates abroad.[14] In foreign-owned firms (foreign MNEs), foreigners possess more than 50 percent of the voting rights. Exporting non-MNEs are firms with export activity, but they are not multinationals; non-exporting non-MNEs are firms that are neither MNEs nor engaged in the export market. Using the firm code of plants, I can separate plants into foreign MNEs, Swedish MNEs, exporting non-MNEs, and purely domestic firms. The firm-level variables are available from the year 1993 on only for larger firms, that is, firms with 50 or more employees. However, since I use plant-level data for the population of plants, I can still observe all the plants owned by a firm, even if that firm drops below the threshold size value.

The clear distinction into different types of MNEs and exporting activities is a distinct advantage of my data over the previous literature. This distinction is very important, since the prospect of survival may differ among different firm structures due to different characteristics, such as those highlighted by Helpman et al. (2004). Moreover, since my data covers the whole population of plants, I can be confident that I am observing true exits that are not confounded with (i) disappearance of a plant code due to mergers and acquisitions (M&A), or (ii) a plant dropping out of the sample due to size thresholds for inclusion in the sample.[15] Furthermore, my data covers the 1990s and early 2000s, which is a particularly interesting period to study given the recent increase in foreign direct investment (FDI).

[13] I have access to plant data from 1986 onwards. For plants entering after 1986, I am able to calculate the exact plant age, while older plants are inaccurately categorized as entering in 1986.

[14] The first year in which I can distinguish Swedish MNEs from non-MNEs is 1993, therefore selected as the year in which my analysis begins.

[15] Plants of firms that switch between domestic and foreign ownership more than once over the period are not included in the sample. However, including these switchers in the sample or excluding all plants of firms that changed ownership does not change the results presented in Section 4.2. These results are available upon request. Also plants of firms that disappear from the sample one year and reappear in later years are excluded.

In the 1990s, many countries abolished or reduced their restrictions on foreign ownership of indigenous firms, and as a result, FDI increased substantially worldwide (Golub, 2003). During this period, Sweden also introduced considerable liberalization reforms, resulting in what appears to be a more pronounced increase in foreign ownership in Sweden than in other OECD countries.[16] Table 1 shows how the employment shares of foreign MNEs, Swedish MNEs, and exporting and non-exporting non-MNEs developed over the period 1993--2002. The increase in employment in foreign MNEs seems to have taken place at the expense of employment in Swedish MNEs. Employment in Swedish MNEs dropped from 53 percent in 1993 to 32 percent in 2002, whereas employment in exporting and non-exporting non-MNEs only dropped by 3 percent. In the same period, employment in foreign-owned firms increased from 21 to 48 percent.

Table 1 here

The decreasing importance of Swedish MNEs can also be seen in Table 2, which shows the evolution of the plant distribution among different types of firms in Swedish manufacturing from 1993--2002. The share of plants of Swedish MNEs fell from 32 to 25 percent, whereas the share of plants of foreign MNEs increased from 26 to 41 percent. The percentage of plants owned by exporting non-MNEs remained fairly constant at around 20 percent over the period, while the percentage of plants of non-exporting non-MNEs dropped by 6 percent. There are a total of 50,748 observations in my data set, 14,593 of which are unique plants. Of the 5,434 plants that existed since the beginning in 1993, 1,848, or 34 percent, still remained at the end of the sample period in 2002.[17]

Table 2 here

Table 3 provides the distribution of the percentage of plants among the four types of firms in different industries. The industries are defined at the two-digit level. As we can see, more than 60 percent of all manufacturing plants belong to multinational firms (foreign and domestic). Swedish

[16] See Hansson et al. (2007). Other explanations for the increase in foreign ownership in Sweden in the 1990s are that there were more opportunities to acquire Swedish firms after EU accession, that Swedish firms were relatively cheap due to the devaluation at the beginning of the 1990s, and that the Swedish tax system favored foreign ownership.

[17] Görg and Strobl (2003b) show that in the Irish manufacturing sector, 35 percent of all plants existing in the beginning of the sample period (1973) still remained at the end of the period (1996). In the US manufacturing sector, 23 percent of the plants remained at the end of the sample period (Bernard and Jensen, 2007).

MNEs seem to be (almost) equally active in all sectors, with an average plant share of nearly 30 percent. Foreign MNEs, however, are mainly concentrated in sectors where product differentiation and R&D intensity are very high, that is, in the sectors of chemicals, electrical machinery, medical instruments, machinery equipment, rubber and plastic, and motor vehicles. This implies that foreign MNEs may face substantially higher sunk costs than domestic MNEs in shutting down their plants.

Table 3 also presents the exit rate of plants owned by the various types of firms in different industries. The exit rate, defined as the number of exiting plants relative to the total number of plants, is, on average, highest among plants of Swedish MNEs and of non-exporting non-MNEs, and is, on average, lowest among plants of foreign MNEs and exporting non-MNEs. These simple calculations suggest that the probability of plant exits is larger in Swedish MNEs and non-exporting non-MNEs.

Table 3 here

4. Modeling and estimating plant survival

4.1 The model

A non-parametric approach to describe the survival rates for different types of plants is to estimate the survivor functions, *S(t)*, that is, the probability of surviving past time *t*, for each type of plant. The Kaplan—Meier estimate of the survivor function is given by

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

where 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 the unconditionally estimated survival functions for plants within Swedish MNEs, foreign MNEs, exporting non-MNEs, and non-exporting non-MNEs. Analysis time represents the number of years the plant remained in the sample.

Table 4 shows that there are clear differences in survival probabilities among these four groups of plants. In line with previous studies, that is, those in Görg and Strobl (2003a), Bernard and Sjöholm (2003), and Van Beveren (2007), the result of the non-parametric approach shows that foreign MNE plants have lower exit rates than domestic plants. However, in contrast to earlier findings, the results presented here reveal that Swedish MNE plants are unconditionally more likely than other plants to exit. After five years, for instance, 48 percent of the Swedish MNE plants survived, whereas 53 percent of the non-exporting non-MNE plants survived, and 65 and 58 percent of foreign MNE plants and exporting non-MNE plants survived, respectively. Moreover, a log-rank test allows me to reject the hypothesis that the survivor functions across Swedish MNE plants and other plants are equal. This hypothesis is also rejected when comparing the survivor functions between plants of non-exporting non-MNEs and other plants. However, the log-rank test shows that the survivor functions across foreign MNE plants and exporting non-MNE plants are equal.[18]

Table 4 here

A drawback to comparing Kaplan—Meier survivor functions of different types of plants is that such an analysis does not take other factors affecting plant survival into account. As discussed in Section 2, the previous literature on plant exits (e.g., Dunne et al., 1988, 1989; and Disney et al., 2003), emphases that plant size and plant age are variables that affect the plants' survival rates. A more or less established stylized fact is that smaller and younger plants have lower probabilities of survival than larger and older plants.

In Table 5, we observe that these and other variables that may have an impact on the survival rates of plants are unequally distributed, in particular across MNEs and non-MNEs. Standard *t*-tests show that MNE plants are significantly older, larger in terms of employment, and more skill-intensive than non-MNE plants. Furthermore, MNE firms have a significantly higher productivity and higher sales than non-MNE firms.

Table 5 here

[18] These results are not presented in the paper, but are available upon request.

To disentangle the effect of various plant-, firm-, and industry-specific factors on plant survival from multinationality and export activity, I turn to a semi-parametric model of plants' hazard rates. Since my data are collected on a yearly basis, I use a complementary log-log model (cloglog) which is the discrete time version of the Cox proportional hazard model.[19]

The underlying assumption of the proportional hazard model is that the hazard ratio $\theta(t, X)$, the rate at which the plants exit in interval t to $t+1$, 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:

$$\theta(t, X) = \theta_0(t) \exp(\beta' X) \qquad (2)$$

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

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

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 interval, period-specific effects on the hazard.

The covariates X in equation (3) are plant size, measured by plant employment at time *t*, and plant age.[20] Plant skill intensity, that is, the percentage of employees with post-secondary education, is added as a proxy of human capital at the plant level. The possibility of being at the technological forefront and using advanced technologies is heavily dependent on the level of education of the employees. Plants with a better-educated workforce are expected to have higher probabilities of survival (Mata and Portugal, 2002).

[19] The related Industrial Organization (IO) literature (e.g., Audretsch and Mahmood, 1995; Disney et al., 2003) generally uses a Cox proportional hazard model for this type of analysis. Given that my data are collected on a yearly basis, the cloglog model is more appropriate. 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).

[20] The definition of all the variables that are included in the covariates X in equation (3) are listed in the Appendix.

I also take into account variables at the firm level. Unfortunately, data on productivity is not available at the plant level; only at the firm level. This can be a problem in the analysis of multiplant firms with large variations in productivity across plants. As a measure of productivity, I use relative labor productivity: namely, the value added per worker at the firm level divided by the average value added per worker at the industry level.[21] The survival rates of plants are expected to be higher within more productive firms. At the firm level, I also include a dummy capturing whether or not a firm is a multiplant operation. This has been shown by Bernard and Jensen (2007) as an important determinant of firm survival.

Moreover, a number of industry controls are included as covariates. In growing industries, profits tend to be higher and the probability of exit is likely to be lower. I use employment growth at the industry level as a measure of sectoral growth. In highly concentrated industries, price-cost margins are also high, which should increase a plant's probability of survival. However, industries with high market concentration may be subject to aggressive behavior by rivals, which may reduce their survival probability. I use a Herfindahl index, calculated as the sum of squared of the plant's employment share in an industry, as a measure of market concentration.

By adding industry export and import intensities, I try to take international competition at the industry level into account. A high import intensity (share of imports in consumption) indicates that the plants in the industry face tough competition from abroad, and consequently the survival rate of plants is lower. In industries with a high export intensity (export share of production), plants of less efficient firms are crowded out on the factor markets by the more productive ones.[22] In addition, time dummies are included to capture business cycle effects, and in some specifications industry dummies are used as an alternative to industry controls.

The key variables in my analysis are the dummy variables showing whether a plant is part of a Swedish MNE, $SMNE = 1$, or if it is part of a foreign MNE, $FMNE = 1$, or if it is part of an exporting non-MNE, $SE = 1$. The coefficients of these variables indicate whether plants of globally

[21] A multi-factor productivity measure would have been a more appropriate measure of performance, since within industry, labor productivity differentials among firms also capture, e.g., variations in capital intensity. However, due to the lack of a good measure of capital stocks, I cannot calculate firm-level total factor productivity for a sufficiently large number of firms.

[22] Colantone and Sleuwaegen (2007) discuss the theoretical and empirical impact of both import and export intensity on exit.

engaged firms, that is, MNEs and exporting non-MNEs, are more or less likely to survive than plants of non-exporting non-MNEs and whether there are differences in the survival ratios between the globally engaged plants. This is an important dimension of the analysis since the prospect of surviving may differ among different firm ownership structures due to their different characteristics, as highlighted, for example, by Helpman et al. (2004). There is consensus in the recent theoretical and empirical literature about the clear ordering of firm types, with the best being outward investors, the next-best being exporters, and the least well-equipped firms remaining in the domestic market.[23] This may have implications for the survival prospects of the plants as well.

However, as described above, there is no theoretical evidence regarding the impact of firm ownership structure on plant survival. On the one hand, we may expect plants of MNEs to have lower survival rates than other plants, since MNEs can easily shift production from one country to another whenever the conditions in the home or host country change to their disadvantage. We may also expect the plant survival rate to be lower for foreign MNEs than for domestic MNEs, since the former are less rooted in the local economy and may respond more quickly to adverse shocks. On the other hand, foreign MNEs may face substantially higher sunk costs of setting up new plants abroad, as do comparable indigenous firms, which should lead to lower exit rates for their plants. Finally, exporting firms are less dependent on the domestic product market. Therefore, if the domestic market is hit by a negative shock, plants of exporting firms are better equipped to survive by cushioning the adverse effects through the export market.[24]

In the econometric analysis below, I first analyze whether the extent of global engagement of the plant (multinational, exporting, none) impacts plant survival. In the second step of the analysis, I examine the impact of increased foreign presence on the survival rates of plants owned by indigenous firms.

[23] See, e.g., Helpman (2006).
[24] Alvarez and Görg (2005) ask a different question. They investigate whether Chilean manufacturing plants of exporting (foreign) MNEs are less likely to exit than non-exporting (foreign) MNEs, and they find this to have been the case in the late 1990s.

4.2 Estimation results

Table 6 reports the result from estimating equation (3) on a sample of Swedish manufacturing plants in firms with 50 employees or more. In interpreting the results, it should be kept in mind that hazard ratios (exponentiated coefficients) rather than coefficients themselves are reported, that is, a coefficient of less than one on an independent variable in the table implies that it increases the chances of survival, ceteris paribus.

At first, the result in Table 6 column (1) reveals that plants of exporting non-MNEs are less likely to exit the market than plants belonging to purely domestic firms. This result, which is in line with the theoretical prediction developed by Bernard et al. (2003) and Melitz (2003), is expected for several reasons. First, as shown in Table 5, plants of exporting non-MNEs are significantly larger in terms of number of employees, are more skill-intensive, and have higher productivity than non-exporting non-MNEs, which implies that the former may face higher sunk costs in exiting the market relative to their non-exporting counterparts. Second, a negative shock on the domestic market has a stronger effect on plants of purely domestic firms since they are more dependent on their home market. Third, tougher competition on international markets makes plants of exporting firms become more efficient than plants of non-exporting firms. However, controlling for plant-, firm- and industry-level characteristics in column (4), the results still suggest that plants of exporting non-MNEs have almost 20 percent higher chances of survival as compared to plants of purely domestic firms.

The results of the control variables in Table 6 are largely as expected.[25] In line with the large IO literature on firm survival, I find that older and larger plants are less inclined to exit, and plants of firms with higher productivity are more likely to survive. Moreover, in line with the results presented by Bernard and Jensen (2007), the results here suggest that plants belonging to multiplant firms are more likely to exit than other plants. From the coefficients on variables at the industry level, I conclude that plant survival is higher in growing industries and lower in import-intensive industries. For the impact of export intensity at the industry level and market concentration defined by a Herfindahl index, the result is insignificant.

[25] As shown in Table 8 in the Appendix, the correlations between the independent variables are generally low.

Table 6 also reveals that the exit rates of MNE plants differ from those of non-exporting non-MNE plants, and also that the exit rates of MNE plants differ depending on whether the MNEs are foreign or domestically owned. Consistent with the existing empirical findings when conditioning on plant-specific differences (e.g, in Bernard and Sjöholm, 2003; Görg and Strobl, 2003a; and Van Beveren, 2007), I find evidence of "footloose" behavior of MNEs, but only for Swedish MNE plants, which have the highest exit rates among all plants in the Swedish manufacturing sector. Controlling for other factors affecting the exit rate in column (3), the results suggest that Swedish MNE plants have a 4.5 and 20 percent higher probability of exiting as compared to non-exporting non-MNE plants and exporting non-MNE plants, respectively. These figures are slightly reduced when including industry controls in column (4) rather than controlling for different baseline hazard (strata) across industries (as in previous columns), which underlines the robustness of the results.

Moreover, it seems that foreign MNEs are more committed to being located in Sweden than Swedish MNEs; the hazard ratio is larger for Swedish MNEs than for foreign MNEs. The results in columns (3) and (4) show that the former have an approximately 23 percent higher exit probability than their foreign counterparts. Plants of foreign MNEs also seem to have lower exit rates than non-exporting non-MNEs, while the exit rate of foreign MNE plants and exporting non-MNE plants does not seem to differ.[26]

The results obtained in Table 6 may indicate that since an investment abroad entails such large sunk costs, even if the conditions deteriorate in a country, foreign MNE plants (and plants of exporting non-MNEs) tend to hang on longer than domestic MNE plants. Taking into account that the sample in Table 6 includes plants in larger firms, that is, firms with at least 50 employees, and that foreign MNEs are more concentrated in sectors where product differentiation and R&D intensity are very high (Table 3), it appears that foreign MNEs may face substantially higher sunk costs than do comparable domestic MNEs. This could explain the result that foreign MNE plants have lower exit rates than plants of domestic MNEs.

The results in Table 9 in the Appendix confirm this point. When estimating equation (3) on the whole sample, including plants in smaller and larger firms in column (2), the results suggest that

[26] A *t*-test shows that the difference in exit rates between foreign MNE plants and Swedish MNE plants is significant, while the difference in exit rates between foreign MNE plants and exporting non-MNE plants is insignificant.

foreign MNE plants have a 5 percent higher exit rate than non-MNE plants.[27] However, the result in column (4), which includes only plants in smaller firms, shows that, as compared to non-MNE plants, the exit rate is almost 50 percent higher in foreign MNE plants, while the result in column (5), including only plants in larger firms, shows that foreign MNE plants have a 10 percent lower exit rate than non-MNE plants (exporting and non-exporting non-MNE). Another interesting result from Table 9 is that no matter which sample is used in estimating equation (3), in all specifications, Swedish MNE plants have the highest exit rates of all plants in the Swedish manufacturing sector.

The results in Table 6 and Table 9 highlight the importance of taking firm level heterogeneity into account when analyzing the survival probabilities of the plants. When not separating the non-MNE plants into exporters and non-exporters, I obtain a similar result as in the previous literature (e.g., Van Beveren, 2007; Bernard and Jensen, 2007), that is, when controlling for other factors affecting plant survival, I find that foreign MNE plants have lower survival rates than domestic non-MNE plants. However, when taking into account the heterogeneity of the domestic non-MNE plants, the results show that foreign MNE plants have higher survival rates than purely domestic plants, while the survival rates of foreign MNE plants and exporting non-MNE plants do not seem to differ.

Table 6 here

As mentioned in the introduction, foreign direct investment increased substantially worldwide in the 1990s, and as we saw in Table 1, this is also the trend in Swedish manufacturing. The impact of increased foreign presence on the survival rate of plants of indigenous firms appears to be ambiguous, as argued in Section 2,[28] and to depend on the type of indigenous firm. Therefore, I proceed by examining the effects of increased foreign presence on the survival prospects of plants that belong to different types of indigenous firms by using, once more, Swedish plant-level data.

First, I present the results on how foreign presence affects plant survival without differentiating the plants into different types of indigenous firms, shown in Table 7 columns (1) and (2). The sample in these two columns contains all of the plants in Swedish manufacturing firms. As a proxy for foreign

[27] Exporting non-MNEs cannot be singled out from other domestic non-MNE plants since data on exports is only available for larger firms.
[28] See also Görg and Strobl (2003b).

presence in an industry, I use the employment share of foreign MNEs in industry *i* at time *t*.[29] The variable is supposed to capture spillover effects (positive) as well as competition effects (negative) on plant survival. The result controlling for firm- and industry-specific characteristics in column (2) shows that increased foreign presence in the industry does not affect the survival of the Swedish firms' plants.[30]

In columns (3) to (6), the results are based on the sample consisting of all Swedish manufacturing plants in firms with 50 or more employees between 1993 and 2002. The results in column (3) are similar to those in column (2): plants in large Swedish firms are not affected by the increased presence of foreign MNEs after controlling for plant-, firm-, and industry-level characteristics. In columns (4), (5), and (6), I estimate equation (3) separately for plants that belong to Swedish MNEs, Swedish exporting non-MNEs, and Swedish non-exporting non-MNEs, respectively.

The results in these columns indicate that the plant survival of Swedish MNEs and exporting non-MNE firms is unaffected by the increased presence of foreign-owned firms. On the other hand, the impact on survival rates of plants in non-exporting non-MNE firms is negative.[31] An explanation for this pattern may be that plants of non-exporting non-MNE firms do not have enough absorptive capacity to benefit from technology spillovers owing to increased foreign MNE presence. Significantly lower skill intensity (share of employees with some post-secondary education) in plants of non-exporting firms than in plants of exporting firms and plants of Swedish MNEs is one indicator of this.[32] Moreover, plants of non-exporting non-MNE firms are more sensitive to, and thus more severely hit by, intensified competition from an increased foreign MNE presence on the product as well as on the factor market. Significantly lower labor productivity in non-exporting firms than in exporting firms and Swedish MNE firms suggests that plants of non-exporting firms are less capable of withstanding intensified competition due to increased foreign MNE presence.[33]

[29] The variable foreign presence in the industry is calculated using the whole sample of plants, i.e., plants of all firms in the manufacturing sector.

[30] The results on how foreign presence affects the survival of plants within smaller firms (with fewer than 50 employees) are reported in Table 10 in the Appendix. The results are similar to those in column (2) in Table 7.

[31] For Irish manufacturing, Görg and Strobl (2003b) find that increased foreign presence has a positive impact on domestic plants' survival in the high-tech sector because of technology spillovers, and a negative impact on other foreign-owned plants' survival in the low-tech sector due to fiercer competition.

[32] In the plants in Table 7, the average share of employees with some post-secondary education in 2002 was only 16 percent in non-exporting non-MNE firm plants, whereas it was about 20 percent in exporting non-MNE firm plants and 26 percent in Swedish MNE plants.

[33] In the firms in Table 7, the average value added per employee (thousand SEK) was 2002 is 257 in non-exporting non-MNE firms, 489 in exporting non-MNE firms, and 598 in Swedish MNE firms.

Yet we should be aware of the fact that the lack of absorptive capacity and the lack of competitiveness of plants in non-exporting non-MNE firms are to some extent controlled for in the regressions in Table 7 by the inclusion of plant skill intensity and the relative labor productivity of the firm.

Finally, one more interesting result appears in Table 7. Analyzing the whole sample in columns (1) and (2) without separating the plants into different ownership structures, it seems that the higher the export intensity in the industry, the less likely plants are to exit. A similar result is obtained analyzing the sample of plants of larger firms in column (3). However, as shown in column (4), Swedish MNE plants that are active in export-intensive industries are more likely to exit the market, while it seems that the impact of sector-level export intensity on the exit ratio is negative for plants of exporting non-MNEs and purely domestic firms, as shown in columns (5) and (6), respectively. The explanation for this result could be that since MNEs can easily shift production to other locations, they are more likely to exit export-intensive industries in order to avoid the innately high competitive pressure. For non-MNEs, however, plants that operate in export-intensive sectors are more efficient and thus impose higher entry barriers on potential new entrants. The higher entry barriers are likely to result in a lower number of new plants and thus a lower exit rate for the plants already operating.

Table 7 here

5. Conclusions

This paper has investigated the impact of different ownership structures on plant survival and also how foreign MNE presence affects the survival of domestic plants. By using a unique data set for Sweden linking firm- and plant-level information, I am able to separate the plants into foreign MNEs, domestic MNEs, exporting non-MNEs, and non-exporting non-MNEs.

The results highlight the importance of taking firm-level heterogeneity into account when analyzing plants' survival probabilities. In line with earlier findings, the results, controlling for other factors affecting survival, show that foreign MNE plants have lower survival rates than non-MNE plants. However, separating the non-MNEs into exporters and non-exporters, the results show that plants of

foreign MNEs have higher survival rates than non-exporting non-MNEs, while the survival rates of foreign MNE plants and exporting non-MNE plants do not seem to differ.

Moreover, the results, unconditional or conditional on controlling for other plant-specific factors, show that domestic MNE plants are more likely to exit the market than other domestic plants. It also appears that domestic MNE plants are more likely to exit than foreign MNE plants. This indicates that due to the high sunk costs of investing abroad, even if the conditions deteriorate in a country, foreign MNE plants will tend to hang on longer than domestic MNE plants.

Technology transfers and intensified competition are two channels through which the increased presence of foreign MNEs may influence the survival rates of indigenous firms. Plant survival of globally engaged firms, such as Swedish MNEs and exporting non-MNEs, seems to remain unaffected by increased foreign presence, whereas there appears to be a negative impact on the survival rates of non-exporting non-MNE plants.

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Table 1 Plant-level employment shares of MNEs and non-MNEs in Swedish manufacturing, 1993-2002. Percent.

Year	Foreign MNEs	Swedish MNEs	Exporting non-MNEs	Non-exporting non-MNEs
1993	21.5	53.3	16.1	9.1
1994	21.1	57.3	14.8	6.8
1995	22.0	55.1	15.3	7.6
1996	27.4	50.4	14.9	7.3
1997	27.8	51.8	14.7	5.7
1998	30.8	48.4	15.3	5.5
1999	34.9	43.6	16.1	5.4
2000	41.1	38.8	14.7	5.4
2001	46.8	32.2	16.0	5.0
2002	48.3	32.3	13.1	6.3

Notes: Only plants in firms with 50 or more employees are included.

Table 2 Evolution of plant distribution among MNEs and non-MNEs, number of observations and number of unique plants, 1993-2002.

Year	All Plants	Foreign MNEs	Swedish MNEs	Exporting non-MNEs	Non-exporting non-MNEs
1993	5,434	1,402 (26)	1,722 (32)	1,141 (21)	1,169 (21)
1994	5,387	1,476 (27)	1,911 (35)	1,141 (21)	859 (17)
1995	5,271	1,534 (29)	1,618 (31)	1,156 (22)	963 (18)
1996	5,156	1,624 (31)	1,495 (29)	1,238 (24)	799 (16)
1997	5,156	1,490 (29)	1,761 (34)	1,044 (20)	861 (17)
1998	5,302	1,686 (32)	1,536 (29)	1,077 (20)	1,003 (19)
1999	4,706	1,774 (38)	1,180 (25)	943 (20)	809 (17)
2000	4,925	1,837 (37)	1,385 (28)	958 (19)	745 (16)
2001	4,930	2,051 (42)	1,216 (25)	954 (19)	709 (14)
2002	4,481	1,815 (41)	1,123 (25)	850 (19)	693 (15)
	Number of observations				
1993-2002	50,748	16,689	14,947	10,502	8,610
	Number of unique plants				
1993-2002	14,593	4,305	4,684	3,047	2,557

Notes: Only plants in firms with 50 employees or more are included. Percent in parentheses.

Table 3 The share of total plants and average exit rate by sectors, 1993-2002. Percent.

SNI92	Industry	The share of total plants				Exit rate			
		Foreign MNEs	Swedish MNEs	Exporting non-MNEs	Non-exporting non-MNEs	Foreign MNEs	Swedish MNEs	Exporting non-MNEs	Non-exporting non-MNEs
15	Food & beverages	35.9	32.9	11.7	19.5	18.8	32.5	21.4	34.2
16	Tobacco products	26.4	36.5	25.7	11.4	49.2	51.8	100	100
17	Textiles	24.1	34.8	19.4	21.7	18.1	17.5	8.7	0
18	Apparel	28.1	32.6	19.2	20.1	25.0	24.2	23.4	40.0
19	Leather, footwear	9.1	10.0	50.0	30.9	9.4	11.7	8.3	11.4
20	Wood	23.3	26.9	34.7	15.1	17.5	19.0	16.5	20.3
21	Paper & pulp	27.4	56.6	9.9	6.1	16.4	18.9	14.7	5.6
22	Publishing, printing	24.7	26.5	13.5	35.3	27.6	28.5	21.9	20.8
24	Chemicals	67.9	19.2	6.9	6.0	19.3	35.1	29.1	0.0
25	Rubber & plastic	40.0	31.5	15.3	13.2	19.3	23.7	19.1	13.6
26	Non-metallic mineral	36.7	27.8	25.3	10.2	16.9	24.1	21.4	26.7
27	Basic metals	38.4	30.7	19.3	11.6	15.0	15.3	8.6	0.0
28	Fabricated metal	14.7	41.6	30.4	13.3	20.7	21.2	18.3	18.0
29	Machinery, eq.	46.5	27.5	17.6	8.4	14.1	21.3	14.9	15.5
30	Electrical & optical	28.5	26.8	27.9	16.8	19.4	41.3	15.4	6.3
31	Electrical machinery	52.4	21.8	15.9	9.9	20.1	36.7	17.1	46.7
32	Radio TV	31.5	30.3	21.2	17.0	29.6	39.0	18.0	28.6
33	Medical instruments	49.0	23.3	15.2	12.5	15.9	31.3	16.2	4.6
34	Motor vehicles	39.7	27.1	19.9	13.3	10.7	34.2	14.9	19.6
35	Other transport, eq.	18.8	39.1	23.5	18.6	10.0	26.5	23.1	22.8
36	Other manufacturing	27.4	24.4	17.3	30.9	17.4	19.8	6.4	12.5
	Average	32.9	29.9	20.9	16.3	19.5	27.3	20.8	21.3

Notes: The exit rate is defined as the number of exiting plants relative to the total number of plants. An exiting plant observed in *t* is present in *t*-1 but absent in *t*+1. Only plants in firms with 50 or more employees are included.

Table 4 Kaplan—Meier estimates of the survivor function for MNEs and non-MNEs, 1993-2002.

Time	Foreign MNEs	Swedish MNEs	Exporting non-MNEs	Non-exporting non-MNEs
1	92.3 (0.004)	86.5 (0.005)	89.2 (0.006)	93.1 (0.005)
2	86.8 (0.005)	78.8 (0.006)	78.8 (0.008)	80.3 (0.008)
3	80.8 (0.006)	70.1 (0.007)	73.0 (0.008)	71.2 (0.010)
4	70.2 (0.007)	60.0 (0.007)	68.6 (0.009)	64.1 (0.010)
5	65.2 (0.007)	47.8 (0.008)	58.1 (0.010)	53.0 (0.026)
6	57.7 (0.007)	42.2 (0.008)	50.4 (0.010)	48.2 (0.011)
7	51.1 (0.007)	34.6 (0.007)	46.0 (0.010)	39.6 (0.011)
8	44.1 (0.007)	28.3 (0.007)	35.6 (0.010)	30.4 (0.010)
9	34.6 (0.007)	28.2 (0.007)	35.6 (0.009)	30.4 (0.010)

Notes: Standard error is within parentheses. Only plants in firms with 50 employees or more are included.

Table 5 Plant and firm characteristics of foreign MNEs, Swedish MNEs and non-MNEs, 2002

Plant variables	Foreign MNEs	Swedish MNEs	Exporting non-MNEs	Non-exporting non-MNEs
Age	9.1	9.1	8.5	8.2
Employment	89	82	56	37
Skill intensity	23.2	25.7	19.6	16.4
Number of plants	1,815	1,123	850	693
Firm variables	Foreign MNEs	Swedish MNE	Exporting non-MNEs	Non-exporting non-MNEs
Labor productivity	640	598	489	257
Employment	362	345	211	209
Sales	587	537	273	98
Number of firms	583	592	444	269

Notes: Skill intensity is the percentage of the employees with post-secondary education.
Labor productivity, i.e., value added per employee, is in thousand Swedish Krona (SEK). Sales is in million SEK.

Table 6 Determinants of plant survival in Swedish manufacturing firms, 1993-2002.

Variables	Complementary log-log model			
	(1)	(2)	(3)	(4)
Foreign MNE $FMNE = 1$	0.920 (2.40)**	0.824 (5.40)***	0.816 (5.66)***	0.797 (7.56)***
Swedish MNE $SMNE = 1$	1.251 (7.66)***	1.043 (1.86)*	1.045 (1.80)*	1.039 (1.87)*
Swedish exporter $SE = 1$	0.896 (3.33)***	0.838 (5.13)***	0.843 (4.96)***	0.805 (6.90)***
Age (Plant level)		0.253 (108.18)***	0.253 (108.42)***	0.244 (116.72)***
Size (Plant level)		0.770 (28.62)***	0.776 (25.26)***	0.803 (23.18)***
Skill intensity (Plant level)		0.994 (1.58)	0.994 (1.63)	0.995 (1.55)
Labor productivity (Firm level)			0.969 (3.64)***	0.972 (3.34)***
Multiplant (Firm level)			1.138 (1.87)*	1.118 (1.66)*
Herfindahl index (Industry level)				0.929 (0.34)
Employment growth (Industry level)				0.996 (3.76)***
Import intensity (Industry level)				1.052 (1.86)*
Export intensity (Industry level)				1.069 (1.33)
Year dummies Industry dummies	Yes Yes	Yes Yes	Yes Yes	Yes No
Observations Wald Chi Square	46,267 2,425***	46,267 22,094***	46,267 22,231***	46,267 22,352***

Notes: Estimations are stratified by industry and year in columns (1) to (3) while in column (4) the estimations are stratified only by year since in this column I control for industry-specific variables. Industries are defined at the SNI92 three-digit level (99 industries). Standard errors in parentheses. ***, **, * indicate significance at the 1, 5, and 10 percent levels, respectively. In all columns only plants in firms with 50 employees or more are included and the period of study is 1993-2002.

Table 7 Effects of foreign MNE presence on the survival of different indigenous plants.

Variables	Complementary log-log model					
	(1)	(2)	(3)	(4)	(5)	(6)
	All indigenous plants	All indigenous plants	All indigenous plants	Swedish MNEs	Exporting non-MNEs	Non-exporting non-MNEs
Foreign MNE Presence	1.023 (9.64)***	1.004 (0.78)	0.990 (1.37)	1.007 (1.22)	0.978 (1.43)	1.106 (3.84)***
Age (Plant level)	0.206 (285.64)***	0.273 (119.20)***	0.242 (118.59)***	0.273 (67.02)***	0.233 (48.99)***	0.211 (48.69)***
Size (Plant level)	0.809 (37.84)***	0.724 (34.61)***	0.808 (22.54)***	0.793 (17.13)***	0.799 (9.56)***	0.775 (9.75)***
Skill intensity (Plant level)	1.000 (0.43)	0.993 (2.35)**	0.996 (1.29)	0.983 (3.35)***	0.989 (1.49)	0.995 (0.57)
Labor productivity (Firm level)		0.982 (3.64)***	0.973 (3.12)***	0.964 (3.91)***	0.877 (2.48)**	1.238 (3.49)***
Multiplant (Firm level)		1.792 (32.40)***	1.143 (2.00)**	1.515 (3.35)***	0.965 (0.27)	0.856 (0.97)
Herfindahl index (Industry level)	1.943 (5.27)***	0.499 (3.34)***	0.671 (1.78)*	2.807 (2.35)***	1.245 (0.37)	1.764 (3.27)***
Employment growth (Industry level)	0.997 (6.92)***	0.996 (6.86)***	0.995 (4.04)***	1.000 (0.24)	1.001 (0.25)	1.001 (0.22)
Import intensity (Industry level)	1.137 (6.21)***	1.193 (4.10)***	0.981 (0.33)	1.203 (2.14)**	0.741 (2.56)***	0.882 (0.69)
Export intensity (Industry level)	0.868 (6.43)***	0.939 (2.48)**	0.896 (3.98)***	1.242 (2.77)***	0.683 (3.25)***	0.365 (4.90)***
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes
Observations	399,575	172,964	31,393	13,824	9,652	7,917
Wald Chi Square	1.03e+05***	33,760***	22,544***	8,076***	4,675***	3,833***

Notes: Estimations are only stratified by year since I use employment share of foreign MNEs in an industry as a proxy for foreign presence. Industries are defined at the SNI92 three-digit level (99 industries). Standard errors in parentheses. ***, **, * indicate significance at the 1, 5 and 10 percent levels, respectively. In columns (1) and (2) plants in all firms are included. In column (1) the period of study is 1993-2002 while in column (2) the period of study is 1996-2002 since firm-level variables are only available for all manufacturing firms from 1996 onwards. In columns (3) to (6) only plants in firms with 50 employees or more are included and the period of study is 1993-2002.

Appendix

Table 8 Correlation matrix

	Foreign presence	Age	Size	Skill intensity	Labor productivity	Multiplant	Herfindahl index	Employment growth	Import intensity	Export intensity
Foreign presence	1.000									
Age	-0.026	1.000								
Size	0.049	0.414	1.000							
Skill intensity	-0.039	-0.106	-0.045	1.000						
Labor productivity	-0.009	0.001	0.011	0.016	1.000					
Multiplant	0.064	-0.229	-0.040	0.080	0.024	1.000				
Herfindahl index	-0.234	-0.043	0.056	0.003	-0.002	0.078	1.000			
Employment growth	0.044	0.001	0.011	-0.005	-0.011	-0.005	-0.040	1.000		
Import intensity	-0.170	-0.038	-0.047	0.014	0.026	0.123	0.151	-0.084	1.000	
Export intensity	0.186	0.032	0.133	-0.022	-0.024	-0.115	0.253	0.027	-0.331	1.000

Table 9 Further results

Variables	Full sample (1)	Full sample (2)	Sample of small firms (3)	Sample of small firms (4)	Sample of large firms (5)
Foreign MNE $FMNE = 1$	1.327 (15.29)***	1.052 (1.95)*	1.567 (7.78)***	1.476 (5.80)***	0.898 (4.30)***
Swedish MNE $SMNE = 1$	1.593 (29.58)***	1.233 (8.85)***	1.556 (9.65)***	1.574 (8.72)***	1.171 (1.87)*
Age (Plant level)	0.211 (285.86)***	0.279 (126.06)***	0.221 (136.90)***	0.259 (100.47)***	0.245 (116.97)***
Size (Plant level)	0.801 (42.85)***	0.732 (36.78)***	0.692 (35.19)***	0.669 (33.67)***	0.802 (23.23)***
Skill intensity (Plant level)	0.998 (1.25)	0.996 (1.38)	0.992 (2.24)**	0.991 (2.42)**	0.995 (1.51)
Labor productivity (Firm level)		0.986 (3.51)***		0.983 (3.57)***	0.971 (3.40)***
Multiplant (Firm level)		1.637 (24.92)***		1.512 (14.41)***	1.127 (1.78)*
Herfindahl index (Industry level)	1.072 (0.58)	0.358 (5.68)***	0.488 (3.00)***	0.469 (2.84)***	0.832 (0.84)
Employment growth (Industry level)	0.997 (8.43)***	0.995 (7.28)***	0.996 (4.54)***	0.996 (5.90)***	0.996 (3.59)***
Import intensity (Industry level)	1.091 (4.32)***	1.166 (3.75)***	1.267 (5.20)***	1.374 (6.36)***	1.059 (1.99)**
Export intensity (Industry level)	0.900 (4.87)***	1.025 (0.72)	0.947 (1.35)	0.990 (0.24)	1.042 (0.83)
Year dummies	Yes	Yes	Yes	Yes	Yes
Industry dummies	No	No	No	No	No
Observations	421,340	188,130	163,983	145,791	46,267
Wald Chi Square	1.09e+05***	38,247***	30,395***	21,869***	22,443***

Notes: Estimations are stratified only by year since I control for industry-specific variables. Industries are defined at the SNI92 three-digit level (99 industries). Standard errors in parentheses. ***, **, * indicate significance at the 1, 5 and 10 percent levels, respectively. In columns (1) and (2) plants in all firms are included. In columns (3) and (4) only plants in firms with less than 50 employees are included while in column (5) plants in firms with 50 employees or more are included. In columns (1), (3) and (5) the period of study is 1993-2002 while in columns (2) and (4) the period of study is 1996-2002 since firm-level variables are only available for all manufacturing firms from 1996 onwards.

Table 10 Effects of foreign MNE presence on the survival of plants within small Swedish manufacturing firms

	Complementary log-log model	
Variables	(1)	(2)
Foreign MNE Presence	0.997 (0.61)	0.995 (0.85)
Age (Plant level)	0.218 (137.02)***	0.256 (100.16)***
Size (Plant level)	0.693 (34.17)***	0.671 (32.62)***
Skill intensity (Plant level)	0.995 (1.59)	0.993 (1.70)*
Labor productivity (Firm level)		0.978 (4.09)***
Multiplant (Firm level)		1.606 (16.36)***
Herfindahl index (Industry level)	0.478 (2.97)***	0.474 (2.70)***
Employment growth (Industry level)	0.997 (4.48)***	0.996 (5.75)***
Import intensity (Industry level)	1.289 (5.53)***	1.373 (6.24)***
Export intensity (Industry level)	0.975 (0.62)	1.007 (0.15)
Year dummies	Yes	Yes
Observations	160,689	143,132
Wald Chi Square	29,689***	21,250***

Notes: Estimations are only stratified by year since I use employment share of foreign MNEs in an industry as a proxy for foreign presence. Industries are defined at the SNI92 three-digit level (99 industries). Standard errors in parentheses. ***, **, * indicate significance at the 1, 5 and 10 percent levels, respectively. Only plants in firms with less than 50 employees are included. In column (1) the period of study is 1993-2002 while in column (2) the period of study is 1996-2002 since firm-level variables are only available for all manufacturing firms from 1996 onwards.

Variable definitions and data sources

A summary of definitions and sources of the variables employed in the analysis is given below.

In this paper, I have used two data sets: the Regional Labor Market Statistics (RAMS) and Financial Statistics (FC), which are provided by Statistics Sweden (SCB). I also use data from Swedish Institute for Growth Policy Studies (ITPS). The period of observation covers the period 1993--2002. I use the information at the plant level for the population of manufacturing plants. The information on the firm-level variables is, however, for larger firms, that is, firms with 50 or more employees. I exclude plants of firms that switch between domestic and foreign ownership more than once over the period. Also, plants of firms that disappear from the sample one year and reappear in later years are excluded.

Plant-level variables:

Exit: Dummy variable. If the unique plant identification number disappears from the sample, I define the plant as having exited. Unfortunately, there is no information available in my data about the types of exit—whether plant exit was due to bankruptcy or to reallocating plant production to other domestic or foreign affiliate plants of the same firm. Source: SCB, RAMS.

*Plant age***:** years of operation. log value. I calculate the exact plant age for those entering after 1986, while older plants are assigned as entering in 1986. Source: SCB, RAMS.

Plant size: log value of total employment at the plant level. Source: SCB, RAMS.

Plant skill intensity: the percentage of a plant's employees with post-secondary education. Source: SCB, RAMS.

Ownership dummies:

Foreign MNEs: firms in which foreign owners possess more than 50 percent of the voting rights are defined as foreign-owned. Source: SCB, FC.

Domestic MNEs: firms that are domestically owned and are part of an enterprise group with affiliates abroad are defined as domestic MNEs. Source: ITPS.

Domestic exporting non-MNEs: Swedish manufacturing firms with 50 employees or more report exports, which means that I can identify exporting and non-exporting firms. Firms that are domestically owned with no foreign affiliates and are exporters are defined as domestic exporting non-MNEs. Source: SCB, FC and ITPS.

Domestic non-exporting non-MNEs: Firms that are domestically owned with no foreign affiliates and are non-exporters are defined as domestic non-exporting non-MNEs. Source: SCB, FC and ITPS.

Firm-level variables:

Labor productivity: log value. Value added per employee. Source: SCB, FC.

Multiplant: a dummy variable that equals one if a firm is a multiplant operation. Source: SCB, RAMS and FC.

Industry-level variables:

Herfindahl index: is calculated as the sum of squared of plants' employment shares in an industry. Source: SCB, FC.

Employment growth: growth in total employment at the three-digit industry level. Source: SCB, FC.

Import intensity: percent. Imports as a share of total sales at the three-digit industry level. Source: SCB, FC.

Export intensity: percent. Exports as a share of total sales at the three-digit industry level. Source: SCB, FC.

Foreign MNE presence: employment share of foreign MNEs at the three-digit industry level. Source: SCB, FC.