Foreign Acquisition, Domestic Acquisition and New Plant Survival

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Abstract

This paper studies the effects of plant control changes on plant survival. A unique feature of the paper is that it groups new born plants as born-domestic and born-foreign, and plant control changes as foreign acquisitions and domestic acquisitions, and then analyzes the effects of foreign acquisitions and domestic acquisitions on the duration of born-domestic and born-foreign plants respectively. Using 26 cohorts of plants born in Canada between 1973 and 1998, the paper finds that both foreign acquisitions and domestic acquisitions significantly increase life durations of born-domestic plants, although domestic acquisitions generate larger effects.

Keywords: Foreign Acquisition, Domestic Acquisition, Plant Survival

JEL No: F2, L1

1. Introduction

Plant control or ownership changes—through mergers and acquisitions (hereafter referred to as acquisitions)—are the most significant events in the life cycle of plants. A plant's life commences with birth and ends when production ceases. With control changes, plants might undertake significant re-organizations, and embark on a different life trajectories, that directly affect industry dynamics. This is probably the major reason why plant control changes have attracted lots of attention from both policy makers and researchers.

Researchers have mainly focused their study on the motivations or short-term outcomes associated with plant control changes. What has been largely ignored is how plant control changes affect plant survival. Understanding the impact of plant control changes on plant survival is practically important. On the one hand, the length of plant life is a proxy for success. Firms/plants that fail are those that do not match their competitors either with respect to product price or product quality. Thus, studying plant survival/death directly addresses industry dynamics. On the other hand, plant control changes occur to both domestic-controlled plants and foreign-controlled plants, and the acquiring firms can be foreign multinationals firms or domestic firms. Due to the intrinsic differences between foreign and domestic firms, it will not be surprising if the effects of plant control changes on the survival of foreign-controlled plants are significantly different from those of domestic-owned plants, and plants acquired by foreign firms have significantly different survival path from those acquired by domestic firms. In the context of plant control changes and survival, survival comparison between foreign acquisitions (acquiring firms are foreign-controlled firms) and domestic acquisitions (acquiring firms are domestic-controlled firms) on born-foreign (plants born to foreign-controlled firms) and born-domestic (plants born to domestic-controlled firms) plants is nonexistent in the literature. However, the above comparison not only portraits the relative riskiness of born-foreign and born-domestic plants in terms of plant closures, but also compares the effectiveness of foreign acquisitions and domestic acquisitions in prolonging their respective life durations. This is what the paper does.

The paper tracks 26 cohorts of manufacturing plants born in Canada from 1973 to 1998 from their birth year to 1999, and explicitly studies how plant control changes affect their life durations with the foreign-domestic dichotomy of plant controlling firms. The new born plants are differentiated as born-foreign and born-domestic and plant control changes as foreign and domestic acquisitions. By explicitly differentiating plant controlling firms' nationality of being foreign and domestic, pre- and post-control changes, the paper can clearly address the following comparisons. First, how differently do born-foreign and born-domestic plants respond to plant control changes in terms of survival? Second, how effective are foreign acquisitions compared with domestic acquisitions in terms of improving plants' survival prospects? And third, do foreign acquisitions and domestic acquisitions generate similar effects on survival to both born-foreign and born-domestic plants?

The survival comparison between born-foreign and born-domestic plants, and the effectiveness comparison between foreign and domestic acquisitions in improving plants' survival are primarily driven by the increasing importance of FDI (foreign direct investment) in the global economy. Governments in many countries have attracted FDI, and foreign presence in many countries is both large and mature, which is especially the case in developed countries which have been open to foreign investment for decades. Canada is a particular case in point. FDI enters Canada either through building new plants (born-foreign) or through acquisition of existing domestic plants (foreign acquisitions), and FDI presence is both mature and large. On average, foreign-controlled plants produce about 45% of output in the Canadian manufacturing sector during the sample period (Baldwin and Gellatly, 2005). Together with nearly three decades of data coverage (1973 to 1999), Canadian manufacturing plant-level panel data provide a unique opportunity to study how the survival profile of born-foreign and born-domestic plants changed after foreign and domestic acquisitions respectively.

The study makes a few notable contributions to the literature. First, the paper explicitly tracks plants' owning firms' nationality, pre- and post-control changes, and thus implicitly differentiates the effects of plant control changes between foreign acquisitions and domestic acquisitions to plants born to foreign firms and to domestic firms. Second, the data contain the universe of tens of thousands of manufacturing plants born in Canada between 1973 and 1998, and were tracked over from birth to 1999. The comprehensiveness of the coverage of plants and time period makes the study the least biased in terms of the results. Lastly, foreign firms have a large and mature presence in Canada over the sample period. The fairly large number of foreign-controlled plants would make a comparison study like this feasible.

The paper reaches the following conclusions. For plants born to domestic firms, both foreign acquisitions and domestic acquisitions generate significant positive effects in prolonging their life durations, but domestic acquisitions generate a much larger effect. For plants born to foreign firms, control changes do not significantly alter their survival profile, no matter whether their effective control was shifted to indigenous domestic firms or to other foreign firms.

2. The Importance of the Foreign-Domestic Dichotomy

Regarding plants' survival, born-foreign plants, or plants being acquired by foreign firms might not necessarily translate into longer durations. On the one hand, multinational firms have been postulated to be superior to domestic firms, and the superiority can be translated into competitiveness, and competitiveness into longer lives. For instance, studies have found that multinational firms are more likely to contain embedded special assets and they may enjoy significant other advantages: rich resources to develop more advanced technologies, access to overseas financial markets, access to overseas markets for their products, and better management skills (Markusen, 1995; Caves, 2007). In Canada, Baldwin and Gu (2005) show that foreign-controlled plants differ substantially from Canadian-controlled plants: they tend to be more productive, pay higher wages and be more innovative because of the embedded special capabilities.[1] On the other hand, foreign-controlled affiliates are often viewed to be "footloose", partly because they have the ability to reorganize their global production chain in response to the changing economic conditions in any particular country.[2] Due to that ability, foreign affiliates might face a lower threshold value before poor performers are divested or closed down. Thus, whether the superiority associated with foreign affiliates is translated into longer life is an empirical investigation.

Further, it is equally important to take into account the heterogeneity between foreign acquisitions and domestic acquisitions. Foreign acquisitions, often as a form of entry of FDI into a particular country, tend to target plants with a particular set of skills. Caves (2007) stresses that multinational (foreign) acquisitions are driven by the desire to transfer knowledge across international boundaries and involve target firms (plants) with the capabilities to ingest the special knowledge assets possessed by multinationals. Baldwin, Gibson and Wang (2009) show some empirical evidences in Canada that foreign acquisitions put more emphasis on

[1] Similar results have been reported for the U.S. (Doms and Jensen, 1998), for the U.K. (Conyon et al., 2002), and for Indonesia (Takii, 2004).

[2] Hood and Young (1997) argue that multinational companies may be more footloose than UK-owned firms due to their having only shallow roots in the host country economy. Cowling and Sugden (1999) also point to potential problems for host country development due to the footloose nature of multinationals' investment. Though Gorg and Strobl (2003a), using Irish data, do not find any significant evidence.

knowledge capital possessed by the acquisition targets, while motivations for economies of scale and scope are more behind domestic acquisitions.

Therefore, regarding the effects of plant control changes on survival, if the effect of acquisitions depends both on the nationality of the acquiring firms, and the nationality of the acquired, studies that do not distinguish plants' pre- and post-controlling firms' nationality will confound the "acquisition" effects and the "ownership" effects. Let's take the following case to illustrate the point. At a given year, plants are observed being foreign-controlled and domestic-controlled respectively. For those being foreign-controlled, they can be grouped into three categories: born-foreign plants which have stayed with the original owner throughout (no acquisitions); born-domestic plants which acquired by foreign firms at some point in the past (foreign acquisitions of domestic plants); and born-foreign plants which were later acquired by other foreign firms (foreign acquisitions of foreign plants). Clearly, although all are observed being foreign controlled, they have gone through a very different plant control change path—some with "acquisition" effects only, some with "foreign ownership" only and some with both. The "foreign ownership" and "acquisition" effects can't be easily separated without proper groupings. With the foreign and domestic ownership dichotomy at birth and at plant control changes, the paper categorizes plant control changes into four groups: F-to-D control changes—born-foreign plants were acquired by domestic firms; F-to-F control changes—born-foreign plants were acquired by other foreign firms; D-to-D control changes—born-domestic plants were acquired by other domestic firms; and D-to-F control changes—born-domestic plants were acquired by foreign firms. Explicitly differentiating plants' controlling firms' nationality, pre- and post-control changes, can help disentangle the mixed "acquisition" and "ownership" effects. At a more aggregate level, control changes can also be aggregated into foreign acquisitions (including F-to-F and D-to-F control changes) and domestic acquisitions (including F-to-D and D-to-D control changes).

3. The Literature on Plant Control Changes and Survival

The majority of the studies on plant control changes have focused either on the motivations behind the process or on the outcomes of the process. On the motivations, studies have postulated two popular themes— the "synergistic" and the "disciplinary" motivations of acquisitions (Baldwin and Wang, 2011; Lichtenberg and Siegel, 1990, 1992; Nguyen and

Ollinger, 2006; McGuckin and Nguyen, 1995; McGuckin, Nguyen and Reznek, 1998). Synergistic takeovers are cases that the acquiring firms target good plants in order to create synergy, and disciplinary acquisitions are cases that the acquiring firms target sick plants in order to turn them around. Although the framework used to inform studies on control changes does not yield a straightforward prediction of the expected impact of changes in plant control, both synergistic and disciplinary theories of takeovers suggest that acquisitions could improve the survival prospects of the acquired targets if they yield improvements in plant performance.

On the outcomes resulting from plant control changes, most of the studies focus on short-run effects, and some even on event studies on very short-run changes in stock market prices. Most economic analyses that use data on sales, wages, or productivity of plants focus on performance changes in the years immediately after a merger (Lichtenberg and Siegel, 1990, 1992; Nguyen and Ollinger, 2006; McGuckin and Nguyen, 1995, 2001; Gugler and Yurtoglu, 2004; Bertrand and Zuniga, 2006; Marsh, Siegel and Simons, 2007). A special case of plant/firm control changes—that previously domestic-controlled plants/firms were taken over by foreign firms—has received lots of attention: researchers have examined how foreign acquisitions affect various aspects of those plants' performance (Fukao et al., 2006; Mattias Arnold and Javorcik, 2010; Girma and Gorg, 2004, 2007).

However, there are only a few studies which have directly focused on the effects of plant control changes on survival. For instance, using plant level data in the US, McGuckin and Nguyen (2001) find that plants that changed hands of control had a higher probability of survival than those that did not; Nguyen and Ollinger (2009) find that control changes are negatively associated with plant closures in the US meat product industries. Girma and Gorg (2004), using UK electronics and food industries, find that the lifetime of domestic-owned plants was reduced once taken-over by foreign firms. Bandick and Gorg (2010), using Swedish domestic-owned plant data, find that acquisitions by foreign owners increase the lifetime of the acquired plants only if the plant was an exporter. These studies suggest that the results of plant control changes may differ across industries and countries and that allowance for the different characteristics of plants, firms, industries and countries may be important if researchers are to identify the various correlates of the impact of control changes on industries. Our study includes all plants born in Canada from 1973 to 1998 (born-foreign and born-domestic) and all control changes (foreign acquisitions and domestic acquisitions), and thus offers a more complete picture on the dynamics of plant control changes in a country.

To a certain degree, this paper is also related to a literature which has compared survival chances between foreign- and domestic-controlled plants, although these studies do not analyze the role of plant control changes, such as Bernard and Sjoholm (2003), Gorg and Strobl (2003), Baggs (2005), and Mata and Portugal (1994).

The paper also introduces a host of other controls to allow for differences arising from plant and firm characteristics that are known to be related to plant life durations—such as size and industry covariates. Large size leads to success and small firms tend to die young (Dunne, Roberts and Samuelson, 1988; Mata and Portugal, 1994; Mata, Portugal and Guimaraes, 1995; Esteve, Sanchis Llopis and Sanchis Llopis, 2004; Persson, 2004). Smaller firms are expected to have lower survival rates, due to cost disadvantages relative to well-established firms that operate at a minimum efficient scale of plant. Plants belonging to multi-plant firms and to more experienced (older) firms have been found to have better survival chances (Baldwin et al., 2000, Bernard and Jensen, 2007; Disney, Haskel and Heden, 2003; Audretsch and Mahmood, 1995). Industry characteristics have also been found to affect plants' survival: high entry rates and/or high exit rates are also found to affect plants' survival probabilities (Audretsch, Houweling and Thurik, 2000; Baldwin et al., 2000, Baggs, 2005).

The remainder of the paper proceeds as follows. Section 4 documents the data, Section 5 describes the main variables, Section 6 discusses the estimation strategy, Section 7 presents the main results, Section 8 conducts some sensitivity analyses and Section 9 concludes.

4. Description of the Data

The data are taken from a longitudinal database of Canadian manufacturing plants that covers the period from 1973 to 1999. Plants born in 1999 (the 1999 cohort) are excluded as it has only one year of observations and thus does not permit a differentiation between true plant death and censoring for the entire cohort. Plants born before 1973 are included in the longitudinal file as well, but are excluded in this study, because there is no information on the nationality of the birth parent, no information on plants' control change history, and no yearly data until 1973. The data come from the Annual Survey of Manufacturing (ASM), conducted and maintained by Statistics Canada. During the sample period from 1973 to 1999, the file was essentially a census of all plants—with the smallest plants being covered with administrative tax files.[3] The data here are unique in terms of the comprehensiveness of the coverage of a population, the length of time covered and the nature and accuracy of firm identifiers that are used to measure control changes. The 1973-99 file has a constant industry classification over this period, which makes it possible to study the impact of industry characteristics on a consistent basis.

A longitudinal data base has been created from the annual data with plant and firm identifiers and the nationality of the owning firms. The plant identifier stays with the plant even with a control change. In other words, regardless of who owns a plant, a plant always carries the same identifier. Firm identifiers were taken from Statistics Canada's Business Register, which is maintained annually and allows plants to be grouped by its owning enterprise.[4] The enterprise identifier is constructed at the level of all firms under common ownership in the Canadian economy, and changes when the effective control of the firm passes from one legal entity to another. In this study, a control change occurs when a plant's firm identifier changes from the current year to the next. The direct linkage between plants and firms, along with firms' nationality, allows the study to track plants' movements from one controlling firm to another, along with the controlling firm's nationality.

Plant birth is coded in the first year of a plant's life, plant death is coded in its last year of data entry if the last year is before 1999, and plant censorship is coded when plants are still alive in 1999, the last year of the sample. Plants that lack data for a couple of years between birth year and the last year, but have the same identifier throughout their lifetime, are treated as continuing plants with missing data. In all the 26 cohorts between 1973 and 1998, there are a total of 69,927 manufacturing plants born (Table 1). The majority of the entrants—67,100 or 96%—are born to firms controlled by Canadians; and the remaining 2827 plants are born to firms controlled by foreigners. Most of the new entrants were born to brand new parent firms (64,650)—new greenfield entrants, and only 5,277 plants were born to firms that have been in business in Canada for sometime—incumbent greenfield entrants (Table 2). As to born-foreign plants, 65% of them are incumbent greenfield entrants (1827/(1827+1000)=65%), while the ratio is only 5.1% for born-domestic plants (3450/(3450+63650)=5.1%). In other words, the majority of born-

[3] It is only post 2003 that the file has become a sample survey.
[4] Because of the care taken to maintain both plant and firm identifiers and the annual coverage of the survey, this file offers much better coverage than some others that have been used to study the impact of mergers. Many of the merger studies (Nguyen and Ollinger, 2009) have been restricted to individual industries like food or meat-packing.

domestic plants are born to brand new firms with no previous business experiences (let alone in other countries), while the opposite is true for born-foreign plants.

Plant control changes analyzed in the paper consist of several different types. Sometimes these changes are associated with the merging of two separate entities into one new firm—when the old firm disappears and a completely new one appears. In other cases, plants will be spun off to a new legal entity while the original owner continues operations with other plants. In still other cases, the divestiture will be done by a firm that continues in existence and the plant is transferred to a firm that was already in existence. It is entirely possible and indeed the case that some plants have gone through multiple control changes. Here, I choose to focus on the effects of the first control change. Altogether, there are 4,992 plants which underwent at least one ownership change.[5] Among these, there are 3,119 D-to-D control changes, 984 D-to-F control changes, 647 F-to-F control changes, and 242 F-to-D control changes (Table 1). That means there are 1,631 (=647+984) total foreign acquisitions, and 3,361 (=3119+242) total domestic acquisitions. It is clear that the majority of plant control changes occur within the same nationality (D-to-D or F-to-F): F-to-F control changes account for 73% (647/(647+242)) for born-foreign plants with control changes, and D-to-D control changes account for 76% (3119/(3119+984)) for born-domestic plants with control changes.

Plant entry, control changes and death (exit) affect a fairly large proportion of Canadian manufacturing plants. From 1973 to 1999, about 10% of all Canadian manufacturing jobs were affected—2.4% of manufacturing jobs were created through opening new plants, 2.7% were destroyed through plant closures, and 4.8% were affected by control changes (Table 3). The share of jobs affected together by job creation and destruction are about the same as the share affected by plant control changes. But both job creation and destruction ratios in born-domestic plants are higher than in born-foreign plants, while the percentage of workers affected by plant control changes is larger in born-foreign plants than in born-domestic plants.

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[5] Among the 4992 plants, the majority, 3115 of them, have only one ownership change during the sample period. And 1551 plants have at least two ownership changes. Focusing on the first control change will not affect the pooled acquisition effects (pooling foreign and domestic acquisitions together). But when we differentiate the nationality of plants' owning firms, pre- and post- control changes, this treatment might be a problem, as the first ownership change determines the direction of the plant' ownership changes. But among the 1551 plants with at least 2 ownership changes, the majority of them were taken over by firms with the same nationality as the first acquiring firm. That is, if a plant was first acquired by a domestic firm, the subsequent acquirers are also domestic firms, and the same is true for foreign acquisitions. Thus, this treatment is unlikely to cause any big problems in the later regression results.

The profile of the merger activity for the 26 cohorts is also summarized in Table 2. For new greenfield entrants, born-foreign plants have a much higher incidence of plant control changes than born-domestic (Canadian) plants: about 5% of born-domestic plants underwent at least one control change during the sample period, while the ratio is 27.2% for born-foreign plants. For incumbent Greenfield entrants, 31.6% of born-domestic plants underwent at least one ownership change, while the ratio is 33.8% for born-foreign plants. Thus, plants belonging to multi-plant firms are more likely to undergo control changes. Taken altogether, 31.45% of born-foreign plants had at least one ownership change during their life time, while this ratio is only 6.11% for born-domestic plants. As to the timing of plant control changes, some plants undergo control changes right after birth in the first year, and others experience control changes relatively later in life. The average time for the 4992 plants with control changes is between ages 7 and 8.

Plants are heterogeneous, especially across the foreign-domestic ownership dichotomy. Born-domestic plants are significantly smaller than born-foreign plants, in terms of plant size (Table 4). Entrants are slightly larger than exiters, and plants undergoing control changes are much larger than those with no control changes, which is true for both born-foreign and born-domestic plants. In sum, dying plants are the smallest in size.

Regarding the survival profile of the manufacturing plants, infant mortality rate is high. Figure 1 depicts the percentage of plants in each cohort that exits each year. On average, 12% of new entrants die at the end of their first year. The death rate starts to decline after the first year, and at their tenth year, it has fallen to 3%. However, after a decade, the cumulative death rate is almost 66% of the original cohort. The average duration for born-foreign and born-domestic plants is 9.2 and 7.3 years respectively. When hazard rates are estimated using the Kaplan-Meier non-parametric method, born-domestic plants that had control changes have significantly higher survival rates (Figure 2). The pattern is not that clear for born-foreign plants. On average, it seems that survival rates for born-foreign plants are higher than for born-domestic plants.

5. The Main Variables

To identify the acquisition effects on plant survival, allowance also needs to be made for other factors which are known to have an influence on plant survival. Here, I include two sets of variables to control for plant level and industry level heterogeneity.

5.1. Plant Level Covariates

Plant level covariates directly affect the probability of a plant's survival and therefore its expected length of life.

Birth_Size: plant size in term of total employment at birth (first year). Plant birth size captures the initial effects of size on plants' survival. Jovanovich (1982) argues that the initial size of a plant is associated with capabilities. Born large plants are more competent since they are better positioned to weather negative environments and are more likely to survive and grow.

Rel_Size: relative plant size measured in terms of total employment relative to its 4-digit SIC80 industry median. Relative plant size is a general proxy for the types of competencies that allow some plants to grow larger. Large firms (plants) also tend to possess assets that allow them to organize and control large-scale production to achieve efficiency. They also tend to have a sound knowledge base, and therefore are more likely to innovate and to perform R&D. These factors lead to a competitive edge for large plants over its competitors, and thus are more likely to survive. Relative plant size is sometimes referred to as minimum efficient scale (Persson, 2004).

OC: a time-switching binary variable. For those plants with control changes, *OC* switches from 0 to 1 at the time when the plant first changed owner, and stays at 1 for the remaining years of the plant. It takes on the value of 0 for those plants with no control changes throughout the sample period. To further differentiate control change by the nationality of the acquiring firms, we code *FOC* and *DOC* when acquiring firms are foreign-controlled and Canadian-controlled respectively. Once plants' birth firms' nationalities are considered, we further code *FFOC*, *FDOC*, *DDOC* and *DFOC* to correspond with ownership changes across different ownership types. For instance, *FFOC* indicates a plant has shifted its control from one foreign firm to another foreign firm (F-to-F control changes) and *FDOC* from a foreign firm to a domestic firm (F-to-D control changes).

Multi_Plant: a binary variable with the value of 1 if a plant is born to a firm that already has operating plants in Canada, and 0 otherwise. This variable captures the parent firm's previous experience in business. Plants born to experienced firms might enjoy better survival chances, as their parent firms can take advantages of their business experiences to deal with adverse events, and to take better advantages of good times.

Owner_Birth: a binary variable with the value of 1 if a plant is born to a foreign parent (born-foreign plants), and 0 to a Canadian parent (born-domestic). This is to capture whether ownership has an additional influence on plants' length of life. If, *ceteris paribus*, access to more advanced technology or a larger overseas market is the dominating advantage, then foreign affiliates might have a better chance of survival and thus a longer life.

5.2. Industry Level Controls

There are certain industry level characteristics that influence plants' survival. Some of the industry characteristics represent conditions that are associated with costly failure. For instance, in the world of entry, experimentation might be expected to reduce the percentage of firms which find out their capabilities via entry. The variables used here are the following.

Rel_Ind_Size: relative industry plant size, calculated as the ratio of the average industry plant size to the manufacturing average.

Rel_Ind_NL: relative industry nonproduction worker ratio, calculated as the number of nonproduction workers to the total number of workers, relative to the manufacturing average.

Rel_Ind_KV: relative industry capital intensity, calculated as valued added subtracted by wages then divided by value added, relative to the manufacturing average.

Plants operating in industries with relatively large plants, higher non-production worker ratios, and higher industry capital intensity are expected to live longer, as these factors act like entry barriers.

EntryRate: the ratio of the number of entrants to the total number of existing plants in an industry. High levels of entry are associated with conditions that make entry experimentation less costly and therefore are expected to be associated with a lower expected length of life.

6. The Estimation Strategy

Different classes of models—continuous versus discrete type—are available for survival analysis. Although the observations are on yearly basis, there are 26 cohorts with nearly 69,927 plants in the dataset and it is therefore reasonable to apply a continuous type survival model, like many other papers have done in the literature. For the continuous type models, several alternatives are most frequently used—proportional hazard type models, such as the Cox proportional hazard model, and the accelerated failure time (AFT) type models, such as the lognormal AFT model.

Without deciding ad hoc whether to use a Cox hazard model or an AFT model, we first plot a kernel density of plants' maximum durations (Figure 3). Together with the death rates in Figure 1, Figure 3 tends to suggest a lognormal AFT-type hazard. A key feature of the lognormal AFT model for survival data is that the hazard function is non-monotonic. The hazard starts at zero, rises rapidly to a peak, and then falls off gradually. The lognormal model thus predicts considerable attrition of the hazard ratio over time, a behavior that is very different from cases in which a proportional hazards model is suitable. The upper tail of the lognormal density is shaped like that of an exponential distribution, which has a constant hazard; hence the hazard function tends to be a constant for large durations. I thus choose the AFT type model with the lognormal distribution. But I also conduct a few tests to see whether the hazard proportionality assumption for a Cox model holds. The test results show that among all of the time-invariant variables (*Birth_Size*, *Owner_Birth*, and *Multi_Plant*), the proportionality assumption only holds for one of them (*Multi-Plant*), which makes it also problematic to apply a proportionality type model.

However, historically, AFT models have been specified by assuming that the vector summarizing subject characteristics is time-invariant (i.e., for cross-sectional analysis):[6]

$$\ln(T) = \beta X + z \,, \tag{1}$$

where β is a vector of parameters, X is a vector of the explanatory variables and *z* is an error term. This expression may be rewritten as:

$$\ln T = \beta X + \sigma u \,, \tag{2}$$

or:

$$\frac{\ln T - \beta X}{\sigma} = u \,, \tag{3}$$

where $u = z/\sigma$ is an error term with density function $f(u)$, and σ is a scale factor (which is related to the shape parameters for the hazard function).

To see why the model is labeled as accelerated failure time, rewrite (2) as:

$$\ln\left(T \exp(-\beta X)\right) = \sigma u \,, \tag{4}$$

The term *exp(-βX)* is a survival time scaling factor. If *exp(-βX)*>1, it is as if the clock ticks faster, and thus failure is "accelerated" (survival time is shortened). Similarly for *exp(-βX)*<1,

[6] The following borrows from the lecture notes by Professor Steven P. Jenkins. See the lecture notes on incorporating time-varying covariates in AFT models discussed in Chapter 3—"Functional Forms for the Hazard Rate", posted on his website.

failure is "decelerated" (survival time lengthened). The Stata routine used for the estimation reports the parameter σ.

Under the traditional setting, some researchers have used the first year data, others have used the last year data to capture the effects of plant level factors on survival. The shortcoming of that approach is that it discards rich historical information which captures year to year changes of plant characteristics. These characteristics tell the growth (change) path of plants which leads to death or survival. Thus, I decide to take advantage of the rich panel data. To be able to incorporate time-varying covariates into the AFT models, an assumption needs to be made, which is that the hazard rate is constant within some pre-defined time interval, though the hazard rate differs for each survival time. Here, I define the pre-defined time interval is one year, and thus assume that the hazard rate in constant within a particular year, though the hazard rate differs for each before and following years. This assumption is not unreasonable given that plants' data are recorded yearly.

Estimation of the AFT models with time-varying covariates thus requires a combination of episode splitting and utilization of estimation routines that allow for conditioned survival functions—so called delayed entry. Episode splitting is to make sure that there is a row entry of data for each plant-year. The plant panel data are already recorded in that way—so episode splitting is complete here. The only crucial step is to correctly define the censor variable (*censored* in this case) for each plant so to properly define delayed entry. To do that, I define the censor indicator *censored* as the following. For every plant-year observation, it (*censored*) takes on the missing value (.) for all observations but the last year, 1 if the last year is not 1999 (a true death), and 0 if the last year is 1999 (censored). In other words, if a plant died after *n* years, the spell (episode) for a plant has been split into *n* sub-spells for each of the year lived: the first *n-1* years are right-censored spell, and the last is a non-censored spell, but with delayed entry (left truncation) at t = n-1.[7] With this technique, the baseline estimation equation is:

$$\begin{aligned} lnT_{i,t} &= \alpha + \gamma OC_{i,t} + \beta_1 Birth\_Size_{i,t} + \beta_2 Rel\_Size_{i,t} + \beta_3 Owner\_Birth_{i,t} \\ &+ \beta_4 Multi\_Plant_i + \beta_5 Ind\_Rel\_Size_{j,t} + \beta_6 Ind\_Rel\_NL_{j,t} \\ &+ \beta_7 Ind\_Rel\_KV_{j,t} + \beta_8 EntryRate_{j,t} + \sum_{w=1} \delta_w Ind_w + \sum_{y=1} \theta_y Cohort_{y,t} + \sigma u_{i,t}, \qquad (5) \end{aligned}$$

[7] On this topic, Professor Steven Jenkins has written detailed notes, and the notes can be freely downloaded from his website.

Where *i* is for plants, *j* for SIC80 4-digit industry and *t* for year. *IND* is industry dummy at SIC80 2-digit level, and *Cohort* is a cohort dummy. Industry and cohort dummies are included to control for the industry and cohort specific effects. Given that industry-level covariates do not change at the plant level, the estimations are clustered.

7. Estimating Plants' Survival Profile

7.1. The Potential Endogeneity of Plant Control Changes

Plants control changes might be endogenous. That is, control changes may occur in those plants with characteristics that presage synergistic control changes or managerial disciplinary control changes. Baldwin and Wang (2011), using Canadian manufacturing plant level data, find that the motivations for plant control changes lie in both synergy and managerial discipline, and there acquirers target on foreign-owned plants and domestic-owned plants for different sets of reasons. To some extent, both synergistic and managerial disciplinary control changes are partially controlled for by including the relevant plant characteristics in the base regressions. But, a formal correction of heterogeneity should be introduced.

There is, however, no formal method of choosing between the standard and the instrumental variables (IV) estimation in the context of a hazard model. Preference of the IV model would be predicted on the assumption of endogenous acquisitions, which is not reliably testable. The previous literature has in general used a probit equation to get the fitted probability of plant control changes, and then used the fitted probability in the main regression equations to capture the effects of plant control changes.[8] This approach is handy, but there are two potential problems. First, this IV approach is nonlinear, thus it is not clear how the correction of the endogeneity effectively purges the endogeneity problem itself. And second, using the fitted probabilities in the main regression changes the nature of the plant control variable from a binary to a continuous type variable. Thus, the regression results based on the fitted probabilities not only capture the switching effects of control changes, but also increases in the probability.

[8] See, for instance, Bandick and Gorg (2010) use this as one approach to correct for the endogeneity associated with foreign acquisition when they estimate the effects of foreign acquisitions on plant survival, McGuckin and Nguyen (2001) use this method to analyze the effect of acquisitions on plant exit in the US, and Conyon et al. (2002) also use this approach in modeling the wage effects of foreign acquisitions. Girma and Gorg (2004) and Bandick and Gorg (2010) also use propensity score matching to correct for the endogeneity of plant control changes. Propensity score matching relies on the strong assumption that the endogeneity associated with plant control changes are completely controlled for by the observables.

With these caveats in mind, we use the IV approach as a robustness check to the baseline results which does not correct the endogeneity, reported under "Baseline" in the results table. We use the following probit equation to predict the fitted probability of plant control changes:

$$Pr(\mathrm{OC}_{it}) = \alpha + \gamma Foreign_i + \delta Multi\_Plant_i + \beta_1 Rel\_Size_{it-1+} \beta_2 \Delta Rel\_Size_{it}$$
$$+\beta_3 \mathrm{Re}l\_WR_{it-1} + \beta_4 \Delta \mathrm{Re}l\_WR_{it} + \beta_5 \mathrm{Re}l\_KV_{it-1} + \beta_6 \Delta \mathrm{Re}l\_KV_{it}$$
$$+\beta_7 Ind\_\mathrm{Re}l\_Size_{jt-1} + \beta_8 Ind\_\mathrm{Re}l\_WR_{jt-1} + \beta_9 Ind\_\mathrm{Re}l\_KV_{jt-1}$$
$$+\sum_{w=1} \lambda_w IND_w + \sum_{y=1} \theta_y Year_y + \varepsilon_{it}, \qquad (6)$$

The probit equation includes both the lagged level variables and their short-term changes. Here, Δ*Rel_Size* is the difference of relative plant size from year *t*-1 to *t*. *Foreign* is a binary variable, with value of 1 for foreign-controlled, and 0 for domestic-controlled. *Rel_WR* is plant relative wage rate—calculated as the ratio of plant's wage rate (wage bill divided by total number of employees) relative to that of the four-digit SIC80 industry mean. Δ*Rel_WR* is the difference of relative wage rate between year *t* and year *t*-1. *Rel_KV* is the plant level capital intensity, calculated as the ratio of value added[9] minus wages and salaries divided by value added, relative to the four-digit SIC80 industry mean, and Δ*Rel_KV* is the change. *Ind_Rel_WR* is calculated as the ratio of industry wage bill divided by total number of employees, relative to the manufacturing average. The predicted probabilities from the probit equation for each plant-year will then replace the value 1 in plant control change variable, *OC*. Using the fitted probabilities, we report the final regression results from the survival equation under the "IV" column, in comparison with those obtained from the baseline regressions.

7.2. The Average Effects of Plant Control Changes on Survival

This sub-section takes a step back and examines how control changes *per se* affect plant survival, by pooling all plant control changes together and by pooling all manufacturing plants together. That is, it assumes that foreign acquisitions and domestic acquisitions generate similar effects, and the binary variable "*Owner_Birth*" can effectively capture the different responses to acquisitions between foreign-born and domestic-born plants. The results are reported in Column (1) in Table 5.

[9] Value added is defined here as the value of sales minus the value of purchases of intermediate goods.

The results clearly indicate that plant control changes increase their length of life, thereby demonstrating an “acquisition effect” (as in Bandick and Gorg, 2010). The results imply that everything else equal, plants, once acquired by other firms, have their durations increased by about 21.7%. Figure 4 plots the estimated hazard rates for plants which had control changes and those which had not. It is evident that the hazard rate for plants which had control changes are monotonically smaller than for those which had not.

Regarding other controls, I get compatible results with those reported in the earlier literature. The positive and significant coefficients on *Birth_Size* and *Rel_Size* imply that plants that start with a relatively large size and that maintain their size advantage enjoy longer lives, a result consistent with other findings in the literature (Dunne et al., 1988; Mata and Portugal, 1994; Mata et al. 1995; Baldwin et al., 2000; Esteve et al., 2004; Persson, 2004). On average, increasing one employee at birth leads to 0.1% increase in plants’ expected durations and a one percentage point increase in plants’ relative size compared to the industry median leads to an 8 percentage point increase in the expected life durations.

The *Owner_Birth* variable that captures the ownership difference between born-domestic and born-foreign plants is not significantly different from zero, which indicates that, in Canada, born-foreign plants do not seem to significantly live longer expected life, *ceteris paribus*.

Plants born to experienced firms, *Multi_Plant*, (incumbent greenfield entrants) live longer: on average, their expected duration is 11% higher — a finding consistent with others in the literature (Disney et al. 2003; Audretsch and Mahmood, 1995).

Other industry level factors that are commonly found to influence plant survival are also significant here. Plants operating in industries with relatively larger plants tend to live longer. Larger plant size implies higher entry costs and is generally associated with longer lives. Plants in industries with higher capital intensity have shorter life expectations. It might be because of the tougher competition environment.[10] Higher entry rates are associated with shorter expected life, both for born-domestic and born-foreign plants, which is consistent with findings in Baldwin et al., 2000 and others. The finding is also consistent with Jovanovich (1982), which shows that higher entry rates suggest low experimentation costs and therefore a lower length of life.

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[10] Audretsch and Mahmood (1995), Audretsch et al. (2000) and Segarra and Callejon (2002) all find that exit rates to be greater in R&D intensive industries given that competition environment is tougher.

The estimate of sigma (σ) is significantly greater than 1 for both born-domestic and born-foreign plants. When the error term μ is augmented by a sigma that is larger than one, the error term is fattened. The estimated *exp*(-βX) is significantly less than 1, implying a decelerated hazard rate.[11]

7.3. Effects on Survival between Foreign Acquisitions and Domestic Acquisitions

This sub-section relaxes the assumption foreign acquisitions generate similar effects as domestic acquisitions, and examines their separate effects on plant survival to incorporate the view that foreign firms are significantly different from domestic firms. Once again, it assumes that the binary variable "*Owner_Birth*" can capture the different responses between foreign-born and domestic-born plants. Foreign acquisitions are termed as *FOC* and domestic acquisitions as *DOC*. Column (1) in Table 6 reports the associated results. The sample includes all 26 cohorts.

Compared with the corresponding results in Table 5, effects from all other factors are not affected by the finer level of differentiation of acquisitions. I will then only focus on the effects from *FOC* and *DOC* respectively. The results indicate that both foreign acquisitions and domestic acquisitions increase the acquired plants' expected life, but domestic acquisitions have a larger impact: about twice as large an impact on expected plant duration as foreign acquisitions. This is interesting, and contrasts with the commonly held perception that foreign acquisitions will exert larger (positive) effects due to their superiority in many aspects, especially in developing countries where foreign-domestic difference is more acute. The results here arise from the Canadian context, and are not contradictory to those found in the developed economy.[12] Baldwin and Wu (2005) show that foreign ownership advantage disappears once foreign affiliates in Canada are compared with Canadian-controlled plants whose parent Canadian firms have business overseas (Canadian multinational firms), which indicates that foreign advantage is a multinational advantage. If the acquiring Canadian firms are indeed large firms with overseas

[11] Recall that Hazard rate in AFT model is defined as: $\theta(t) = f(t)/S(t) = f(t)/(1-F(t))$. The probability density function $f(t)$ summarizes the concentration of spell lengths (exit times) at each instant of time along the time axis. The hazard function summarizes the same concentration at each point of time, but conditional the expression on survival in the state up to that instant, and so can be thought of as summarizing the instantaneous transition intensity. There is a one-to-one relationship between a specification for the hazard rate and a specification for the survivor function.

[12] Girma and Gorg (2004) found negative effects of foreign acquisitions; Bandick and Gorg (2010) documents positive foreign acquisition effects only when domestic plants are exporters.

operations, then it is not surprising that domestic (Canadian) acquisitions generate larger effects in that they also know the culture better.[13]

Figure 5 plots the hazard rates for plants acquired by foreign firms and by domestic firms respectively, in comparison with those having no control changes. It is clear that plants with no control changes have the highest hazard rates. Plants acquired by domestic firms have the lowest hazard rates, and plants acquired by foreign firms lie in between. The nearly identical hazard rates for plants with *FOC*=0 and for plants with *DOC*=0 comes from the fact that both subsets of plants include those plants which had not control changes.

7.4. Effects of Foreign and Domestic Acquisitions on Born-Foreign and Born-Domestic Plants

In order to take into consideration the argument that born-foreign plants are systematically different from born-domestic plants, I further differentiate plant control changes according to the plants' controlling firms' nationality, pre- and post-control changes. Doing so leads to four groups of plant control changes, coded as *FFOC*, *FDOC*, *DDOC*, and *DFOC* respectively. This most detailed differentiation can compare which types of plant control changes (foreign versus domestic) are more effective in prolonging which types of plants (born-foreign or domestic-born). Column (1) in Table 7 reports the corresponding results, described below.

First, for born-domestic plants, both foreign acquisitions (*DFOC*) and domestic acquisitions (*DDOC*) have a significant impact on their life expectations, though domestic firms acquiring born-domestic plants (*DDOC*) generate larger effects than foreign firms acquiring born-domestic plants (*DFOC*). For born-foreign plants, control changes that involve a switch of control to other foreign firms (*FFOC*) do not significantly improve its expected life durations; those acquired by domestic Canadian firms (*FDOC*) witness only marginal increases in their expected durations. In other words, the results suggest that when Canadian firms are the acquirers, the acquired plants genuinely benefit from this new control and live longer lives. Foreign acquisitions are only effective to born-domestic plants, although their effects are smaller than those obtained from domestic acquisitions. What it implies is that for born-foreign plants, changing hands of control does not seem to alter their survival profile.

[13] The ASM plant-level database is not linked with Canadian firm-level database, and thus it is not possible to make a concrete argument. However, Baldwin et al. (2000) show that acquiring firms are much larger.

7.5. Results from the Correction of Plant Control Change Endogeneity

Using the probit equation and its predicted values to correct the control change endogeneity, I re-estimate the equations in Tables 5, 6 and 7, and report the corresponding results under the column "IV" in all the tables. How robust are the baseline results compared with those obtained from IV? It is evident that the results from the IV approach are consistent with those estimated from the baseline approach, but are larger in magnitudes. Basically they confirm the main findings that plant control changes do increase their expected life in general, and domestic acquisitions exert much larger impacts than foreign acquisitions. If faith were to be put on the IV results, they suggest that the baseline estimates underestimate the effects of plant control changes, primarily driven by the managerial disciplinary motivations—as managerial disciplinary control changes target sick plants.

7.6. A Further Test on the Different Responsiveness to Plant Control Changes for Born-Foreign and Born-Domestic Plants

In the previous subsections, I assume that the binary variable, *Owner_Birth,* can capture all the differences arising between born-foreign and born-domestic plants, conditional on other plant level factors. But this might not be true, and plant factors might respond differently across foreign-domestic dichotomy.[14] Accordingly, only including ownership dummy may hide the real reasons for differences in length of life between born-domestic and born-foreign plants if the significant differences in the characteristics between born-domestic and born-foreign plants respond differently to plant control changes. As shown in Table 4, born-foreign plants are much larger than born-domestic ones. This sub-section will estimate for born-domestic and born-foreign plants separately to capture their respective responsiveness to plant control changes. In light of the findings in section 7.5, I here only proceed with the baseline approach. Results are shown in Table 8.

For born-domestic plants, acquisitions *per se* (Column (1)), foreign acquisitions or domestic acquisitions (Column (2)), have strong and significant effects on plants' expected life durations. Domestic acquisitions are the more effective in improving born-domestic plants' durations than foreign acquisitions. For born-foreign plants, acquisitions in general, foreign

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[14] Baldwin and Wang (2010) show foreign-owned plants have different tendencies for plant ownership changes, and those different possibilities are only partially captured by the foreign (domestic) ownership dummy.

acquisitions or domestic acquisitions do not significantly affect their survival profile (Columns (3) and (4)). This seems to confirm the previous findings that born-foreign plants are not responsive to plants' control changes, in terms of survival.

Initial plant size has similar effects on plants' duration for both born-domestic and born-foreign plants, but the increase in relative plant size generates a larger impact on born-domestic than for born-foreign plants. For born-domestic plants, a one percentage point increase in relative plant size leads to an increase in plants' expected life of 9 percentage points, while it is 3 percentage points for born-foreign plants. The smaller marginal effects for born-foreign plants reflect the diminishing marginal effects of relative plant size, as born-foreign plants are on average much larger than born-domestic plants (Table 4).

For born-foreign plants, their parent firms' previous business experiences in Canada (*Multi_Plant*) does not seem to matter regarding their expected life durations, in contrast with born-domestic plants. This finding is not shocking though. *Multi_Plant* is not a perfect measure to capture foreign firms' (parents to born-foreign plants) previous business experiences. By definition, even though the parent firm of a born-foreign plant does not have previous business experiences in Canada (*Multi_Plant* is 0 in this case), it has already accumulated business experiences in other countries. These business experiences can be easily transferred to their Canadian affiliates. This is not the case for born-domestic plants, where a 0 value of *Multi_Plant* truly indicates no previous business experience of the owning firm.

For born-domestic plants, those operating in higher capital intensity industries have shorter expected life, while the opposite is true for foreign-born plants. This may be driven by the fact that born-domestic plants lag behind their foreign counterparts in terms of technology, as born-foreign plants enjoy access to their parent firms' technology, and thus they are better able to reap the benefits operating in higher capital intensity industries.

8. Some Sensitivity Analyses

This sub-section conducts a robustness test by examining how censorship affects the main results. Since the data contain a very long record for plants from their birth year to 1999, the effect of censorship can be examined. As indicated, by the time plants reached their 10^{th} birthday, about two thirds of the original cohort have died. For those cohorts that are born in the late 90s, censorship is high—for the 1998 cohort, the censorship is 82%. In order to test the effects of censorship on the main results, the cutoff criterion is the mean duration between 7 and 8 years. Those cohorts which could not be observed longer than 8 years are excluded, that is from cohort 1992 to cohort 1998. The 1973 to 1991 cohorts provide a time span ranging from 9 to 27 years, with 57,868 births, 44,186 true deaths, and 458,279 observations. Among those plants, 55,697 were born to domestic firms, and 2,171 were born to foreign firms, accounting for 3.75%, roughly similar to the pooled sample (4.04%). Therefore, the differences in results, if at all, will be mainly driven by censorships, rather than by a different representation of plants born to foreign and domestic firms. The associated results are reported under "Long Cohorts" in Tables 5, 6 and 7.

Compared with the base results, all of the coefficients from the long cohorts are quite similar with the baseline results. They reinforce the main findings and suggest that censorship *per se* does not affect the results significantly.

9. Conclusions

Plant control changes through mergers and acquisitions are significant events in plants' life cycles. Plant control changes would affect many aspects of plants' life, and ultimately their death/survival. Plant death/survival directly relates to industry dynamics, by ceasing production and displacing workers. Further, with the deep penetration of foreign direct investment in the global economy, foreign multinationals frequently enter host countries by building new facilities (greenfield entrants). Like their domestic counterparts, during their life cycles, some of these foreign entrants would undergo plant control changes, and the acquiring firms could be foreign-controlled firms or domestic-controlled firms.

This paper examines how plant control changes affect plants life durations, explicitly differentiating plant controlling firms' nationality of being foreign versus domestic at plant birth, and the acquiring firms' nationality of being foreign versus domestic at plant control changes. In so doing, four groups of plant control changes are recorded: D-to-F—plants born to domestic firms were acquired by foreign firms; D-to-D—plants born to domestic firms were acquired by other domestic firms; F-to-F—plants born to foreign firms were acquired by other foreign firms; and F-to-D—plants born to foreign firms were acquired by foreign firms. The paper can then compare which types of plant control changes (foreign acquisitions versus domestic acquisitions) are more effective in prolonging born-foreign and born-domestic plants. It examines the above issues using a rich plant level panel data from 1973 to 1999 in Canada, containing tens of thousands of new plants born between 1973 and 1998.

The paper reaches the following conclusions. First, for plants born to domestic firms, control changes, both foreign acquisitions and domestic acquisitions, generate significant positive effects in prolonging their life durations, but domestic acquisitions are more effective in prolonging born-domestic plants' life durations than foreign acquisitions. Second, for plants born to foreign firms, control changes do not significantly alter their survival profile, no matter whether their effective control was shifted to indigenous domestic firms or to other foreign multinational firms. The results indicate that plants born to domestic firms are very responsive to plant control changes, especially so to domestic acquisitions.

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Table 1: Direction of Plant Control Changes

	birth firm's nationality	control change history	number of firms	Percentage I	Percentage II
Greenfield Entrants (69927)	Born-domestic (67100)	no control changes	62997	93.89%	93.89%
		D-to-F control changes	984	1.47%	6.11%
		D-to-D control changes	3119	4.65%	
	born-foreign (2827)	no control changes	1938	68.55%	68.55%
		F-to-D control changes	242	8.56%	31.45%
		F-to-F control changes	647	22.89%	

Table 2: Plant Born Mode and Tendency for Plant Control Changes

	Born Mode	Birth Firm Nationality	Plant Control Change	Number of plants	Percentage
Greenfield Entrants (69927)	New Greenfield Entrants (64650)	Born-Domestic (63650)	OC=0	60636	95.3%
			OC>=1	3014	4.7%
		Born-Foreign (1000)	OC=0	728	72.8%
			OC>=1	272	27.2%
	Incumbent Greenfield Entrants (5277)	Born-Domestic (3450)	OC=0	2361	68.4%
			OC>=1	1089	31.6%
		Born-Foreign (1827)	OC=0	1210	66.2%
			OC>=1	617	33.8%

Table 3. The Importance of Plant Control Changes, Entrants and Exitors
(Share of Employment: %)

	All Plants	Employment in Affected Foreign-controlled Plants over Total Employment	Employment in Affected Domestic-controlled Plants over Total Employment	Employment in Affected Foreign-controlled Plants over Total Employment in Foreign-controlled plants	Employment in Affected Domestic-controlled Plants over Total Employment in Domestic-controlled plants
Exitors	2.7	0.6	2.0	1.8	3.1
Entrants	2.4	0.4	2.0	1.1	3.0
Plants with Control Changes	4.8	1.8	3.0	5.3	4.6

Table 4. Relative Plant Size Comparison Among Plants with Control Changes, Entrants and Exitors (1973-99)

All plants:	
Entrants	0.40
Plants with Control Changes	2.26
Exitors	0.37
Born-foreign plants:	
Entrants	1.31
Plants with Control changes	2.79
Exitors	1.49
Born-Domestic plants:	
Entrants	0.35
Plants with Control Changes	1.91
Exitors	0.29

Note: Ratios calculated as weighted average across all plants in each year and averaged over 1973-99 (source: Baldwin, Gibson, and Wang, 2009).

Figure 1: Death Rate of Plants

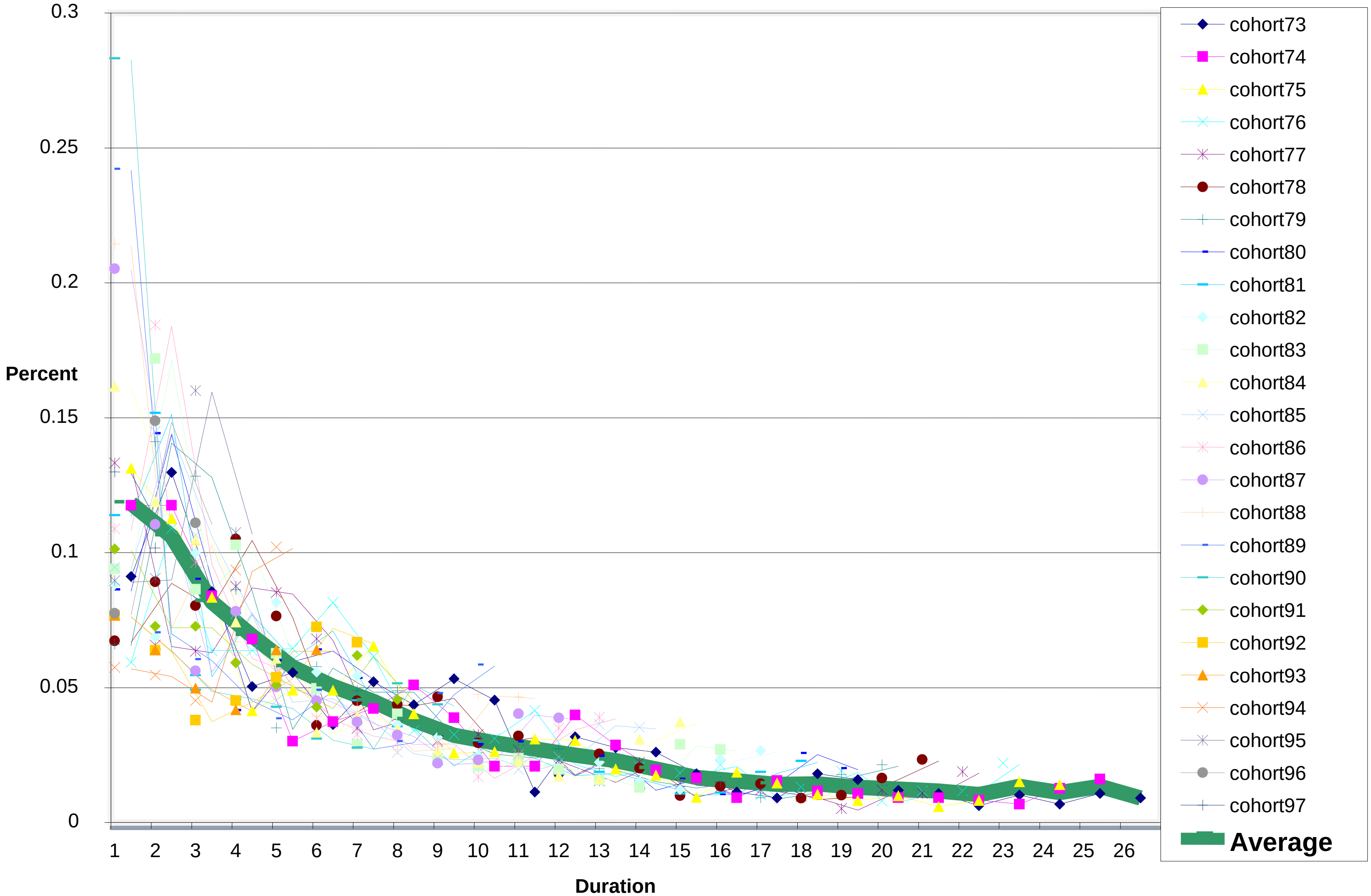
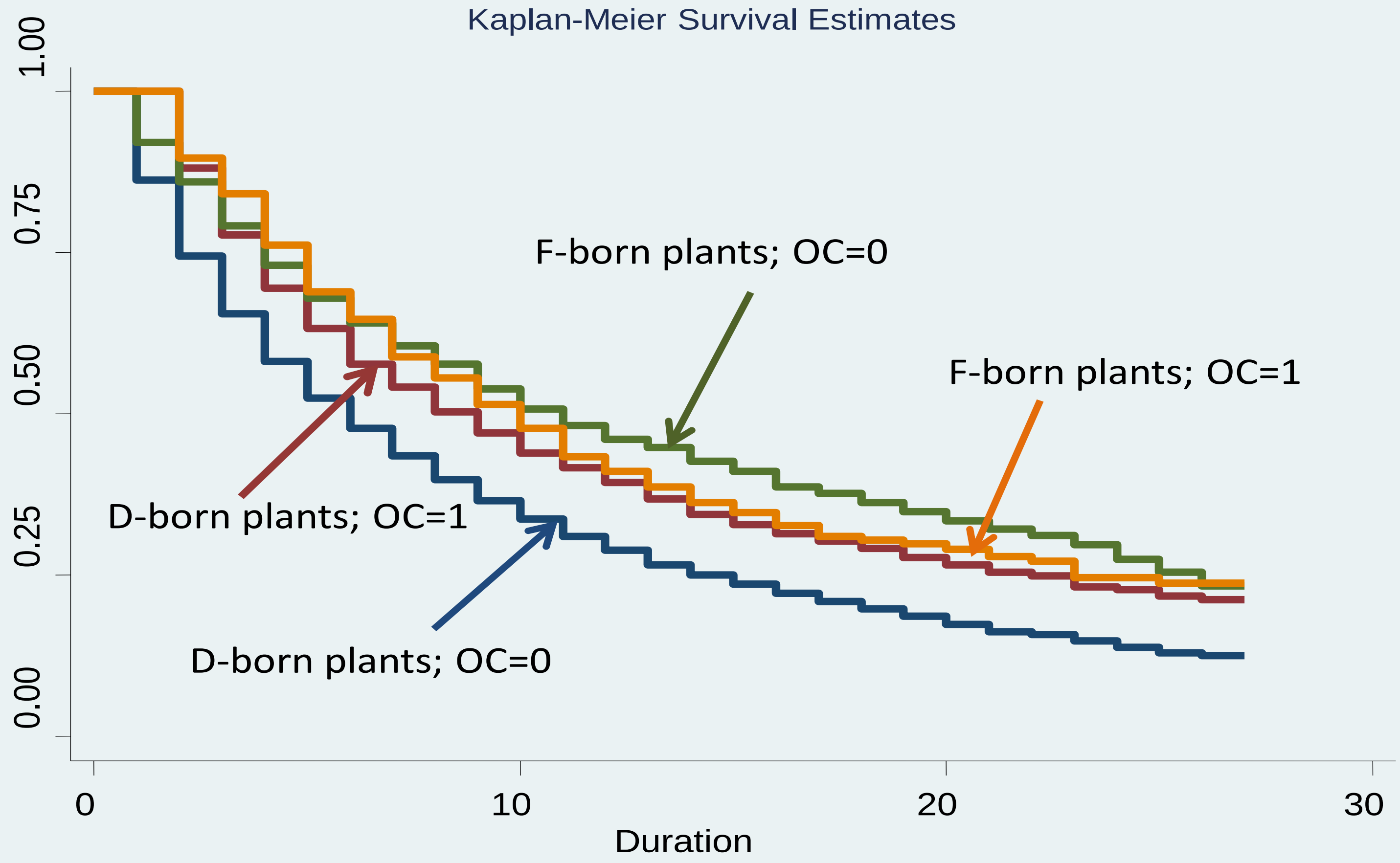


Figure 2: Survival Comparison By Ownership Change Status and By Nationality



D-born and F-born plants are those plants which were born to firms with controlling owners being domestic and foreign respectively.

Figure 3: Kernel Density of Maximum Durations

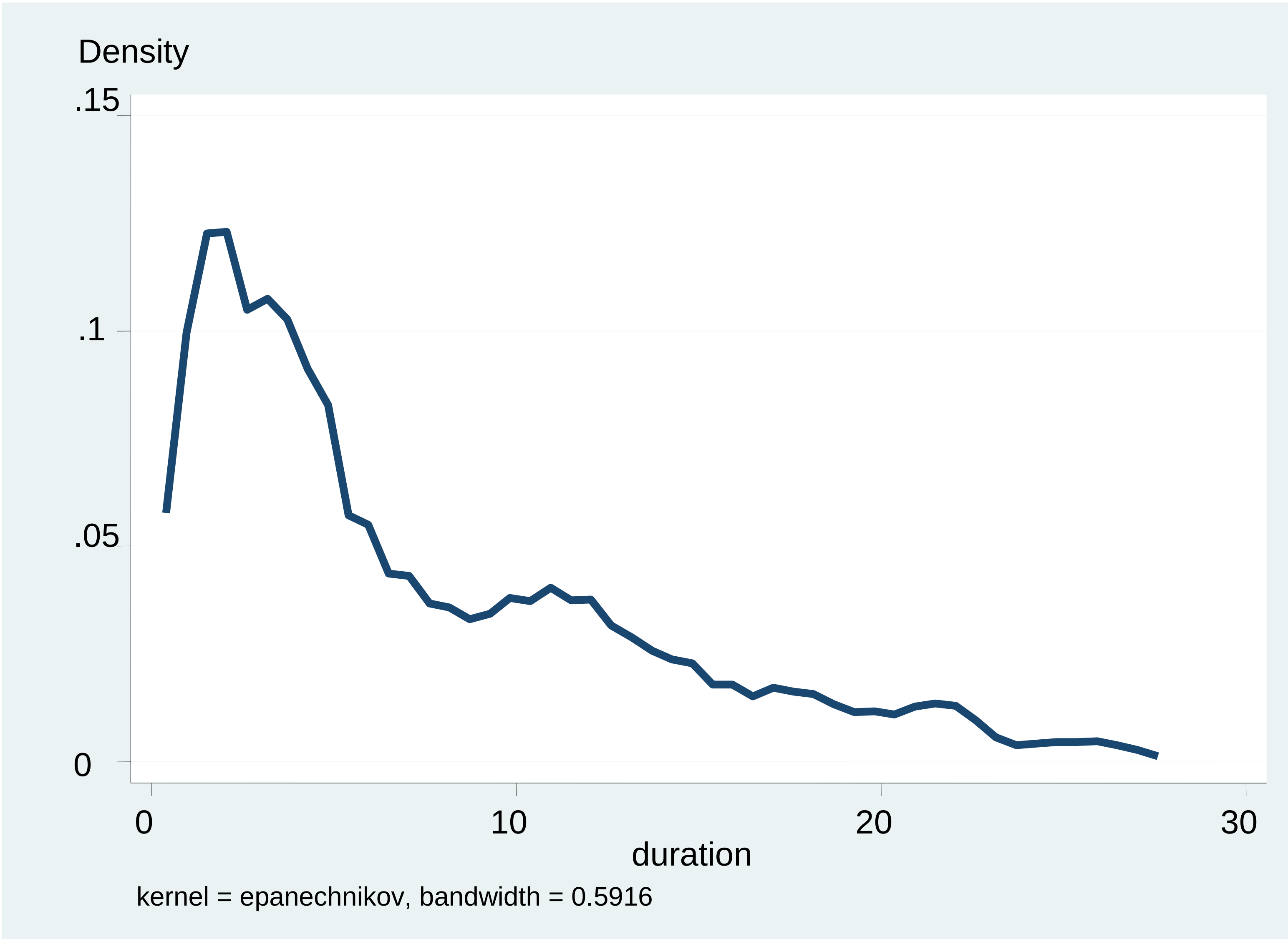


Table 5: Average Ownership Change Effects on Duration—Pooled Sample

variables	(1) Baseline		(2) IV		(3) Long Cohorts	
OC	**0.2174*** **	(0.0283)	**0.3279*** **	(0.0507)	**0.1913* **	(0.0313)
Other plant control						
Plant Size At Birth	**0.0009*** **	(0.0003)	**0.0010*** **	(0.0003)	**0.0009*** **	(0.0003)
Relative Plant size	**0.0799*** **	(0.0060)	**0.0803*** **	(0.0061)	**0.0913*** **	(0.0062)
Firm Level Controls						
Owner_Birth	**0.0285**	(0.0281)	**0.0297**	(0.0282)	**0.0426**	(0.0309)
Multi_Plant	**0.1240*** **	(0.0221)	**0.1280*** **	(0.0222)	**0.1064*** **	(0.0249)
Industry Level Controls						
Relative Industry Plant Size	**0.0219*** **	(0.0055)	**0.0220*** **	(0.0055)	**0.0240*** **	(0.0058)
Rel. Industry Human Capital Ratio	**0.0187**	(0.0161)	**0.0188**	(0.0162)	**0.0287** **	(0.0175)
Relative Industry Capital Intensity	**-0.1133*** **	(0.0333)	**-0.1127*** **	(0.0333)	**-0.0990*** **	(0.0352)
Entry Rate	**-2.3160*** **	(0.0613)	**-2.3178*** **	(0.0613)	**-2.6043*** **	(0.0672)
sigma	**1.0896*** **	(0.0034)	**1.0903*** **	(0.0034)	**1.0946*** **	(0.0036)
Number of plants	**69927**		**69927**		**57868**	
Number of deaths	**48309**		**48309**		**44186**	
Number of Obs	**502591**		**502591**		**458279**	
Ward chi2	**4525.67**		**4466.60**		**4382.32**	

Note: Numbers in parentheses are robust standard errors. Regression results on constant, cohort dummies, and 2-digit SIC industry dummies are not reported due to space limitations. ***, ** and * indicate 1, 5 and 10 percent significance levels respectively.

Figure 4: Hazard Rates for Plants with and Without Ownership Changes—Pooled Sample

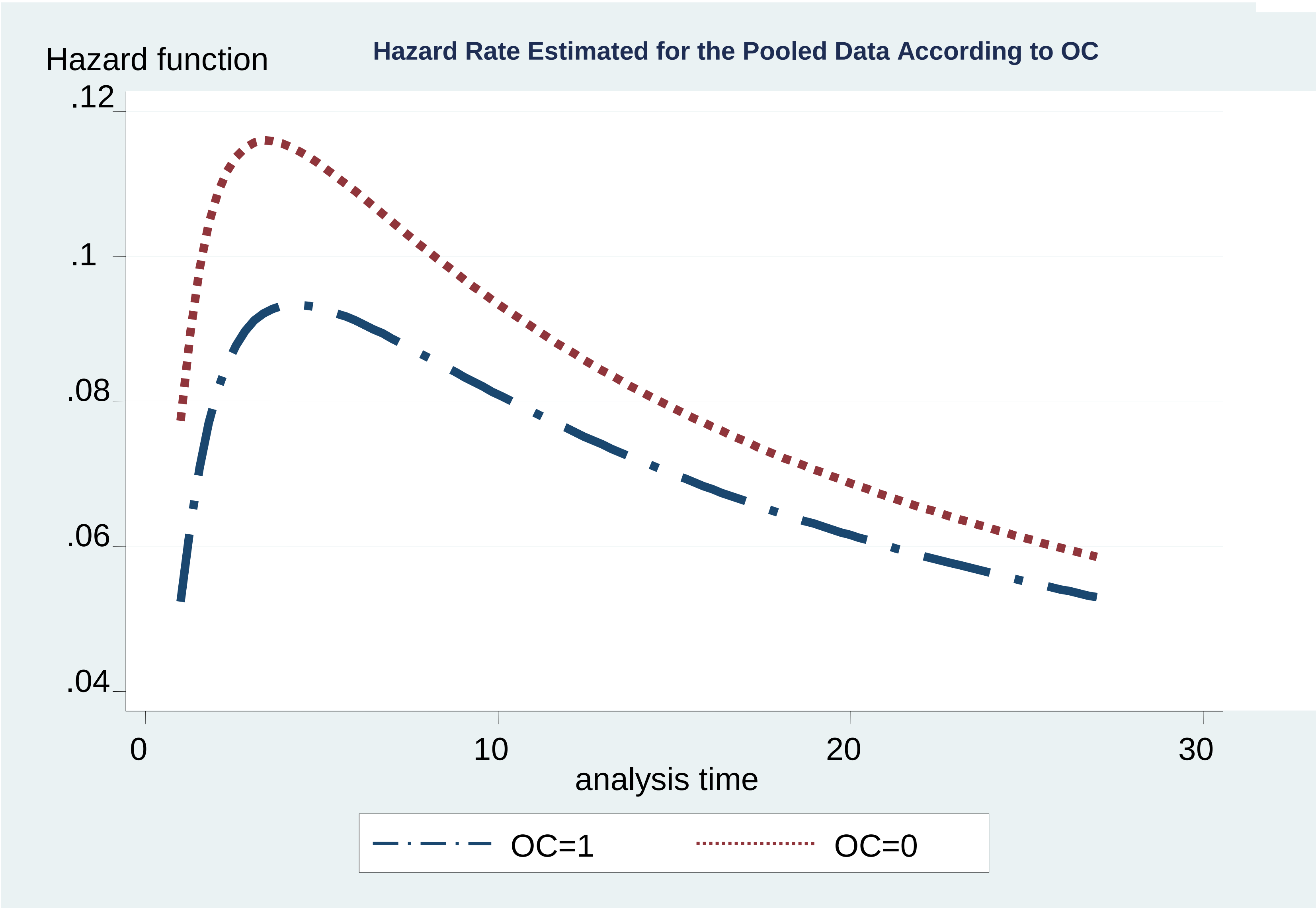


Table 6: Average Effects on Duration of Foreign and Domestic Acquisitions—Pooled Sample

Variables	(1) Baseline		(2) IV		(3) Long Cohorts	
FOC	**0.1328*** **	(0.0453)	**0.2227** **	(0.0844)	**0.1139** **	(0.0483)
DOC	**0.2636*** **	(0.0351)	**0.3814*** **	(0.0618)	**0.2344*** **	(0.0386)
Other plant controls						
Plant Size At Birth	**0.0009*** **	(0.0003)	**0.0010*** **	(0.0003)	**0.0009*** **	(0.0003)
Relative Plant size	**0.0797*** **	(0.0060)	**0.0803*** **	(0.0061)	**0.0911*** **	(0.0062)
Firm Level Controls						
Owner_Birth	**0.0364**	(0.0285)	**0.0348**	(0.0285)	**0.0504**	(0.0314)
Multi_Plant	**0.1232*** **	(0.0221)	**0.1277*** **	(0.0222)	**0.1054*** **	(0.0249)
Industry Level Controls						
Relative Industry Size	**0.0218*** **	(0.0055)	**0.0219*** **	(0.0055)	**0.0279*** **	(0.0058)
Rel. Industry Human Capital Ratio	**0.0187**	(0.0161)	**0.0188**	(0.0162)	**0.0287** **	(0.0175)
Relative Industry Capital Intensity	**-0.1131*** **	(0.0333)	**-0.1126*** **	(0.0333)	**-0.0987*** **	(0.0352)
Entry Rate	**-2.3159*** **	(0.0613)	**-2.3177*** **	(0.0613)	**-2.6043*** **	(0.0672)
sigma	**1.0895*** **	(0.0034)	**1.0903*** **	(0.0034)	**1.0946*** **	(0.0036)
Number of plants	**69927**		**69927**		**57868**	
Number of deaths	**48309**		**48309**		**44186**	
Number of Obs	**502591**		**502591**		**458279**	
Ward chi2	**4543.00**		**4479.86**		**4384.31**	

Note: Numbers in parentheses are robust standard errors. Regression results on constant, cohort dummies, and 2-digit SIC industry dummies are not reported due to space limitations. *** and ** indicate 1 and 5 percent significance levels respectively.

Figure 5: Hazard Rates Comparison between Foreign and Domestic Acquisitions—Pooled Sample

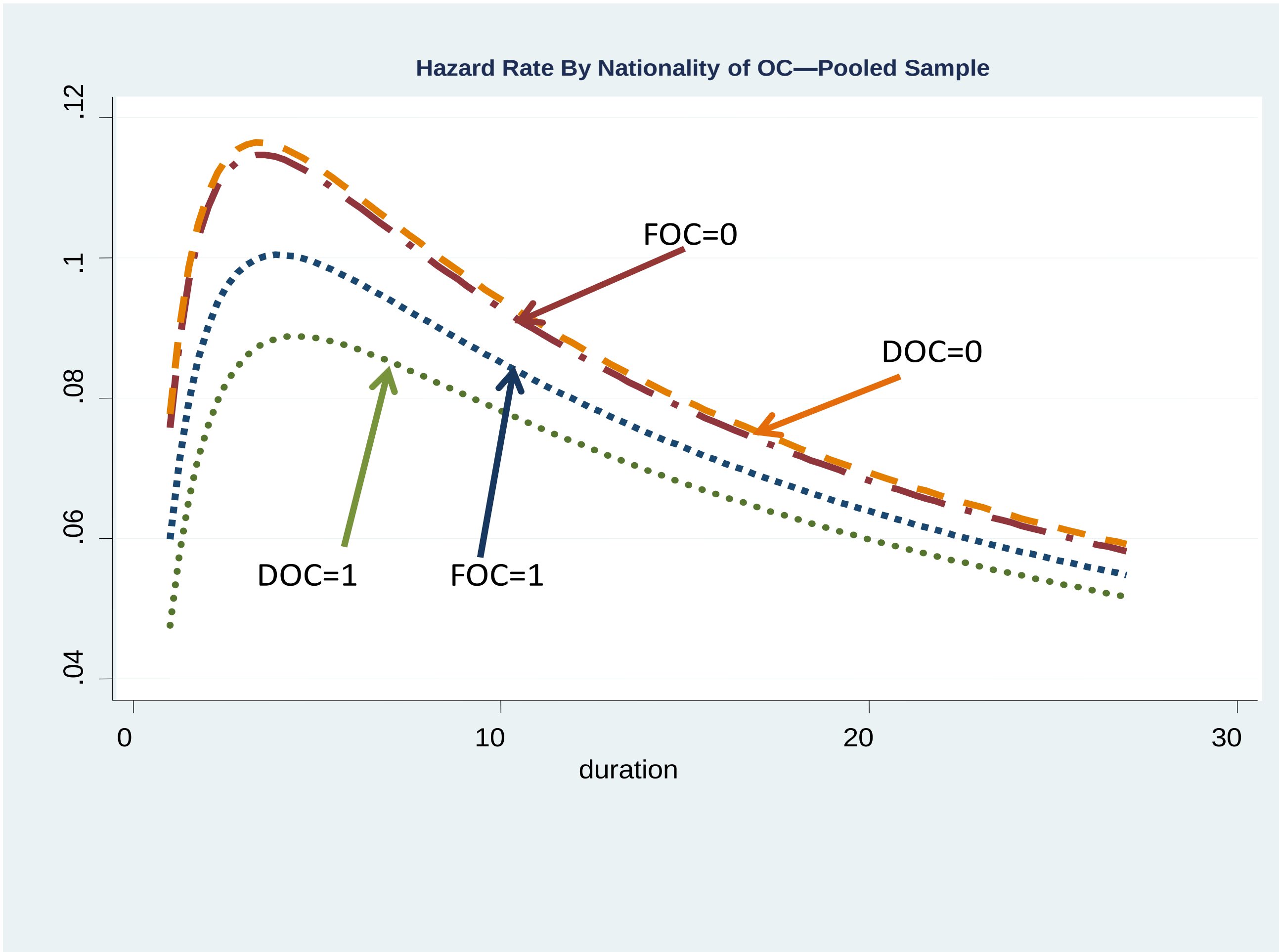


Table 7: Average Effects on Duration of Foreign and Domestic Acquisitions to Foreign- and Domestic-born Plants

variables	**(1) Baseline**		**(2) IV**		**(3) Long Cohorts**	
FFOC	**0.0658**	(0.0799)	**0.0643**	(0.1521)	**0.0694**	(0.0795)
FDOC	**0.2372***	(0.1251)	**0.3173***	(0.2171)	**0.1600**	(0.1349)
DDOC	**0.2659*****	(0.0364)	**0.3871*****	(0.0643)	**0.2421*****	(0.0402)
DFOC	**0.1709*****	(0.0551)	**0.3134*****	(0.1013)	**0.1394*****	(0.0602)
Other plant control variables						
Plant Size At Birth	**0.0009*****	(0.0003)	**0.0009*****	(0.0003)	**0.0009*****	(0.0003)
Relative Plant size	**0.0797*****	(0.0060)	**0.0802*****	(0.0060)	**0.0911*****	(0.0062)
Firm Level Controls						
Owner_Birth	**0.0455***	(0.0304)	**0.0465**	(0.0305)	**0.0600***	(0.0335)
Multi_Plant	**0.1228*****	(0.0221)	**0.1272*****	(0.0222)	**0.1049*****	(0.0250)
Industry Level Controls						
Relative Industry Size	**0.0218*****	(0.0055)	**0.0219*****	(0.0055)	**0.0238*****	(0.0058)
Relative Industry Human Capital Ratio	**0.0188**	(0.0161)	**0.0190**	(0.0162)	**0.0287***	(0.0175)
Relative Industry Capital Intensity	**-0.1137*****	(0.0333)	**-0.1134*****	(0.0333)	**-0.0992*****	(0.0352)
Entry Rate	**-2.3152*****	(0.0613)	**-2.3168*****	(0.0613)	**-2.6037*****	(0.0672)
sigma	**1.0896*****	(0.0034)	**1.0904*****	(0.0034)	**1.0946*****	(0.0036)
Number of plants	**69927**		**69927**		**57886**	
Number of deaths	**48309**		**48309**		**44186**	
Number of Obs	**502591**		**502591**		**458279**	
Ward chi2	**4558.19**		**4501.88**		**4390.25**	

Note: Numbers in parentheses are robust standard errors. Regression results on constant, cohort dummies, and 2-digit SIC industry dummies are not reported due to space limitations. ***, ** and * indicate 1, 5 and 10 percent significance levels respectively.

Table 8: Average Effects on Duration of Born-Domestic and Born-Foreign Plants

Variables	Born-Domestic Plants (Baseline)				Born-Foreign Plants (Baseline)			
	(1)		(2)		(3)		(4)	
OC	**0.2201*** **	(0.0320)			**0.0380**	(0.0730)		
FOC			**0.1597*** **	(0.0555)			**-0.0053**	(0.0835)
DOC			**0.2429*** **	(0.0371)			**0.1470**	(0.1250)
Other plant controls								
Plant Size At Birth	**0.0012*** **	(0.0003)	**0.0012*** **	(0.0003)	**0.0010** **	(0.0004)	**0.0010*** **	(0.0004)
Relative Plant size	**0.0905*** **	(0.0072)	**0.0904*** **	(0.0072)	**0.0308*** **	(0.0086)	**0.0307*** **	(0.0086)
Firm Level Controls								
Multi_Plant	**0.1109*** **	(0.0245)	**0.1105*** **	(0.0245)	**0.0336**	(0.0546)	**0.0352**	(0.0547)
Industry Level Controls								
Relative Industry Size	**0.0217*** **	(0.0060)	**0.0216*** **	(0.0059)	**0.0121**	(0.0135)	**0.0121**	(0.0135)
Rel. Industry Human Capital Ratio	**0.0328** **	(0.0164)	**0.0327*** **	(0.0164)	**-0.0527**	(0.0873)	**-0.0507**	(0.0873)
Relative Industry Capital Intensity	**-0.1455*** **	(0.0341)	**-0.1450*** **	(0.0341)	**0.4468*** **	(0.1654)	**0.4480*** **	(0.1654)
Entry Rate	**-2.3246*** **	(0.0620)	**-2.3149*** **	(0.0620)	**-1.9945*** **	(0.4097)	**-1.9963*** **	(0.4097)
sigma	**1.0836*** **	(0.0035)	**1.0836*** **	(0.0035)	**1.1850*** **	(0.0216)	**1.1850*** **	(0.0216)
Number of plants	**67100**		**67100**		**2827**		**2827**	
Number of deaths	**46711**		**46711**		**1598**		**1598**	
Number of Obs	**476975**		**476975**		**25616**		**25616**	
Ward chi2	**4265.43**		**4267.36**		**252.79**		**255.63**	

Note: Numbers in parentheses are robust standard errors. Regression results on constant, cohort dummies, and 2-digit SIC industry dummies are not reported due to space limitations. *** and ** indicate significance levels of 1 and 5 percent respectively.