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Firm-Specific Characteristics and the Timing of Foreign Direct Investment Projects

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Firm-Specific Characteristics and the Timing of Foreign Direct Investment Projects

by Horst Raff and Michael J. Ryan

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ABSTRACT

This paper uses a proportional hazard model to study foreign direct investment by Japanese manufacturers in Europe between 1970 and 1994. We divide each firm's investment total into a sequence of individual investment decisions and analyze how firm-specific characteristics affect each decision. We find that total factor productivity is a significant determinant of a firm's initial and subsequent investments. Parent-firm size does not have a significant influence on the initial decision to invest. Large firms simply have more investments than smaller firms. Other firm-specific characteristics, such as the R&D intensity, export share and keiretsu membership, also play a role in the investment process. JEL no. F23, L20

1. Introduction

Foreign direct investment (FDI) has replaced international trade as the main driving force behind the global integration of product markets. According to UNCTAD (2004), aggregate sales by foreign affiliates have exceeded world exports for more than two decades. If one looks at the firm level, the typical pattern behind this development has been that firms that used to supply foreign markets through exports from a production facility at home have established production plants in those markets to supply them locally. This raises a number of questions, including which kinds of firms will switch from exporting to FDI, at what point in time will they switch, and how many investments will they undertake. We address these questions using data on Japanese manufacturers' FDI into Europe during the period 1970 to 1994. In particular, we examine (i) how firm productivity, size and other firm-specific characteristics affect the likelihood and timing of a firm's first manufacturing project in Europe, and (ii) whether these same characteristics remain as FDI influences as the firm continues to invest.

The paper differs from previous studies of FDI in two ways. First, most of the existing FDI literature consists of proximity-concentration models that link the export-versus-FDI choice to country- and industry-level determinants, including factor endowments, market size, trade costs and economies of scale (see Markusen 2002 for a recent survey). The current paper is about firm-level influences on the choice of FDI and about heterogeneity in the investment behavior of firms, issues on which there has been comparatively little systematic research.[1]

Second, we track a firm's sequence of individual investment decisions, and are hence much better able than most previous papers to distinguish between those firm-specific characteristics that determine a firm's initial decision to invest and those influencing the firm's subsequent investments. Why this matters can best be illustrated using a hypothetical firm-level data set. Suppose there are four Japanese firms, as

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[1] Since Hymer (1960) and Horst (1972), firm-level empirical studies have identified a firm's size as the key determinant of its propensity to undertake FDI. Swedenborg (1979), Blomström and Lipsey (1991), and Trevino and Daniels (1994) have found firm size as well as R&D expenditures, export intensities, and previous investment experience all contribute to increased FDI likelihood. More recently, Helpman, Melitz and Yeaple (2004), Head and Ries (2003), Girma, Gorg, and Strobl (2004), and Raff, Ryan and Stähler (2007) have identified a firm's productivity as a determinant of the choice between exporting and FDI. See Greenaway and Kneller (2007) for a survey.

illustrated in Table 1, each with a different number of manufacturing investments in Europe between 1970 and 1994. Firm 1, for example, established a first affiliate early in the sample period, a second affiliate toward the middle of the period and then, in short order, two more affiliates (we do not consider subsequent investments into the same affiliate). Firm 2 set up only a single affiliate in the middle of the period, firm 3 established two affiliates, and firm 4 has three affiliates.

[Insert Table 1 about here]

Previous studies typically follow one of two approaches: (i) they pool all the investments for all the firms - so that there are 10 separate investments in total - and then examine how firm productivity, size and other characteristics influence the average investment decision; or (ii) they pool the investments of each firm and investigate how firm characteristics affect a firm's total number of investments (or the total amount of capital invested). Both approaches ignore information that is potentially very valuable in understanding FDI decisions. First, pooling the data implies that one cannot distinguish between how firm characteristics affect the likelihood of making a first investment and how they affect the likelihood of subsequent investments (and thus the investment total). Second, these studies disregard the inter-temporal nature of investment decisions. For instance, they do not take into account the option value of waiting to make an irreversible investment until the firm has learned more about demand and other host-country factors, or that firms may learn from earlier investments about the likely profitability of subsequent investments. Third, they fail to take into account possible interdependencies between the investments of a given firm, since they effectively treat each firm as a single-product/single-plant firm. But like probably most multinational firms, the ones in our Japanese sample typically have multiple product lines, and most likely multiple products within each line.

In the current paper we separate a firm's investment total into a sequence of individual investment decisions, and analyze how firm-specific characteristics affect the investment likelihood at each stage. In particular, we distinguish between those firm-specific characteristics that determine a firm's initial decision to invest and those influencing the firm's subsequent investments. We avoid sampling bias by including both investing and non-investing firms in our sample. Empirical analysis is through the proportional hazard model that focuses on the duration between events (investments),

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thus allowing us to focus on investment timing. The hazard model's temporal dimension allows a firm's time-varying characteristics (e.g., productivity, size) to be continually updated throughout the investment sequence. This will lead to increased estimation efficiency as compared to the (typically employed) empirical tests that use a single data point for each variable included in their analysis, while also allowing each individual stage of the investment sequence to be examined separately (see Cameron and Trivedi 1998: 8).

Estimation results indicate that total factor productivity is a significant determinant of FDI at each stage of the investment process: the more productive a firm is the more likely it is to undertake an investment and the shorter is the duration between investments. Firm size, by contrast, only matters for later stages, which simply means that large firms on average undertake more investment projects. These results are related in two ways to the previous literature.[2] First, they shed light on the "threshold effect" found in previous studies. Blomström and Lipsey (1991), for instance, find that only firms exceeding a certain critical size engage in FDI, whereas studies along the line of Helpman, Melitz and Yeaple (2004) suggest that only firms exceeding a critical level of productivity choose FDI. Specifically, we find such an effect only for productivity. Second, Blomström and Lipsey (1991) argue that firm size has no effect on the extent of a firm's investment, whereas papers on the role of productivity implicitly treat firms as single-product firms and thus have nothing at all to say about the extent of a firm's investment. Our paper shows that larger and more productive firms tend to have more investments.

We also obtain different results than earlier papers when we consider the effect of keiretsu membership on FDI. Specifically we find that keiretsu membership only significantly impacts investment at later investment stages. This means that keiretsu firms are not more likely than other firms to have a foreign manufacturing affiliate, they simply have more of them on average. By contrast, most of the theoretical and empirical papers

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[2] In addition to the papers already cited above, one should mention Chang and Rosenzweig (2001) who find that firm specific determinants of the entry-mode choice (wholly owned vs. joint venture) change over the investment sequence. Drake and Caves (1992) examine how the determinants of aggregate FDI flows change over time.

in this literature find that keiretsu membership raises the likelihood of investment.[3] Like in the case of firm size, the difference between our results and those of previous papers may be explained by the fact that we do not pool the FDI data: if we do pool that data, we arrive at the same conclusion as previous papers, namely that productivity, size and keiretsu membership all matter for the FDI decision.

This paper continues as follows. In Section 2 we present the theoretical framework, including our own model and a discussion of related theory papers. Section 3 contains the predictions. Section 4 describes the FDI data and the choice of control variables. Section 5 provides the empirical models, and Section 6 the estimation results. Section 7 concludes. The Appendix contains proofs and data sources.

2. Theoretical Framework

In this section we set up a model of a multi-product, multi-plant firm that exports various goods to a host country and has to decide whether and at what time to switch to supplying a good locally by setting up a production facility in the foreign country.[4] Consider a firm based in the home country (h) that manufactures differentiated goods in the production facilities that it has established there. We refer to this firm as firm h. It sells these goods at home and initially also exports them to the foreign country (f). Foreign demand grows at an exogenously given rate, and the firm has to decide whether and at what time to switch from exporting a good to producing it locally in the foreign country. The direct trade-off between exporting and FDI is the usual proximity-concentration trade-off: the firm saves transportation costs but incurs a sunk cost of setting up a new plant. We want to know how this trade-off and therefore the timing of investment projects is affected by (i) the firm's productivity, (ii) the number of goods it produces, (iii) the number of

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[3] For example, see recent empirical studies by Belderbos and Sleuwaegen (1996), Head, Ries, and Swenson (1999), and Blonigen, Ellis, and Fausten (2005).

[4] Various aspects of this decision problem have already been examined elsewhere. In Rob and Vettas (2003), for example, a single-product firm faces growing but uncertain demand in the foreign country and has to decide whether and at what time to invest abroad to install production capacity. They show that demand uncertainty tends to delay FDI. Horstmann and Markusen (1987) have a model, again of a single-product firm, in which demand is growing at a fixed rate but the firm faces potential entry from local rivals. Baldwin and Ottaviano (2001) examine the exporting-versus-FDI decision from the point of view of a multi-product firm, but do so in a static framework.

investments it has already undertaken, (iv) the degree of substitutability/complementarity among its products, and (v) the number of local competitors, i.e., market concentration.

To focus attention on firm h's investment decision, we assume that the markets in h and f are segmented, i.e., that there is no consumer arbitrage, and we let marginal production costs be constant. This implies that all FDI decisions are determined solely by the market equilibrium in country f. Firm h produces n goods, and sells quantities $x_1,\ldots,x_n$ in country f. The foreign market is also served by m foreign rivals. We think of these rivals as being "small" firms, where each produces only a single good for the local market. We denote their outputs by $y_1,\ldots,y_m$. The number of identical foreign consumers at time t is denoted by $N(t)$. Consumers base their demand for a good i at time t only on the price at t, $p_i(t)$. Assuming quadratic, quasi-linear preferences, the inverse demand at time t for a good i produced by firm h is:

$$p_i(t) = a - \frac{b}{N(t)}\left(x_i(t) + d\sum_{j\neq i} x_j(t) + e\sum_{k=1}^{m} y_k(t) \right), \qquad (1)$$

where $a > 0$, $b > 0$, d and e are time-invariant demand parameters. Parameter d measures the degree of substitutability between firm h's products. If $d=1$, they are perfect substitutes; if $0<d<1$, they are imperfect substitutes; if $d=0$, demands are independent of each other; and if $d<0$, they are complements. Parameter e measures the degree of substitutability between firm h's products and those of its rivals. We assume that the local firms' products are imperfect substitutes for those of firm h, i.e., $0<e<1$, but perfect substitutes for each other. The demand for a good l produced by a local firm hence is:

$$p_l(t) = a - \frac{b}{N(t)}\left(\sum_{k=1}^{m} y_k(t) + e\sum_{i=1}^{n} x_i(t) \right), \qquad (2)$$

When producing good i in country $j=h,f$, firm h incurs a marginal cost of $c_{ij} = w_j - \theta_i$, where w_j denotes the country-j wage rate and θ_i is a productivity parameter specific to good i. On each unit that firm h exports to country f it incurs shipping costs of s. We assume that the sunk cost of building a plant in the foreign country is G; this cost has to be incurred for each product. The local firms in country f have a marginal cost of w_f.

Firms maximize the present value of their profits and are able to borrow at a constant rate r to cover sunk costs. They engage in Cournot competition. We assume that

at time $t=0$ cost and demand conditions are such that firm h can profitably export all n goods to the foreign market in equilibrium; demand is too small to support a subsidiary in country f. Over time, the number of consumers in f and hence demand grows at a fixed rate. We see this assumption as a convenient shortcut to represent the more realistic scenario where demand increases come in spurts due to economic growth in Europe and the process of European integration.

3. Predictions

In this section, we characterize the investment strategies predicted by the model; first-order conditions and formal proofs of the results are provided in Appendix I. Two preliminary results help us in deriving the predictions. First, for a given investment strategy, per-capita output and profits in Cournot equilibrium are independent of t. This is simply a consequence of three assumptions, namely that consumers base their decision on current prices, that demand is linear, and that the marginal cost is constant.

Second, if $w_f < c_{ih} + s,$ then providing any given product i through FDI yields firm h a bigger profit, gross of the sunk cost of investment, than if it exported the product. This is due to the direct effect of having a lower variable cost and to the additional, strategic effect of gaining market share vis-à-vis local competitors.

Together, these preliminary results imply that as the market grows over time firm h will switch from exporting to FDI. More precisely, there exists a time t_1 at which the firm will switch to FDI in one good, since demand has grown large enough to compensate for the sunk cost associated with FDI. There also exists a time $t_2 > t_1$ at which the firm will undertake a second investment, and so on.

We can now examine the influence of the time-invariant parameters on t_1 and t_2. The impact of country- and industry-specific variables is the same as in the standard proximity-concentration models. An increase in per-capita demand makes it more attractive to save transportation costs by engaging in FDI. Higher home relative to foreign wages, higher transportation costs and lower sunk costs of establishing a

subsidiary also make FDI more profitable and hence reduce the time to investment. The number of foreign competitors, i.e., industry concentration, has an ambiguous effect.[5]

Firm-specific characteristics have the following effects. The greater is firm h's productivity, the bigger is the firm's market share and hence the more profitable is FDI and the shorter is the time to investment at each stage. The size of a firm in our model also depends on the number of goods it produces. This number has an ambiguous effect on the FDI decision, since the effect depends on the degree of substitutability or complementarity between goods. However, we can prove that if firm h's goods are imperfect substitutes, t_2 will be delayed due to a cannibalization effect, i.e., the fact that the second product will take market share away from the first product. In particular, Suppose that $1>d>e>0$ so that firm h's products are imperfect substitutes, but better substitutes for each other than for the goods produced by local firms. Then, ceteris paribus, the time to the first investment is shorter than the time between the first and second investment.

An important consideration of the investment timing decision that we did not analyze in our model is demand uncertainty. However, Rob and Vettas (2003) provide clear predictions about the effect of demand uncertainty that we can use almost directly for our empirical analysis. Since uncertainty about demand (and other relevant host country parameters) tends to delay FDI and since a firm's estimates of these parameters are likely to improve as it gains investment experience, we would expect later investments, ceteris paribus, to be made more quickly than a first investment. We can test this prediction directly using a Kaplan-Meier test; more on this later.

4. Data and Descriptive Statistics

Our sample consists of the investments of 286 Japanese manufacturing firms. [6] Inclusion into the sample was dependent upon meeting the following criteria: availability of firm-

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[5] If all products were homogeneous and marginal costs were identical across firms, the effect of a greater number of foreign firms clearly would be to reduce the attractiveness of FDI. The ambiguity hence comes from the different degrees of substitutability/complementarity between goods and cost heterogeneity.
[6] See the Appendix II for details on data collection.

specific data for the entire sample period (1970-1994),[7] and for the firm's entire European manufacturing FDI to occur after 1969. The choice of this time period (1970-94) follows the Japanese government's initial deregulation of outward Japanese FDI in 1969.[8] This time period also allows us to avoid the impact of the Asian financial crisis on outward FDI as well as the number of mergers/acquisition between Japanese firms in the late 1990s that would have significantly decreased the number of firms in the sample.[9]

Once selected, investments in which the firm's shareholding stake is below 10% were eliminated from the firm's investment history. Of the 286 firms, each of which is listed on one of the Japanese stock exchanges, 176 firms established manufacturing affiliates in Europe, 103 had only non-manufacturing FDI, and 7 firms did not establish any European affiliate during this period. 184 firms were keiretsu members.

The sample contains a total of 372 manufacturing investments with 269 (72%) of these investments made by keiretsu members. While the average date of initial manufacturing investment is earlier for keiretsu members (1983) than for non-members (1985), pre-1986 manufacturing investments as a percentage of a firm's investment total does not vary significantly according to keiretsu affiliation. Also, 57% of all Japanese MNEs that ultimately invested in Europe by 1994 had already done so by 1985, indicating that much of the Japanese investment into Europe between 1985-1994 was from experienced investors and not from firms new to the European market. Finally, keiretsu membership does appear to affect the number of investments, as members established on average 2.2 affiliates, slightly more than the 1.79 affiliates for non-members.

There are several methods to examine the duration between investments. There is an average duration of 4.5 for the establishment of a second affiliate, and 4 years for the

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[7] Hazard models are quite data intensive as they require data from each period (year) in the sample, in contrast to other typically used models (e.g., logit, probit) that require just a single data point for each observation, whether it be contemporaneous or lagged data, or an average across the sample period. Thus, only firms with complete data are included in our sample.

[8] Pre-1970 investment was quite limited, in part by the 1949 Foreign Exchange and Foreign Trade Control Law that essentially required Japanese government approval of all foreign direct investment until deregulation began in 1969. See Mason (1994) for more details. By 1994, investment into European manufacturing affiliates by the sample firms had fallen to 1973-levels.

[9] The reorganization of Japanese multinationals in the late 1990s was also due to European integration and new investment opportunities in Central and Eastern Europe.

establishment of a third, if all (including right-censored) durations are considered.[10] For the same investment spells, the average duration rises to 5.2 (4.2) years if only those durations between established affiliates is considered; the rise is a result of the large fraction of single- and double-affiliate investors that invested late in the sample, creating numerous short (right-censored) second and third duration spells. If we account for the year of the firm's initial investment, we find that duration spells have fallen since the 1970s; for instance, the average duration between first-second investment and second-third investments fell from 7.9 (5.9) years for firms initially investing between 1970-1974 to 3.0 (1.5) for those investors initially entering between 1985-1989. While this does suggest a "catch-up" by late-investing firms, we are most concerned with the general result (as illustrated in the Kaplan-Meier plots) that subsequent investments, regardless of duration measure, occur more rapidly than the previous investments.

Our model suggests that we should include two categories of explanatory variables: firm-specific characteristics, and country- and industry-specific controls. Here is how we proxy for them.

4.1 Firm-Specific Characteristics

According to the model, a firm's productivity and size play an important role in its investment strategy. Data availability allows us to measure a firm's total factor productivity (*TFP*) via the Levinsohn-Petrin (2003) method. Our model suggests that the greater is the firm's productivity, the shorter is the time to investment at each stage.

A firm's total assets (in billions of 1993¥) are included as a measure of firm size (*Size*). The data is lagged by one year to eliminate possible endogeneity and to account for the potential time lag between the investment decision and the actual investment that shows up in our database. *Size* is positively correlated with *TFP*, as indicated by the model; but the correlation is only moderate: 0.261 (see Table 2). An alternative measure of firm size is the parent employment levels (*Employ*). This measure is highly correlated with *Size* (correlation coefficient: 0.654), and we hence use it only for robustness checks.

[Insert Table 2 about here]

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[10] While certainly possible, our dataset includes no firms that simultaneously establish multiple affiliates.

A firm's size also can also be measured through the range of products it produces. While the data for the Japanese firms that comprise our sample does not indicate an exact number of product lines and we do not know the degree of complementarity among these lines, we are able to determine the percentage of sales disaggregated by the firm's major business lines or specific corporate branches. In most cases, this information is available at the 2- or 3-digit SIC level. We use this sales data to create a firm-specific Hirschmann-Herfindahl Index (*HHI*), calculated as the sum of the squared sales percentages for each business line listed for the firm by the dataset. The index values range from 0 to 10,000, with larger values indicating a less diversified corporation in terms of its sales breakdown. Note that the *HHI* is positively, but moderately correlated with both *Size* and *TFP*. No a priori prediction can be made on the *HHI* index's effect on FDI, given the unknown degree of complementarity between product lines.

In addition to the HHI index, we also evaluate possible cannibalization or complementarity between products by identifying the affiliate's main business line. We create the variable *Diversification* to measure the degree of diversification in the parent's investment strategy. For each affiliate established by a Japanese parent, *Diversification* takes the value of 1 if it is established in an industry different from those previously established, and 0 if the affiliate is in the same industry as a previously established affiliate. For the first manufacturing affiliate established by each firm, a 1 is given if the affiliate's main business line differs from the parent's core business line, and 0 if it is the same. Determination of the affiliate's main business line occurs at the 3-digit SIC level.

In the model section, we assume for simplicity that all of the firm's products are initially exported. Obviously this is not the case in practice, where the firm will export only those goods that it can manufacture at a high enough level of productivity to be able to compete with local producers of substitute goods and to justify the transportation costs (and possible additional fixed exporting costs that we do not model). Hence the firm's annual export share (*Exprt*), computed as the ratio of export sales to total sales in a given fiscal year, should also be an indicator of the firm's productivity and competitiveness.[11] *Exprt* and *TFP* are indeed positively correlated as indicated by Table 2. Annual R&D intensity (*R&D*) is measured by the ratio of R&D expenditures to total sales for the fiscal

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[11] Note that actual exports to Europe are not available at the firm level.

year. It constitutes another indicator of the firm's productivity and ability to compete with local rivals.[12] *Exprt* and *R&D* are lagged by one year to account for possible endogeneity. Both *Exprt* and *R&D* should have a positive influence on the likelihood of FDI at each point in time.

Next, we also want to account for the obvious fact – not dealt with in the model – that a firm may gain knowledge or experience from investment projects that is useful for subsequent projects. For each firm, the number of previously established European manufacturing affiliates (*PrevManufInvst*) is determined at the time of each investment. Use of this *PrevManufInvest* alone limits investment history heterogeneity to differences in previous investment totals. As a result, we also include the size of the firm's European distribution and service network (*PrevNonManufInvst*) that is determined by the count of all previously established non-manufacturing European affiliates at the time each manufacturing affiliate is established. The establishment of a distribution network typically precedes investment into manufacturing. While this may lengthen the time to a manufacturing investment, e.g., if managerial or financial resources are scarce, having an established distribution network may also be helpful in establishing a manufacturing affiliate, e.g., because it provides information and contacts with customers. We also include the length of the firm's previous manufacturing investment spell (*PrevDuration*) to control for previous investment timing. This variable allows for firms with similar investment totals to have different previous investment experiences based on when the previous investments occurred.

A caveat for our analysis is that we do not control for the fact that firms in our sample may invest not only in Europe, but also in North America and East Asia. If these firms require time to digest these (unobserved) investments and recover their financial position, this should be reflected in the durations between investments.

4.2 Additional Controls

We control for industry-specific influences using industry affiliation dummies created for each investing parent at its 2-digit SIC code. With regard to country-level influences note that in our empirical analysis we treat Europe as a single country, controlling for changes

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[12] Firms' 1986 R&D expenditures are used for the years prior to 1986 when R&D expenditure data was not available. See Padmanahban and Cho (1996).

in country-level influences over time with a time dummy and by including European GDP (*EuropeanGDP*), measured in constant US dollars.[13]

Since we are dealing with Japanese FDI, we have to control for the existence of "horizontal" and "vertical" keiretsu. Membership in such a keiretsu is believed to increase FDI likelihood as compared to non-members and non-Japanese MNEs with similar firm-specific characteristics. Keiretsu affiliation and the firm's inclination toward its particular keiretsu are located in various editions of Dodwell Marketing's *Industrial Groupings in Japan*.[14] For the purposes of this study, the dummy variable *KeiretsuMember* takes a value of 1 if the firm is keiretsu member, with the dummy variables *HorizontalKeiretsuMember* and *VerticalKeiretsuMember* taking the value 1 if the firm is affiliated with a horizontal or vertical keiretsu, respectively. Note that we do not use all three variables in the same regression; rather we will use *KeiretsuMember* in most regressions, and on occasion use the *HorizontalKeiretsuMember/VerticalKeiretsuMember* pair. All three variables are expected to have a positive affect on a firm's propensity for investment. In addition, we will interact the membership dummy variables with *Size* and *TFP* to measure size and TFP differentials between keiretsu members and non-members.

Finally, we control for three measures of the firm's financial health: *GrossRevenue*, calculated as the firm's gross revenue divided by its total assets; *InterestBurden*, calculated as its interest payments divided by gross revenue; and *CashFlow*, which is a measure of its post-tax profits plus depreciation divided by gross revenue. A priori, we expect *GrossRevenue* and *CashFlow* to positively influence investment likelihood, while a higher *InterestBurden* should negatively affect investment likelihood.

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[13] Since Japanese affiliates in Europe often serve the entire European market, we do not consider the question of where in Europe a firm may chose to invest. To address this question properly we would have to estimate multiple hazard models, one for each potential host country.
[14] The Dodwell keiretsu classification system is chosen over other systems because it applies the most rigid standards to group affiliation. See Belderbos and Sleuwaegen, note 10 (1996).

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5. Econometric Estimation

5.1. Kaplan-Meier Estimation

The first prediction we want to test is that uncertainty about demand (and other relevant host-country parameters) tends to delay FDI and that, as a firm's estimates of these parameters improve with experience, later investments are made more quickly than the first investment (see Rob and Vettas, 2003). We can test this prediction using a Kaplan-Meier test. To do so, note that in a repeated investment model, an observation is defined as a distinct time spell until an investment occurs. For firms with multiple investments, individual spells are recorded for each investment. For example, a firm establishing two manufacturing affiliates in 1982 and 1991, respectively, generates three spells, the third of which (1992-1994) is right-censored. A single right-censored spell of 25 years is created for firms without a manufacturing affiliate. Left-censoring is not a consideration, as none of the sample firms established a European manufacturing affiliate prior to 1970.

Following Kiefer (1988), let T be a random variable that measures the duration between spells with the probability distribution $F(t)=Pr(T<t)$ and corresponding density function $f(t)$. The survivor function, or the probability that the duration between investments survives beyond time t is defined as $S(t)=1-F(t)=Pr(T\geq t)$. In addition, the duration between investments can be characterized by the hazard function $\lambda(t)=f(t)/S(t)$. $\lambda(t)$, the conditional probability that investment occurs shortly after t, given that investment has not taken place at time t, is precisely defined as

$$\lambda(t) = \lim_{h \to 0} Pr(t \leq T \leq t+h \mid T \geq t)/h \tag{3}.$$

The shape of $\lambda(t)$ indicates duration dependence. Positive duration dependence, $d\lambda(t)/dt>0$, indicates that the probability that an investment will occur increases with spell length, while $d\lambda(t)/dt<0$ indicates negative duration dependence.

[Insert Figure 1 here]

Figure 1 plots the Kaplan-Meier hazard function estimates of (3) by position in the investment sequence, where each curve corresponds to an individual investment spell. Note that each individual-stage hazard function displays positive duration dependence, indicating that at no time during the investment process do firms cross a threshold upon

which FDI likelihood decreases.[15] However, this desire for new investment is not uniform across location in the investment sequence. A Mantel-Cox log-rank test for hazard function equality reveals significant differences among hazard rates at each investment stage, indicating that investment likelihood increases over the firm's FDI sequence, as we expected.

5.2. Cox Proportional Hazard Model

Although the Kaplan-Meier results indicate differences in investment likelihood across individual investment stages, these results do not allow us to examine how firm-specific factors affect investment likelihood at each stage. For this purpose, we apply a Cox (1972) proportional hazard model. A semi-parametric partial likelihood model, the Cox model allows us to model the effects of the explanatory variables parametrically, while not requiring a parametric functional form for duration dependence. For this reason, as well as for the ability to include and update values for each time-varying covariate, the Cox model is preferred to fully parametric specifications.

The Cox model can be formulated as

$$\lambda_i(t) = \lambda_o(t)exp(\ \beta'x_i(t)) \tag{4}$$

where $x_i(t)$ represents a vector of the ith firm's covariates at time t, assumed to capture the effect of the firm-specific characteristics that influence investment likelihood. $\lambda_o(t)$ is the "baseline" hazard function (with unknown parametric form); it takes the interpretation as the hazard rate for the respective firm when all independent covariates are set to 0. $\lambda_i(t)$ is the proportion of $\lambda_o(t)$ determined by the effects of the firm-specific explanatory variables. We assume a multiplicative relationship between the covariates and the baseline hazard; in effect, each explanatory covariate affects the baseline hazard proportional to its effect on FDI likelihood. Firm-specific characteristics that positively influence investment are associated with higher investment hazards, which correspond to greater investment likelihood, whereas variables that negatively influence investment likelihood yield lower investment hazards. As we report our coefficient estimates via a

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[15] In the FDI literature, Kaplan-Meier tests have often been used to examine the survivor function $S(t)$ of newly established firms, finding that survival rates decline as the firm ages. In contrast, we focus on the opposite case, or the likelihood of establishing a new firm, and thus produce a figure (Figure 1) opposite of that found in the firm survival literature.

hazard ratio,[16] variables that positively (negatively) affect investment produce hazard ratios greater than (less than) 1.

Finally, as the Cox model is a continuous model while the investment data and explanatory variables are measured discretely, ties in spell duration length may occur. Breslow's (1974) approximation is employed to account for such occurrences.

The underlying assumption of the study is that initial investment spells begin in 1970. Initial firm- and macro-level characteristics are set to 1970 values, although they may be functions of prior values and may hence not truly be "initial." However, the initial conditions bias suggested by Heckman and Singer (1984) is avoided as strict restrictions on Japanese FDI in manufacturing existed prior to the Japanese government's 1969's five-stage deregulation of outward FDI controls (Mason, 1994). Therefore, the earliest most firms could establish foreign manufacturing affiliates was 1969, for which their 1970 firm-specific covariate values serve as good approximations.

6. Estimation Results

Estimation results (Tables 3-5) are provided to indicate how firm-specific characteristics affect both the likelihood of initial investment as well the likelihood of subsequent investment.

6.1 Pooled Investment Estimation

Table 3 provides estimates for the sample firms' pooled investment histories. While regressions based on pooled investment data are typically used to determine how firm-specific characteristics affect a firm's foreign investment, here they are provided only to compare the overall fit of the data in relation to previous studies. In Tables 4-5, the first three investment stages (1st, 2nd, and 3rd investment) are examined separately to indicate how the firm's characteristics affect investment at each stage. For both the pooled and individual stage regressions, two separate specifications are examined: the first uses *KeiretsuMember* to differentiate between keiretsu and non-keiretsu members, while the second employs *VerticalKeiretsuMember* and *HorizontalKeiretsuMember* to distinguish

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[16] Hazard ratios are determined as the exponentiated linear prediction, or exp(xβ).

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between non-keiretsu members and those who are members of vertically-oriented or horizontally-organized keiretsu.

Table 3 reveals several important results. Firm size has the predicted positive and significant influence on investment, regardless of whether we control for *Size* alone (column 1), or *Size* with *TFP* (columns 3-5). From the keiretsu-size interactive dummy variable (column 4), which measures size differentials between keiretsu members and non-members, the impact of size on investment appears similar regardless of keiretsu membership status.

[Insert Table 3 here]

We also find that a firm's Levinsohn-Petrin *TFP* measure positively and significantly affects its investment likelihood. In column (2) we include *TFP* without also controlling for firm size, while in columns (3) – (5) we control for both *Size* and *TFP*. In each case, both *TFP* and *Size*'s influence on investment likelihood remain, even with the positive correlation between the two variables.

In regard to the other firm specific variables, the *HHI* coefficient is significantly less than 1 across all specifications, indicating its negative relationship with investment likelihood. This suggests that a greater concentration in firm sales leads to less FDI possibly due to worries about cannibalization effects. A cannibalization effect may also be underlying the *Diversification* variable coefficient estimate, which reveals that a firm's future investment is more likely to come in an industry different than in previous investments.

Firms' *R&D* intensities and export ratios have a significant and positive affect on FDI. The hazard ratio for previous manufacturing experience (*PrevManufInvst*) is significantly greater than 1, indicating that the number of previous manufacturing investments greatly increases the firm's future investment likelihood. Just as importantly, the coefficient on the *PrevNonManufInvst* is significantly less than 1, indicating that investment into wholesale/retail affiliates tends to push off investment into manufacturing.[17]

Keiretsu membership is shown in columns (1) - (4) to be a significant influence in the pooled investment sample, regardless of the firm size/productivity measures

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[17] Note that while we also control for European GDP as a measure of demand, it is never a statistically significant investment influence.

employed, suggesting that group members gain from at least one of the aforementioned keiretsu investment "benefits". As indicated in column (5), both horizontal and vertical keiretsu membership increases investment likelihood, with the marginal impact of vertical membership greater than that of horizontal membership. Finally, the firm's debt interest burden and cash flow had only slight impacts on the investment decision.

We conclude from Table 3 that the predictions of our model appear to match up well with the data. In cases where we expected positive influences on investment, the data support our conclusions. Where we had no *a priori* expectations, such as in the case of the firm's Hirschann-Herfindahl sales index, the results are consistent with the presence of a cannibalization effect. Moreover, using pooled data we are able to reproduce the literature's standard findings on how firm size, productivity and keiretsu membership affect FDI.

Of course, we did not select the hazard model to analyze pooled data, but rather because it allows us to examine individual investment steps. The results for the individual investment stages are presented next.

6.2. Individual Spell Regressions

Viewing each investment decision separately allows us to tell exactly when in the investment process the explanatory variables generate their influence. In a repeated spell specification firms' investment histories are partitioned by investment (first, second, third,…); we choose to focus on the first three individual stages, as they account for the complete investment history for 92% of our sample firms. Each stage is examined separately under the assumption of weak exogeneity between investment stages, so influences on the first investment can be viewed separately from those on subsequent investments.[18]

Separate analysis of each investment stage requires that the unobserved heterogeneity associated with previous stages be taken into account. Inclusion of variables that measure past history *(PrevManufInvest, PrevNonManufInvest)* in each regression satisfies this requirement. Table 4 displays the results of Cox regression analysis of the first investment stage, which indicates the stage at which the firm first

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[18] See Ross (1996) for justification of this approach.

becomes a manufacturing MNE in Europe, while Table 5 displays the estimation results for the second and third individual stage, which represent the firm's expansion of its European manufacturing network. Note that at each stage, *PrevManufInvst* drops out of the regression, as it is the same for all firms.

[Insert Tables 4-5 about here]

Combining the results from Tables 4-5, several of the strongly significant FDI influences from the pooled regression do not retain their significance at each individual investment stage. For instance, it appears that the "hurdle" of establishing a manufacturing presence in Europe is not associated with a firm's size, as in the first investment decision *Size* is shown to be an insignificant influence on investment. It is only later, at the third investment stage, that firm size becomes an important investment determinant. This suggests that larger firms tend to have more investments than smaller firms, but are not more likely to become multinational firms. In contrast, *TFP* is shown to be a highly significant investment influence at each investment stage, including the first stage, indicating that productivity levels tend to increase investment likelihood throughout the investment sequence. Thus, while it is not the case that all firms have at least one investment (recall that in our dataset, only roughly two-thirds of the firms have manufacturing investments), these results suggest a high degree of *Size* and *TFP* heterogeneity among firms with at least one manufacturing investment. On the other hand, however, it appears that only the largest and most productive firms have larger manufacturing networks, and that smaller, less productive firms have not established such systems.

A firm's status with regard to keiretsu membership appears not to play a role in the decision to start manufacturing operations in Europe. With keiretsu membership not a significant FDI influence at the first and second investment stages, but rather only a significant FDI determinant at the third investment stage, membership appears to have no role in the firm's initial investment decision. This would suggest that keiretsu members and non-members are equally likely to become MNEs, a result on the surface to contradict most previous empirical studies on the keiretsu-investment link. However, recall that most of these studies found the keiretsu-investment link using pooled investment data. This is exactly what we found in Table 3. However, by using the hazard model, this study is able to isolate the result that it appears that keiretsu members are

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simply more likely to have more investments. As a result, the keiretsu traits of informational exchanges, cross-ownership of stock, and eased capital market restrictions associated with firms' association with member banks, do not appear to have a significant effect on the decision to initially establish a manufacturing affiliate in Europe, but rather, membership appears to be mostly associated with increased investment totals. This indicates that the "credit channel" benefit of membership may not pertain to the ability to become a MNE, but rather the ability to expand holdings abroad.[19]

Similarly, a firm's *HHI* index, while a significant investment deterrent in the pooled investment sample, does not affect a firm's initial or second investment decision. Much like *Size* and *KeiretsuMember*, *HHI* only plays a significant role for the firm's third investment. There *HHI* has a negative effect. In contrast, *Diversification* affects all stages of the firm's investment sequence. Hence large firms with diversified product lines are the ones most likely to set up several affiliates abroad.

Similar to the *TFP* result, it appears that the hurdle of becoming a MNE may be better overcome by firms that are active in export markets and invest heavily in R&D. Both a firm's export ratio (*Exprt*) and *R&D* intensity are strongly significant determinants of initial investment. In the case of *R&D,* while it has a highly significant ($p<0.01$) affect on initial investment, its significance in impacting FDI declines at each investment stage, and by the firm's third stage, it no longer affects the investment decision.

We also find that previous investment into non-manufacturing, highly significant in the pooled investment regressions, significantly reduces the likelihood of initial investment, which suggests that firms choose to enter foreign markets through wholesale/retail affiliates as stepping stones to subsequent local production. However, once the firm has committed to producing abroad, the role of *PrevNonManInvst* diminishes as expected, and *PrevNonManInvst* does not impact subsequent investment decisions. Finally, the firm's financial health had little impact on the decision to become a MNE. *InterestBurden* and *CashFlow* only marginally affect the first and second-stage decisions, with none of the three variables impacting the third investment stage.

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[19] Results not shown here also indicate vertical keiretsu members are more likely to have three investments as compared to horizontally affiliated members. We also find that, using a keiretsu-size interactive dummy variable, keiretsu firms with three investments were much smaller than non-members with similar investment totals, which suggests that member firms may indeed be following the group's main (and larger) firm abroad.

Altogether these results suggest that firm-specific influences change over the investment sequence, and that these changes would not be recognized in a pooled investment history framework. Interestingly, *Size* and *TFP* have different impacts on investment over the entire sequence, suggesting that it is productivity, and not asset holdings, which help firms overcome the barrier to establishing a manufacturing presence in Europe.[20]

6.3 Robustness Check and Multiple-Investor Regressions

We conduct several checks on the robustness of these results. First, in regressions not reported here, we replaced *Size* with parent employment levels (*Employ*), and found similar results. This is not surprising given the relatively high pair-wise correlation between the two variables of 0.654 (Table 2). Next, we take the natural log of each of the firm-specific characteristics (excluding keiretsu membership) and perform similar regressions to those indicated in Tables 3. With one exception, our original results hold; the exception is in the *HHI* index, which in most specifications now carried coefficients of around 0.642, representing a much more highly significant negative influence on investment likelihood than in the previous specifications.

Finally, one may look at the regression results from the individual stages and wonder if our results are being generated by firms leaving the sample at each stage. That is, firms in the sample for the second investment stage regressions (Table 5, columns (1)-(3)) have made one previous manufacturing investment, while firms in the "Third Investments" sample (Table 5, columns (4)-(6)) have established two previous manufacturing investments. As a result, firms with only one established manufacturing affiliate at the end of our sample are not included in the regression analysis of this stage.

Could it be that, by realizing a change in the sample firms as we proceed through the investment stages, we are biasing our results? To check this, we restrict the sample to those firms that establish at least 3 manufacturing investments, and re-run the Cox

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[20] We are grateful to a referee for suggesting an alternative interpretation of the results, based on the notion that TFP represents a short-run characteristic of the firm – in the sense that it fluctuates in the short run – , whereas size, keiretsu membership and HHI represent long-run determinants. TFP may then reflect the short-run affordability of each investment project, whereas the long-run determinants indicate a firm's ability to carry out multiple investments.

regressions at each investment stage. Our results, reported in Table 6 for the firms'

pooled, first, and second investment stages,[21] generally support our findings from our

previous estimation that saw firms leave the sample at different investment decision

stages. With this restricted sample, we find that keiretsu membership, firm size, and the

HHI index all do not affect the firm's initial investment decision, even though in the

pooled investment regressions they are found to be highly significant determinants.

Similar to the full sample regressions, we see that *TFP* is significant for both the pooled

sample as well as in each individual stage. We also find that previous non-manufacturing

investments increase the time to first investment (decreased investment likelihood), while

having no statistically significant impact on subsequent investments. Thus, it appears that

our results are robust to the changing dataset as we move through the investment

sequence, and the full sample results are not generated by firms simply leaving the

sample as their investment sequence ends.

[Insert Table 6 about here]

Finally, concerns over multicollinearity typically arise when working with firm-

specific data, especially in regard to firm size, TFP, and exports. Although Table 1

suggests low pair-wise correlation between these variables, and the inclusion of *TFP* and

Size does not affect each variable's coefficient estimates when included together in the

regression analysis, we do wish to consider that there may be multicollinearity within the

other group of firm specific variables. In Appendix Table 1, we sequentially add each

firm specific variable into the model estimating the pooled investment data for the entire

sample of firms. Analysis of these results suggests that there is no significant

multicollinearity in our dataset.

7. Conclusions

This paper examined how firm-specific characteristics affect a firm's decision to

establish an overseas affiliate and, thereafter, to expand its overseas operations. The use

of a hazard model allowed us to analyze each individual investment stage separately. This

revealed that the determinants of investment decisions change over the investment

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[21] Third stage regression results are nearly identical to those found in Table 5, columns (4)-(6), since there is approximately the same number of firms in each sample; thus, we do not repeat these results here.

sequence. Specifically, we find that total factor productivity has a significant positive impact on the likelihood of investment at each stage, whereas firm size and keiretsu membership only become significant for later investments. In other words, the more productive a firm is, the greater is the probability that it undertakes an investment, no matter whether this is the first or a subsequent investment. Larger firms and keiretsu members, however, are no more likely to undertake an initial investment than smaller firms or firms without keiretsu ties. They simply have more foreign affiliates on average. The opposite effect is observed with respect to a firm's R&D intensity, export ratio, and previous non-manufacturing FDI: they only significantly affect the firm's initial investment.

Our conclusions, specifically with regard to firm size and keiretsu membership, differ from those in the existing literature. We showed that this is likely to come from the fact that previous studies have pooled the investment data and thereby ignored information that is important for understanding the FDI decision. In particular, these studies cannot distinguish between factors that determine a firm's investment total and those that affect the decision to set up an initial subsidiary. Strictly speaking, pooling the investment data is only justified if multinationals are single-product firms. But this is simply not the case in reality. By contrast, our approach and our results are fully consistent with a world in which multinationals are multi-product firms and where firm size is not only a function of productivity but also of the scope of the firm's product range.

Appendix I: Proofs

Each period, firm h chooses output to maximize $\sum_{i=1}^{n}(p_i(t)-c_{ij}-\lambda_{ij}s)x_i(t)$, where $p_i(t)$ is given by (1) and the indicator variable λ_{ij} equals 1 if good i is produced in country h and zero if it is produced in country f. The corresponding first-order condition for a product i is:

$$a-2\frac{b}{N(t)}\left(x_i(t)-d\sum_{j\neq i}x_j(t)\right)-\frac{b}{N(t)}e\sum_{l=1}^{m}y_l(t)-c_{ij}-\lambda_{ij}s=0. \tag{A.1}$$

Summing over all n first-order conditions for firm h, and letting $X(t)\equiv\sum_{i=1}^{n}x_i(t)$ and $Y(t)\equiv\sum_{l=1}^{m}y_i(t)$, we have

$$na-\frac{2b(1+d(n-1))}{N(t)}X(t)-\frac{ben}{N(t)}Y(t)-\sum_{i=1}^{n}(c_{ij}+\lambda_{ij}s)=0. \tag{A.2}$$

Similarly, by adding up all the m first-order conditions for the local firms in country f we obtain

$$ma-\frac{bem}{N(t)}X(t)-\frac{b(m+1)}{N(t)}Y(t)-mw_f=0. \tag{A.3}$$

We can now solve (A.2) and (A.3) for the equilibrium values of $X(t)$ and $Y(t)$, and then use the following reformulation of (A.1) to derive firm h's output of product i

$$x_i(t)=\frac{N(t)}{b(2-d)}\left(a-\frac{bd}{N(t)}X(t)-\frac{be}{N(t)}Y(t)-c_{ij}-\lambda_{ij}s\right)=0. \tag{A.4}$$

It is straightforward to show that we can write $X(t)=[N(t)/b]X(\cdot)$ and $Y(t)=[N(t)/b]Y(\cdot)$, and therefore also $x_i(t)=[N(t)/b]x_i(\cdot)$, where $(\cdot)$ indicates dependence on the model's time-invariant parameters. Moreover, the contribution of good i to firm h's profit (gross of sunk costs) turns out to be $\pi_i(t)=[N(t)/b](x_i(\cdot))^2$. The total gross profit of firm h in period t thus is $\Pi(t)=[N(t)/b]\sum_{i=1}^{n}(x_i(\cdot))^2$. If n is large and the contribution of each good to firm h's profit small, then the total profit is approximately $\Pi(t)=[N(t)/b](X(\cdot))^2$.

Now consider firm h's intertemporal investment problem. To determine the time t_1 at which the firm will undertake its first investment, we have to compare the present value of exporting all n goods to the present value of producing one good locally and exporting the remaining $n-1$ goods. It is straightforward to establish that marginal changes in the time-invariant parameters that raise the Cournot equilibrium profit of producing one good locally and exporting the rest relative to the Cournot profit associated with exporting all goods imply an earlier t_1. Hence to establish our results we have to carry out comparative static exercises on (A.2) to (A.4).

Consider, for example, the effect of a marginal increase in firm h's productivity (assuming equal productivity in each good). Using (A.2) and (A.3), we note that this raises the firm's overall output $X(\cdot)$ and lowers the total output of the local firms $Y(\cdot)$. However, the output of firm h rises by more, if it produces one good i in country f,

provided that $w_f < c_{ih} + s$. First, the lower variable cost associated with one FDI project implies a bigger gain in market share relative to the local firms. Second, the output of the good produced in f rises relative to the output of the other goods produced by firm h (see (A.4)), thus providing an additional efficiency gain. Hence an increase in productivity means that the firm will invest earlier. Similar comparative static effects can be derived for the other time-invariant parameters, including per-capita demand, wages, and industry concentration.

To prove the result concerning the cannibalization effect, we need to compare the change in profit from (i) moving from one affiliate to two affiliates with the change in profit from (ii) moving from zero to one affiliate. Subtracting the change in profit of (ii) from that of (i), we obtain.

$$-\frac{2\big(d(1+m)-e\big)bt^2\big(4(1+m)(1-d)+2mn(d-e^2)+n(3d+dm+e)\big)}{(2-d)\big(2(1+m)(1-d+dn)-mne^2\big)^2}. \quad (A.5)$$

Note that for $1>d>e>0$ this expression is strictly negative, which gives the desired result.

Appendix II: Data Description

- Japanese FDI data was compiled from three separate volumes (1985, 1993, 1995) of Toyo Keizai Inc.'s *Japanese Overseas Investment: A complete listing by firms and countries*.

- A consistent determination of industry affiliation for the principal Japanese parent and the European affiliate requires the collection of each firm's primary 4-digit 1987 U.S. Standard Industry Classification (SIC) code for the year of initial investment. SIC codes for the Japanese parents were found in Dun and Bradstreet's Principal International Businesses, National Register's Directory of Corporate Affiliations, and other publicly available sources. Numerous publicly available European sources provided the affiliates' codes. Since some of the European affiliates are too small to gain entry into corporate listings, the main offices of most national foreign investment agencies (e.g. Invest in Denmark Agency, Invest in Finland Bureau, Hungarian Trade Commission) provided information on affiliates' main business lines. Main business lines reported in earlier SIC revisions (1972, 1977) or in the European NACE format were converted to the 1987 SIC equivalent by standard classification concordances.

- Firm-specific characteristics (size, R&D, exports) are located in various issues of Toyo Keizai's *Japan Company Handbook* as well as the Pacific Basic Capital Markets (PACAP) database.

- Data for *IndExp* is located in the OECD's *International Trade by Commodities Statistics* CD-ROM. Standard classification concordances are used to convert the data to 4-digit SIC.

- Countries in the sample include: EU-15, plus Cyprus, Czech Republic, Hungary, Iceland, Norway, Poland, and Switzerland

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Table 1: Hypothetical Sample

	Investment Sequence				
	1970_____1994				
Firm 1	1		2 3 4		
Firm 2		1			
Firm 3			1 2		
Firm 4	1	2		3	

Table 2: Correlation between Major Firm-level Variables

	TFP	Size	Export%	R&D	Keiretsu	HHI	Employ
TFP	1.000						
Size	0.261	1.000					
Export%	0.258	0.173	1.000				
R&D	0.274	0.225	0.216	1.000			
Keiretsu	0.254	0.204	0.174	0.156	1.000		
HHI	0.236	0.345	0.011	0.055	0.152	1.000	
Employ	0.267	0.654	0.185	0.232	0.215	0.015	1.000

Table 3: Firm-Specific Investment Determinants for Pooled Investment Histories: All Firms

	(1)	(2)	(3)	(4)	(5)	(6)
Firm Size/Productivity						
Size	1.101^a	.	1.101^b	1.001^b	1.101^a	1.101^a
KeiretsuMember*Size	.	.	.	0.989	.	.
TFP	.	1.131^a	1.131^b	1.131^b	1.128^b	1.098^b
KeiretsuMember*TFP	.	.	.	1.059^a	.	.
Other Firm Characteristics						
HHI	0.943^a	0.953^b	0.978^b	0.962^a	0.963^a	0.961^a
Diversification	1.271^a	1.281^a	1.281^a	1.297^a	1.285^a	1.283^a
Export Ratio (*Exprt*)	1.007^b	1.005^b	1.006^c	1.005^c	1.005^c	1.005^c
R&D Expenditure (*R&D*)	1.092^a	1.098^a	1.090^a	1.090^a	1.089^a	1.088^a
PrevManufInvst	1.169^a	1.177^a	1.107^b	1.106^b	1.106^b	1.105^b
PrevNonManufInvst	0.958	0.966^c	0.956^c	0.956^c	0.956^c	0.957^c
Keiretsu Membership						
KeiretsuMember	1.307^b	1.234^c	1.119^c	1.236^c	.	1.232^c
VerticalKeiretsuMember	.	.	.	.	1.177^c	.
HorizontalKeiretsuMember	.	.	.	.	1.121^c	.
Financial Data						
Gross Revenue	.	.	.	.	.	1.047
Interest Burden	.	.	.	.	.	0.963^c
Cash Flow	.	.	.	.	.	1.029^c
Industry Membership Dummy	Yes	Yes	Yes	Yes	Yes	Yes
Year Dummy	Yes	Yes	Yes	Yes	Yes	Yes
Number of Observations	5880	5880	5880	5880	5880	5880
Log-Likelihood	-1480.83	-1384.53	-1380.12	-1382.62	-1383.72	-1372.27
Wald Test	138.84	138.44	140.15	147.97	148.01	156.10
χ^2 test	0.000	0.000	0.000	0.000	0.000	0.000

Coefficients expressed as hazard ratios. Significance Levels: [a] - $p<0.01$, [b] - $p<0.05$, [c] - $p<0.10$

Table 4: Firm-Specific Investment Determinants for First Investments: All Firms

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Firm Size/Productivity								
Size	1.000	.	1.000	.	1.000	1.000	1.000	1.000
KeiretsuMember*Size	.	.	.	.	.	0.999	.	.
TFP	.	1.103[b]	.	1.102[b]	1.101[b]	1.101[b]	1.101[b]	1.101[b]
KeiretsuMember*TFP	.	.	.	.	.	1.042[b]	.	.
Other Firm Characteristics								
HHI	.	.	0.999	0.997	0.996	0.997	0.997	0.996
Diversification	.	.	1.147[a]	1.159[a]	1.148[a]	1.151[a]	1.147[a]	1.161[a]
Export Ratio (*Exprt*)	.	.	1.010[c]	1.010[c]	1.009[c]	1.009[c]	1.009[c]	1.010[c]
R&D Expenditure (*R&D*)	.	.	1.137[a]	1.131[a]	1.133[a]	1.134[a]	1.133[a]	1.131[a]
PrevNonManufInvst	.	.	0.786[a]	0.800[a]	0.794[a]	0.787[a]	0.790[a]	0.842[a]
Keiretsu Membership								
KeiretsuMember	.	.	1.010	1.065	1.091	1.099	.	1.074
VerticalKeiretsuMember	.	.	.	.	.	.	1.101	.
HorizontalKeiretsuMember	.	.	.	.	.	.	1.121	.
Financial Data								
Gross Revenue	.	.	.	.	.	.	.	1.026
Interest Burden	.	.	.	.	.	.	.	0.972[c]
Cash Flow	.	.	.	.	.	.	.	1.067[c]
Industry Membership Dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of Observations	4698	4698	4698	4698	4698	4698	4698	4698
Log-Likelihood	-651.83	-617.25	-631.72	-604.44	-597.36	-596.48	-597.96	-592.37
Wald Test	31.45	34.20	91.54	93.31	94.13	94.16	94.18	95.87
χ^2 test	0.048	0.025	0.000	0.000	0.000	0.000	0.000	0.000

Coefficients expressed as hazard ratios. Significance Levels: [a] - $p<0.01$, [b] - $p<0.05$, [c] - $p<0.10$

Table 5: Firm-Specific Investment Determinants for Second and Third Investments: All Firms

|	Second Investment				Third Investment			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Firm Size/ Productivity								
Size	1.001	.	1.001	1.001	**1.050[b]**	.	**1.050[b]**	**1.051[b]**
TFP		**1.070[b]**	**1.065[b]**	**1.065[b]**	.	**1.097[c]**	**1.099[c]**	**1.097[c]**
Other Firm Characteristics								
HHI	1.000	1.000	1.000	0.999	**0.945[a]**	**0.955[a]**	**0.953[a]**	**0.953[a]**
Diversification	**1.188[a]**	**1.189[a]**	**1.210[a]**	**1.211[a]**	**1.242[a]**	**1.245[a]**	**1.251[a]**	**1.251[a]**
Export Ratio (Exprt)	**1.040[c]**	**1.050[c]**	**1.040[c]**	**1.038[c]**	**1.022[b]**	**1.015[b]**	**1.017[b]**	**1.017[b]**
R&D Expenditures	**1.108[b]**	**1.138[b]**	**1.124[b]**	**1.125[b]**	0.942	0.980	0.963	0.961
PrevNonManufInvst	0.955	0.947	0.956	0.952	1.010	1.049	1.039	1.041
PrevDurationLength	**0.971[a]**	**0.971[a]**	**0.976[a]**	**0.977[a]**	0.922	0.926	0.930	0.930
Keiretsu Membership								
Keiretsu Membership	1.090	1.107	1.090	1.090	**1.389[c]**	**1.440[c]**	**1.389[c]**	**1.389[c]**
Financial Data								
Gross Revenue	.	.	.	1.021	.	.	.	1.019
Interest Burden	.	.	.	**0.974[c]**	.	.	.	0.981
Cash Flow	.	.	.	1.054	.	.	.	1.047
Industry Member Dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of Observations	3239	3239	3239	3239	1906	1906	1906	1906
Log-Likelihood	-207.58	-199.97	-196.76	-195.89	-88.93	-85.79	-82.09	-81.17
Wald Test	80.89	82.65	84.67	85.29	45.67	46.78	46.99	47.34
χ^2 test	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Coefficients expressed as hazard ratios. Significance Levels: [a] - $p<0.01$, [b] - $p<0.05$, [c]- $p<0.10$

Table 6: Firm-Specific Investment Determinants for Multiple Investors Only

	All (Pooled) Investments			First Investments			Second Investment		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Firm Size/Productivity									
Size	1.101^b	.	1.100^b	1.000	.	1.000	1.000	.	1.001
TFP	.	1.098^b	1.097^b	.	1.141^c	1.139^c	.	1.053^c	1.051^c
Other Firm Characteristics									
HHI	0.945^b	0.952^b	0.957^b	0.999	0.999	0.999	0.999	0.999	0.999
Diversification	1.171^a	1.184^a	1.185^a	1.117^a	1.196^b	1.197^a	1.156^a	1.169^b	1.177^a
Export Ratio (*Exprt*)	1.006^b	1.009^b	1.008^b	1.007^a	1.008^a	1.009^a	1.006^b	1.011^b	1.011^b
R&D Expenditure (*R&D*)	1.107^a	1.109^a	1.097^a	1.005^b	1.009^b	1.110^b	1.076^c	1.074^c	1.074^c
PrevManufInvst	1.080^b	1.088^b	1.088^b	.	.	.	.	.	.
PrevNonManufInvst	0.957^b	0.968^b	0.962^b	0.946^b	0.9510^b	0.921^b	0.999	0.997	0.978
PrevDuration	.	.	.	.	.	.	0.973^a	0.972^a	0.974^a
KeiretsuMembership									
KeiretsuMember	1.196^b	1.186^b	1.189^b	1.054	1.040	1.051	1.096	1.096	1.095
Financial Data									
Gross Revenue	.	.	1.043	.	.	1.106	.	.	1.020
Interest Burden	.	.	0.962^c	.	.	0.984^c	.	.	0.973^c
Cash Flow	.	.	1.024^c	.	.	1.061^c	.	.	1.057
Industry Member Dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Log-Likelihood	-805.67	-779.65	-771.85	-242.56	-225.24	-221.15	-167.77	-161.29	-163.24
Wald Test	88.03	92.03	96.94	90.16	93.92	94.67	87.56	91.56	92.49
χ^2 test	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Coefficients expressed as hazard ratios. Significance Levels: [a] - $p<0.01$, [b] - $p<0.05$, [c] - $p<0.10$

Figure 1. Kaplan-Meier Integrated Hazard Estimates of Individual Investment Stages
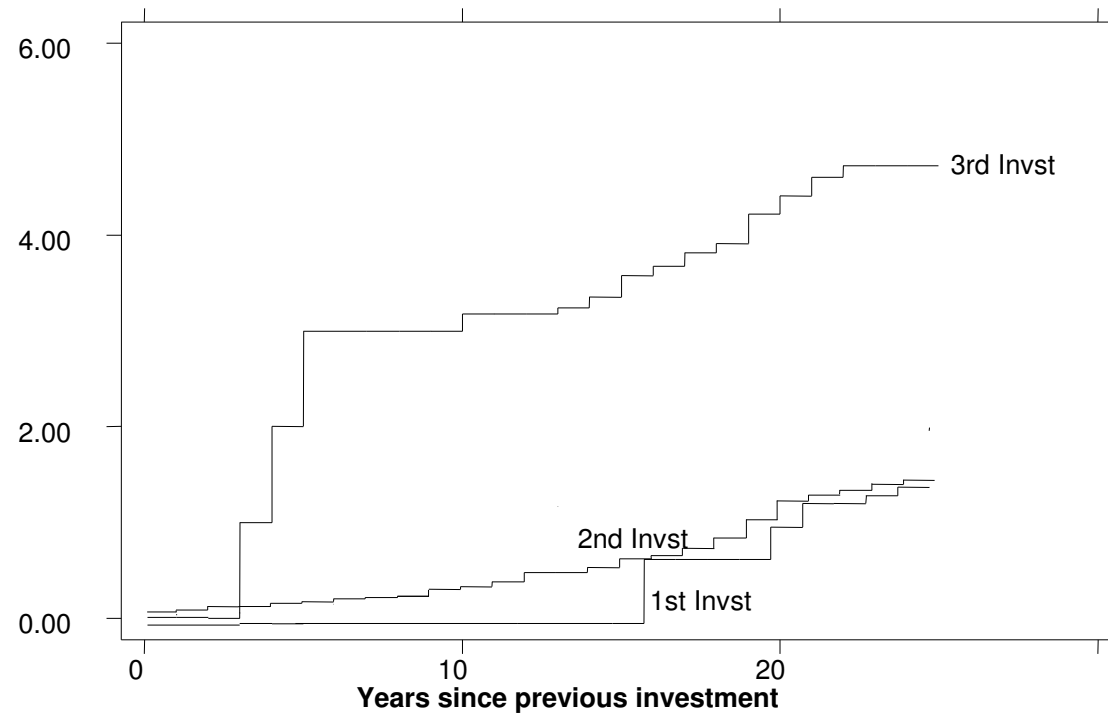
Appendix Table 1. Additional Regression Table for Pooled Investment History: All Firms

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Size	1.101[a]		1.101[a]	1.097[a]	1.095[a]	1.093[a]	1.093[a]	1.092[a]	1.092[a]	1.091[a]
TFP		1.141[a]	1.139[a]	1.139[a]	1.137[a]	1.136[a]	1.136[a]	1.136[a]	1.132[a]	1.132[a]
Keiretsu Membership				1.321[b]	1.322[b]	1.314[b]	1.299[b]	1.274[b]	1.269[b]	1.257[b]
HHI					0.963[b]	0.953[b]	0.953[b]	0.952[b]	0.948[b]	0.945[b]
Export Ratio						1.082[b]	1.083[b]	1.079[b]	1.077[b]	1.076[b]
R&D							1.098[a]	1.090[a]	1.090[a]	1.090[a]
PrevManuf								1.167[a]	1.137[a]	1.123[a]
PrevNonManuf									0.956[c]	0.956[c]
Diversification										1.281[a]
Number of Obs.	5880	5880	5880	5880	5880	5880	5880	5880	5880	5880
Log-Likelihood	-1529.49	-1431.59	-1421.30	-1418.64	-1415.11	-1413.55	-1407.66	-1403.52	-1400.87	-1380.12
Wald Test	11.21	11.22	60.41	60.97	96.92	100.08	114.90	129.73	130.15	140.15
χ^2 test	0.047	0.047	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Coefficients expressed as hazard ratios. Significance Levels: a - p<0.01, ** - p<0.05, *- p<0.10.