# Sequential Investment, Firm Motives, and Agglomeration of Japanese Electronics Firms in the United States

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*Recent research finds that firms investing abroad tend to agglomerate with other foreign entrants. Yet firms often invest multiple times within the same host country, which raises the question of whether firms agglomerate with their competitors' or their own prior investments. Collocation's attractiveness also may vary as a firm's entry motives evolve. The activities of prior and present investments often differ—initial investment may be for distribution while later ones might be for manufacturing. For Japanese investment into the United States in the electronics sector from 1980 to 1998, we find that firms tend to collocate only with their own prior investments. The exception is firms with little of their own experience, who tend to collocate with competitors. These results demonstrate the importance of firm heterogeneity in determining agglomeration behavior.*

## 1. Introduction

A key strategic choice for firms is where to locate. While firms choose locations to maximize profit, classic studies also have focused on interfirm dynamics. For example, Knickerbocker (1973) argued that oligopolists tend to respond to each other by investing abroad at similar times and into similar locations. This "follow-the-leader" behavior explains why

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competitors enter the same countries. At a finer grained level of analysis a related question is where the competitors locate within a specific host country—do they spatially separate or agglomerate?

Recent research in the new economic geography identifies forces promoting agglomeration. Krugman (1991) argues that firms might agglomerate due to increasing returns—the presence of more firms expands the worker population, which increases market demand, thereby decreasing firms' costs, which raises workers' real wage that in turn attracts more workers. Extending the Krugman (1991) model, Venables (1996) introduced vertically related industries—an upstream industry feeds a downstream industry that then sells to end consumers. The upstream firms would like to locate close to their customers, which are the downstream firms. In turn, the downstream firms would like to locate where there are more upstream firms, since this reduces the downstream firms' input costs. Adding a Marshallian perspective, a geographic concentration of similar activity results in technical externalities—development of specialized suppliers, workers investing in industry specific skills, and knowledge spilling between firms—all of which could reduce firms' costs, could improve their product quality, or both. Formalizing such ideas, Fujita and Thisse (2002, pg. 283) show that when transportation costs are low, firms collocate to benefit from a production cost reduction without losing much business in other locations. Empirical examinations are consistent with these expectations. Head, Ries, and Swenson (1995) showed that Japanese firms entering the United States tend to replicate the location choice of prior Japanese subsidiaries; even after accounting for incumbents' locations and other factors, Japanese firms locate their manufacturing facilities in the same regions of the United States.

These agglomeration forces are opposed by forces promoting separation: increased competition and transportation costs. While firms may be attracted initially to those locations with high demand or to those rich with critical factor inputs, such locations may become crowded. Market share and/or price will fall with more firms. And as more firms draw on these factor sources, factor prices will be bid up. Thus, in situations of such crowding, firms may separate to avoid such increased competition. Separation also may result when transportation costs are low. With low costs, a firm could serve proximate and distant markets from a single central location without substantial disadvantage. But as transportation costs climb, the profitability of such a configuration diminishes; if transportation costs are high enough, the firm would prefer to have facilities distributed geographically.

While prior studies highlight several forces both for and against agglomeration, our interest is in how firms' traits affect their propensity to agglomerate. Related work in international strategy has begun to

emphasize the importance of firm heterogeneity for foreign entrants' strategic choices. An important dimension of heterogeneity is that firms often invest sequentially into the same country. Chang and Rosenzweig (2001) show that as Japanese and European firms introduce additional subsidiaries in the United States, their preferred entry mode evolves, which they argue reflects firms' learning and accumulated experience in the host environment. Similarly for location choice among nations, Song (2002) shows that multinational firms' prior investments in technological and sourcing capabilities affect their subsequent investment location choices. Sequential investment may be equally important when examining whether or not firms agglomerate within a particular host country. By collocating several of its subsidiaries, a firm could benefit from greater scale economies by sharing facilities, personnel, and other resources across subsidiaries.[1] Besides such physical infrastructure, initial units also may accumulate useful local knowledge by developing social networks with suppliers, business and community leaders, and government officials.

While infrastructure and knowledge can spill over from other firms' subsidiaries, such gains are more likely among affiliated units. Firms are likely to make distinct efforts to share among their own units, thus making such gains more definitive. Further, as multiple units of the same firm, activities can be coordinated so that increased competition—participants driving down revenues while increasing input prices—may be tempered; the multiple units jointly could optimize outputs' prices and quantities and could coordinate the sourcing of inputs. These additional benefits suggest that the location where a firm already has prior units is more likely to be preferred for its subsequent investments. Recognition of multiunit firms and sequential investment raises the question of whether firms agglomerate primarily with their own units or with competitors: whether agglomeration is within or between firms.

A second, related dimension of firm heterogeneity is the firm's reason or motive for investing. The traditional perspective is that firms expand abroad themselves to avoid market failures inherent with licensing or other outsourcing and thereby obtain the greatest returns from their intangible capabilities: Firms "internalize" their capabilities. Starting a decade ago Cantwell (1989), Kogut and Chang (1991), and others began emphasizing that firms also expand to obtain access to new technology that resides abroad. Knowledge's tacit dimensions require proximity for transfer. A third reason, raised by Yamawaki (1991), is that export sales performance from the home nation can be heightened by committing resources for distribution in host markets. Other researchers

1. Firms also could enjoy greater economies by increasing the size of existing plants. Unfortunately, the data for our empirical test do not capture such activity.

have raised still further motives—tax minimization, managerial rent seeking, and others. The important point is that investment motives can differ. Such heterogeneous motives suggest that firms will create subsidiaries focused on different activities—distribution, manufacturing, and/or research. For example, firms pursuing the more traditional motive of internalization are likely to open manufacturing subsidiaries. In contrast, a firm pursuing access to new technology is likely to open a research and development (R&D) subsidiary, while a firm supporting its exporting efforts will establish a subsidiary for distribution.

Motives and sequential investments are interlinked. A firm's motive for investing may evolve overtime; commitment may increase, and/or its focus may shift. As a firm's motive changes so does the activity of subsequent investment. Recognizing the presence of different activities raises the question of whether firms collocate these activities and under what conditions. By definition these value-chain activities are linked, which suggests a parallel to Venables' (1996) vertically related industry argument that upstream industry participants gain by collocating with downstream firms and vice versa. Proximity between the stages of the chain similarly may offer cost benefits such as reduced development time and improved quality or enhanced revenues by generating new product ideas. While offering potential gains from superior coordination across stages of the value-added chain, this pull is countered by (1) each activity's attraction to different location attributes; and (2) the activity specificity of spillovers. Different activities will be drawn to location attributes that similarly are heterogeneous. Likelihood of agglomeration also decreases because the gains from externalities lessen between dissimilar activities. Sales/distribution, manufacturing, and R&D will differ as to the knowledge and infrastructure that are required.

In this paper, we examine how these two dimensions of firm heterogeneity affect foreign firms' tendency to agglomerate. More specifically, we examine whether foreign entrants tend to replicate their competitors' or their own past investment location choices and how this differs based upon the activity of the subsidiary. Firms face a tension between what location best serves their present investment's activity versus locations that can provide net benefits from agglomeration. We investigate several questions. Do firms collocate with their own prior investments and/or their competitors' investments? How does the tendency to agglomerate change with subsidiaries' activities? Do firms with less experience in the host nation agglomerate more? To answer these questions, we use an experimental setting where substantial investment in a single industry flowed from one nation to another. Attention to a single industry permits us to obtain firms' actual investment activities.

By examining a single-industry and a single-nation pair, we hold both industry and country effects constant, which allows for greater theoretical and empirical attention to firms' traits. Within the host nation, we examine variation in location—into which state investment falls—which allows us to assess how location and firm traits interact.

Several of the forces promoting and deterring agglomeration will be of particular interest as firms expand internationally, especially Marshallian externalities. When establishing a facility in a new host country, the entrant will be ignorant somewhat about local business practices and local institutions—for example, how to tap into the local labor market, who are the best local suppliers, and how to adhere to municipal regulations. Therefore, entrants will look to others for an indication of how best to proceed. Shaver, Mitchell, and Yeung (1997) argued that subsequent foreign entrants observe and learn from the successes and failures of earlier entrants in making strategic decisions. Of note is that the knowledge of other recent entrants is more useful than that of longer term incumbents; such recent entrants' experiences will be applicable directly to challenges new entrants face. Subsequent entrants also may take advantage of specific infrastructure established by earlier foreign entrants such as specialized suppliers and local institutions that are sensitized to new entrants' requirements.

Leveraging others' infrastructure and experience will be beneficial particularly when a firm has little of its own. While such a firm could generate its own experience, it faces time and financial costs. Therefore, appropriating the benefit from the knowledge and infrastructure created by others may be attractive especially for firms with less experience. This suggests that firms with few of their own investments are more likely to choose locations populated by their peers.

Examining international expansion provides variation in firms' prior host nation experience and subsidiaries' activities, but we also need an industry setting where the other forces affecting agglomeration are present. Before we can assess the importance of these dimensions of firm heterogeneity on likelihood of agglomeration, agglomeration first has to be likely to happen. We need the primary phenomena to conduct finer-grained analysis of it. This means that our setting should have increasing returns for production, transportation costs that are low to moderate, and knowledge transfer costs that are high. The presence of these conditions would promote agglomeration. At the same time, we also need firms to produce differentiated goods that are sold across the geographic market in roughly the same distribution. The presence of differentiated goods is needed for firms to have multiple units, some of which are engaged in the same activity—such as manufacturing. Otherwise, there would be a single monolithic plant producing one

homogeneous good. Finally, we also need a setting where the links between stages of the value chain are important for firm performance. Given such needs, we select an industry setting in the empirical section that exhibits such qualities, without which firms would more likely have multiple smaller facilities distributed geographically making our investigation somewhat futile.

We now can state several expectations formally. First, a firm investing multiple times may be able to benefit more by collocating its own establishments than by agglomerating with competitors; by coordinating across units, gains will be more definite while costs from increased competition will be tempered. Thus, we expect that a greater count of own prior investments in the same location increases the likelihood of collocation. Second, the value of collocation is a function of an establishment's activity—sales/distribution, manufacturing, or R&D. Here opposing forces are at work. Spillover benefits likely being activity specific suggests that a firm will locate where it has prior investment of the same activity. In contrast, tight links among stages of the value-added chain suggest that dissimilar activity is drawn together. We expect that the attractiveness of own prior investment of same activity will differ from that of own prior investment of different activity but will leave the determination of which has greater economic influence to the empirical analysis. Third, recognizing that firms invest sequentially suggests that firms may have differential experience in a host country. Some may have several subsidiaries in place; others may be less experienced. We expect firms that have fewer of their own prior investments are more likely to agglomerate with competitors.

## 2. Empirical Model

Examining firms' location choice for their investments, we use discrete choice models to test our hypotheses. Firms face a set of choices, each choice has different attributes, and the firm chooses one from the set. We use the McFadden (1974) conditional logit model that has been applied to areas including foreign direct investment (FDI) site selection, residential choice, and travel destination location.

The conditional logit method focuses upon attributes of the choices in the set—in this case, attributes of the U.S. states. These attributes can be constant across all choosers, such as the land area of each state, or can differ for each chooser, such as the number of their own prior investments in the state.

We assume that a firm selects a state that has the greatest probability of yielding the highest profit. Profit is determined by both firms' demand and firms' production functions. Similar to Head, Ries, and

Swenson (1995, pg. 244) and Head, Ries, and Swenson (1999, pg. 200), we assume a log linear-demand function and Cobb-Douglas production function. Firms set price equal to marginal cost to profit maximize, which also determines output quantity. The result After substituting the demand and production functions into the profit function and then taking logs, the result is an expression of profit that is linear in market attributes and factor inputs. This resulting form is amenable to estimation using the conditional logit.

The conditional logit model is specified as follows. We define an underlying latent variable, $V_{ijt}$, to represent the profit/value to firm $i$ of opening a subsidiary in state $j$ at time $t$; where $j = 1$ to $m$ are all states where at least one subsidiary was established between 1980 and 1998. Each observation has m rows of data, each corresponding to a specific state. Then the observed dependent variable $Y_{ijt}$ is such that

$Y_{ijt} = 1$ if $V_{ijt} > V_{ikt}$ for all $k \neq j$, and $k = 1$ to $m$, indicating the state chosen, and
$Y_{ijt} = 0$ otherwise, indicating the $m - 1$ states are not chosen.

Due to the log-linear form of the latent variable representing profit/value, we can write

$$V_{ijt} = \beta' X_{ijt} + e_{ijt}. \tag{1}$$

$X$ is a vector of independent variables of theoretical interest (counts of the focal firm's and other firms' subsidiaries in each state) and control variables such as market demand that are discussed in the next section. The functional form of the profit function and the log transformation means that the resulting coefficient estimates reflect probability elasticities for whether a state is chosen. Positive values for the coefficients $b$ indicate that states possessing higher values of the associated variables have a higher probability of being chosen.

## 3. Data and Measures

Our empirical context is Japanese firms in the electronics sector investing in the United States from 1980 to 1998 inclusive. We choose the electronics sector given the several assumptions in the theory section. We need a context in which agglomeration is likely to occur, so that we can explore the influence of firm heterogeneity on agglomeration. The electronics industry is well suited. First, it has a substantial fixed cost suggesting increasing returns for production. All electronics manufacturing requires a fair amount of plant and equipment. Second, transportation costs are moderate. While not as low as software, these are high value-added

goods that are shipped easily by palett and container. Given their value added to transportation-cost ratio, some semiconductor products are shipped regularly by air. Third, electronics are differentiated products demanded across the United States. Lastly, the need for face-to-face meetings between engineers developing, manufacturing, and selling products is a possibility.[2]

We examine where—in which state—these Japanese electronics firms choose to locate their investments. Our investigation requires data for the investing Japanese firms and for state attributes. While including several state attributes of theoretic interest, we also conduct our analysis using "alternative specific constants" (state fixed effects) and state-specific time trends.

Our main data are drawn from multiple issues of the Toyo Keizai's *Kaigai Shinshutsu Kigyo Soran* (Japanese Overseas Investment) report and are supplemented by the Electronic Industries Association of Japan's (EIAJ) *Kaigai Hojin Listo* (Annual Directories of Overseas Subsidiaries). We focus on the electronics industry, which in the Toyo Keizai's Japanese Overseas Investment reports corresponds approximately to the two-digit U.S. standard industrial classification (SIC) code of "36: Electronic and other electrical equipment and components." The Toyo Keizai provides information on new subsidiaries established by greenfield investment or acquisition but not for plant expansions of existing subsidiaries. For our analysis, we included both acquisitions and greenfield investments expecting that location of potential acquisition targets is not a tight constraint; if a certain location was important, the firm would determine whether a suitable acquisition target was available; if not, then the firm would pursue a greenfield investment. In the robustness section, we explore results from excluding acquisitions and discuss how such results are similar to those reported with both acquisitions and greenfield investments included. The resulting database provides comprehensive information for the Japanese firms' U.S. subsidiaries with coverage from the very first Japanese electronics firms entering in 1957 and forward.[3] We restrict our investigation to 1980 forward to keep the FDI and state data from about the same time period (availability of state data prior to 1980 is limited), while using the pre-1980 data to construct the stocks of existing Japanese subsidiaries across locations. For 1980–1999, there were 435 separate subsidiaries established by

2. For example, with semiconductors, product R&D takes place in a pilot plant or on a pilot line of a manufacturing "fab"; the craft nature of production requires developing and qualifying new products on equipment similar to actual lines. Proximity aids exchange of knowledge by permitting more frequent face-to-face exchange between scientists and engineers.

3. The first edition of the Toyo Keizai *Japanese Overseas Investment* report is 1974, which reports subsidiaries in the United States back to 1957.

156 Japanese firms. The locations of these subsidaries are shown in Figure 1.

While information on subsidiaries' motives is the Toyo Keizai's main advantage, the data suffer a disadvantage: lack of fine-grained industry definitions. There is limited reporting of the subsidiaries' SIC or actual products. Only about 20% of the subsidiaries' four-digit SIC is observed, which would leave us with few observations. As an alternative, we supplement the Toyo Keizai data using the EIAJ directory.

While also not reporting four-digit SIC, the EIAJ does break the industry into four subclasses: consumer electronics, industrial electronics, electrical components, and semiconductors. Of the 435 observations, using the EIAJ directory, we have subclass information for 322 observations from 128 different firms. These 322 observations are our final dataset.

For subsidiary activity, the Toyo Keizai reports 11 response categories for the investments' motives, of which we focus upon three: (1) sales and distribution; (2) manufacturing; and (3) research and development. The eight other motive categories are natural resource seeking, labor seeking, government preferential treatment, follow the customer, hedge exchange-rate risks, information-collection outpost, regional coordination, and response to the trade frictions. We exclude these categories because these motives' corresponding activities are unclear. Is a subsidiary motivated by "follow the customer" involved in sales/distribution, manufacturing, R&D, or some combination of these three activities? With our three focal motive categories, we are reasonably certain of the corresponding activity: A distribution subsidiary does sales/distribution; a manufacturing subsidiary is involved in manufacturing; an investment motivated by research and development results in a subsidiary focused on R&D. Of the 322 subsidiary observations, 229 fall into at least one of these three motive categories. For the remaining 93, we leave the activity as missing; the impact of which we discuss below.

We use the data from 1957 forward to generate counts of prior Japanese FDI in the United States within the electronics industry. We disaggregate the total count of Japanese investment ("Cnt TOTAL Prior Investment) by two levels. First, we split total count into two categories—those by the same firm ("Cnt OWN Prior Investments") and those by other Japanese firms ("Cnt OTHERs' Prior Investment"). These counts vary by state and are different for each firm in each year; they are firm-state-year varying. These two counts then are disaggregated further by motive/activity: into prior investments of the same activity ("Cnt OWN Prior Inv—Same" and "Cnt OTHER Prior Inv—Same") and

for different activity ("Cnt OWN Prior Inv—Diff" and "Cnt OTHER Prior Inv—Diff").

These four counts are activity specific. The count of prior investments of the same activity is different for manufacturing investments versus distribution investments; these are activity-firm-state-year varying. For the 93 subsidiaries where activity is missing, we conduct subsequent analysis alternately defining all prior investments as either the same or different; doing so yields similar results, which we discuss in the robustness section.

Some investments list multiple motives—a subsidiary might both conduct research and manufacture; 58 of the investments list more than one of these three motives. When an investment lists more than one motive/activity, it is counted only as a single observation, but having multiple motives increases the likelihood that it is counted by others as a same activity investment while decreasing the likelihood that others count it as a different investment. If a subsidiary both conducts research and manufacturing, then only others' sales/distribution subsidiaries will count it as a different activity. Table I presents descriptive statistics for these counts of Japanese subsidiaries.

The values in Table I are the original values. We transform these original values by taking the natural log for the statistical analysis. For those variables bounded below by zero, we first add one. Recall that the profit equation to be estimated is log linear. Logs are taken to transform the profit equation into the linear form to be estimated.

Our state data are drawn from several government sources listed in the Appendix. We use the state as our level of analysis for several reasons. Detailed economic data often is available only at the nation or state level. As a result, most if not all prior FDI location studies are conducted at the state level. We follow suit to aid comparability. We limit our choice set to those 34 states that attract at least one investment during our study period.

Beyond the counts of Japanese subsidiaries, we include several variables of theoretic interest. The Krugman increasing return story involves market size, industry concentration, and wage rate; larger markets attract firms that benefit from lower fixed costs, which results in high real wages for workers, which draws more workers to that location, which increases the market. To reflect market size, we use two measures: a state's gross domestic product (GDP) ("Own state GDP"); and the GDP of surrounding states ("Neighbor states GDP"). For industry concentration we use the count of establishments in SIC 36 ("Cnt Establishments SIC 36) in each state. As a general indicator of wage rate, we use the states' average weekly wage rates ("Average Weekly WAGE"). For both "Average Weekly WAGE" and "Cnt Est

**Table I.**
**Descriptive Statistics of State and Firm Attributes**

| FDI Transaction Attributes (Japanese electronic firms entering United States, 1980–1998) | | $n^*$ | mean | std dev | minimum | maximum |
|---|---|---|---|---|---|---|
| Cnt OWN Prior Investments | count in each state | 10948 | 0.11 | 0.55 | 0 | 9 |
| Cnt OWN Prior invest—Same | count in each state | 10948 | 0.05 | 0.36 | 0 | 8 |
| Cnt OWN Prior Invest—Different | count in each state | 10948 | 0.06 | 0.35 | 0 | 8 |
| Cnt OTHERS ′ Prior Invest | count in each state | 10948 | 3.02 | 7.97 | 0 | 94 |
| Cnt OTHERs′ Prior Inv—Same | count in each state | 10948 | 1.50 | 5.03 | 0 | 73 |
| Cnt OTHERS ′ Prior Inv—Different | count in each state | 10948 | 1.52 | 5.20 | 0 | 94 |
| Summation of Own Prior Invest | count across states | 10948 | 3.72 | 3.45 | 1 | 16 |
| Investment Motive | categorical | 322 | | | | |

| State Attributes [based on data for 34 states (50 states and Washington, D.C., less 17 that never received investment)] | | $n^*$ | mean | std dev | minimum | maximum | min | max |
|---|---|---|---|---|---|---|---|---|
| Own-State GDP | millions of dollars | 10948 | 178222.50 | 174977.70 | 20172 | 1096091 | DE | CA |
| Neighbor-States GDP | millions of dollars | 10948 | 629728.70 | 351378.70 | 0 | 1563682 | CA | PA |
| Average Weekly WAGE | dollars/week | 10948 | 450.03 | 77.34 | 288.68 | 757.64 | NC | MI |
| Cnt Establishments SIC 36 | count | 10948 | 473.96 | 635.64 | 7 | 3817 | DE | CA |

$*$ 322 observations x 34 states = 10,948
Note: These are original values; regressions use natural log of these variables (after adding 1 for those variables with a 0 minimum).

SIC 36") data availability falls short of the full 1980–99 investigation window. For missing years, we substitute the closest available year. For example, data from 1996 "Cnt Est SIC 36" is also used for 1997, 1998, and 1999. Each variable's data sources and years available are shown in the Appendix.

While including these state attributes of theoretic interest, we follow Head, Ries, and Swenson (1995) and include alternative specific constants (ASCs) to capture all other explanations. ASCs are equivalent to dummy variables but are for each location. ASCs capture characteristics of each location choice that are time invariant. Examples of effects captured by ASCs would be other indicators of demand and factor inputs such as population density, income levels, land area, tax rates, and so forth. Of course, some of these variables change slightly over time, but to the extent that they are relatively constant across time, they are reflected by the ASCs. With a state-level analysis of the 34 states that received at least one investment, we have 33 constants. To supplement the ASCs that are time invariant, we also include time trends that are choice specific—one for each state. As a robustness test—in addition to the ASCs, state-specific time trends, and the previously mentioned four controls—we also included seven other controls used by Coughlin, Terza, and Arromdee (1991). We discuss the results in the robustness section, which are similar to those reported here.

## 4. Results and Discussion

The benchmark specification with the total count of prior investment ("Cnt TOTAL Prior Investment") appears in column 1 of Table II. The coefficient is positive and significant, indicating that prior investment by Japanese firms in the same industry subclass (consumer electronics, industrial electronics, electric components, or semiconductors) increases the likelihood of further Japanese investment in the same subclass. This is consistent with other findings and suggests the importance of agglomeration forces for firms' location choice.

Turning to other variables in column 1, few are significant. Only "neighbor states' GDP" is positive and significant, while the other controls are not significantly different from zero. Not shown are the alternative specific constants and state-specific time trends capturing other important unobserved factors; as a group the ASCs are significant as are many of the ASCs individually. The alternate specific constants and time trends potentially account for most variation. The significance of neighbor-state GDP is consistent with firms choosing locations that offer greater revenue potential.

TABLE II.

## DETERMINANTS OF JAPANESE FDI LOCATION CHOICE IN THE UNITED STATES, 1980–1998

| | Dep. Var.: Prob (firm *j* chooses state *j*) | | | | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Alternative-Specific Constants | included | included | included | included | included | included |
| State-Specific Time Trends | included | included | included | included | included | included |
| Own-State GDP | 3.4611 | −1.0184 | −0.7597 | −0.4541 | −1.0425 | 0.7048 |
| | (2.897) | (4.595) | (4.669) | (4.603) | (4.724) | (4.979) |
| Neighbor-States GDP | 6.2955** | 9.0901* | 3.3754 | 8.2222 | 4.0349 | 7.7230 |
| | (3.096) | (5.136) | (5.340) | (5.153) | (5.396) | (5.962) |
| Weekly WAGE | 2.4058 | 13.5709* | 10.5899 | 13.3555* | 10.8909 | 17.3928** |
| | (5.092) | (7.657) | (7.742) | (7.673) | (7.804) | (8.646) |
| Cnt of Establishments in SIC36 | −1.0909 | −0.9340 | −0.8484 | −0.8832 | −0.6796 | −1.4542 |
| | (2.144) | (3.025) | (3.038) | (3.033) | (3.032) | (3.457) |
| Cnt TOTAL Prior Investments | 2.2100*** | | | | | |
| | (0.245) | | | | | |
| Cnt OWN Prior Investments | | 6.5397** | | 6.5281**** | | |
| | | (0.357) | | (0.356) | | |
| Cnt OTHERS' Prior Invest | | 0.1693 | 0.1969 | | | |
| | | (0.258) | (0.253) | | | |
| Cnt OWN Prior Invest—Same | | | 7.4507*** | | 7.7469*** | 8.6559*** |
| | | | (0.424) | | (0.468) | (0.545) |
| Cnt OWN Prior invest—Different | | | 3.5799*** | | 3.3897*** | 4.5490*** |
| | | | (0.310) | | (0.319) | (0.383) |
| Cnt OTHERS' Prior Inv—Same | | | | 0.2684 | −0.2731 | 0.8950*** |
| | | | | (0.168) | (0.184) | (0.247) |
| Cnt OTHERS' Prior Inv—Different | | | | 0.0425 | 0.1770 | 0.9913*** |
| | | | | (0.194) | (0.203) | (0.262) |

(Continued)

**Table II.**
**CONTINUED**

| | Dep. Var.: Prob (firm *j* chooses state *j*) | | | | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Cnt OTHRs' Prior—Same* Σ OWN | | | | | | −1.2587*** |
| | | | | | | (0.159) |
| Cnt OTHRs' Prior—Diffrnt* Σ OWN | | | | | | −0.5858*** |
| | | | | | | (0.141) |
| Observations | 10948 | 10948 | 10948 | 10948 | 10948 | 10948 |
| Transactions | 322 | 322 | 322 | 322 | 322 | 322 |
| Choices | 34 | 34 | 34 | 34 | 34 | 34 |
| Log Likelihood | −691.8908 | −302.8314 | −295.0894 | −289.8535 | −292.8153 | −234.5053 |
| Pseudo *R*-squared | 0.403 | 0.739 | 0.745 | 0.750 | 0.747 | 0.798 |
| Likelihood Ratio Test: | | | | | | |
| Model versus Model | | (2) vs (1) | (3) vs (2) | (4) vs (2) | (5) vs (2) | (6) vs (5) |
| Difference in Log-Likelihood | | 389.1 | 7.7 | 13.0 | 10.0 | 58.3 |
| Chi-Square Probability | | 0.000*** | 0.005 | 0.000 | 0.007 | 0.000*** |
| Degrees of Freedom | | 1 | 1 | 1 | 2 | 2 |

*, **, *** significant at 10%, 5%, and 1% level for two-tailed tests.
Standard errors below estimates.
Notes: Conditional logit models of location choice among 34 states by inward FDI (16 states are excluded, which never are chosen) by Japanese firms in the electronics industry. Variables reflecting count of investments vary by firm and year in each of these 34 states. Alternative specific constants ("state–fixed effects") and state–specific time trends included.

To interpret the economic significance of the coefficient estimates, we make use of the method employed by Head, Ries, and Swenson (1995, pg. 237) for obtaining average probability elasticities—the independent variables' probability elasticity for the "average" state in the choice set. The average probability elasticity is the sum across all states of the individual probabilities of an investor choosing each particular state. The resulting expression downweights the coefficient estimate by $(n - 1)/n$, where $n$ is the number of choices. In this case, 34 states have at least one investment that means that coefficient estimates are downweighted slightly ($33/34 = .97$). In column 1, the 2.210 coefficient estimate indicates that a state having a 10% increase in the number of Japanese subsidiaries increases its likelihood of being chosen by 21.45%, which is a substantial change. In comparison, Head, Ries, and Swenson (1995) obtain elasticities around 0.60 for change in number of Japanese subsidiaries. With their sample being across manufacturing industries, the difference in magnitude potentially suggests that Japanese electronics firms have a stronger preference for colocation than other industries.

Past this benchmark specification, our interest is in reflecting the sequential investment both within and between firms. Columns 2 through 5 decompose the count of prior Japanese investment. Column 2 splits the total count into the count of own prior investment in each state and count of others' prior investment. Between columns 1 and 2, the pseudo *R*-squared almost doubles, indicating that splitting the count provides a better fit.[4] "Cnt OWN Prior Investments" is positive and significant. The coefficient magnitude of 6.54 is large, suggesting that a 100% increase in a firm's own subsidiaries in a state leads to a sixfold increase in likelihood of being chosen. "Cnt of OTHERs' Prior Invest" is positive but not significant. Together these two estimates indicate that observed agglomeration behavior is driven mainly by firms locating subsequent subsidiaries near their own prior ones. A possible explanation is that certain traits not captured by the various controls may be firm specific in their attractiveness, causing firms to locate repeatedly in the same place: An unobserved trait that initially attracts a firm continues to attract it subsequently. Alternately, assuming sufficient controls, these results suggest that the ability to coordinate activity among a firm's own subsidiaries is important for obtaining infrastructure and experiential knowledge.

Columns 3, 4, and 5 further decompose "Cnt OWN Prior" and "Cnt OTHER Prior" by subsidiary activity—counting subsidiaries that

4. Pseudo *R*-square is 1–the ratio of the maximum likelihood functions of the unconstrained over the constrained model.

are conducting the same or different activity from that of the focal subsidiary. Column 3 splits only "Cnt OWN Prior" into "Cnt OWN Prior—Same" and "Cnt OWN Prior—Different." Column 4 splits only "Cnt OTHER Prior." Column 5 splits both own and other counts. Columns 3 and 4 are intermediate specifications to demonstrate that the coefficient estimates in column 5 are similar regardless of the order in which the splits are introduced. In column 5, while both "Cnt OWN Prior—Same" and "Cnt OWN Prior—Different" are positive and significant, the effect of "Cnt OWN Prior—Same" is about twice as great—7.75 versus 3.39—which suggests that activity specific gains from sharing infrastructure and experiential knowledge among similar activities are more important than knowledge sharing between value-chain stages. For count of other firms' subsidiaries, disaggregating "Cnt OTHER Prior" into same and different does not uncover any significant underlying heterogeneity.

The specification in column 6 explores how the attractiveness of other firms' prior FDI activity changes as a function of the focal firm's own experience in the United States. For experience, we use a firm's current count of investments across all states. A firm with only one subsidiary in the United States has less experience than a firm with five subsidiaries. We interact the sum of a firm's own subsidiaries across states with the counts of others' investments, both same and different. When including these interaction terms, several coefficient estimates change. First, the interaction terms are both negative and significant. Second, the coefficient estimate for the main effects "Cnt OTHERs' Prior—Same" and "Cnt OTHERs' Prior—Different" now are both positive and significant. This suggests that firms with more (less) of their own experience rely less (more) on others. Interpreting the estimates, the values suggest that colocating with others of the same activity is attractive for firms with fewer than 2.0 investments ($0.8950 + (-1.2587) * 0.711 = 0$ and inverse log of 0.711 is 2.0), and colocating with others of different activities is attractive for firms with fewer than 5.4 investments ($0.9913 + (-.5858) * 1.69 = 0$ and inverse log of 1.69 is 5.4). For our sample, the average number of prior subsidiaries is 3.7, and the median is 2. This suggests that while moderately experienced firms seek spillovers from competitors of different activity, inexperienced firms also colocate with competitors' same activity facilities. Considering the estimates another way, for firms one standard deviation above and below the mean experience (3.73 subsidiaries plus or minus 3.45) the resulting effect is –1.59 and 2.50 for count of others' same activity subsidiaries. For a 100% increase in count of other's same activity subsidiaries, more experienced firms are 1.4 times less likely to choose that state, while less experienced firms are 2.3 times more likely to choose

the state.[5] For others' different activity subsidiaries, the resulting effects are –0.16 and 1.74 for more-versus-less experienced firms.

Comparing the results for own-versus-others' prior investments, of note is that while attractiveness of own prior investment may proxy for unobserved firm-specific state traits, a similar explanation does not apply to others' prior investment. Thus, the result of less experienced firms colocating with competitors is the main finding for agglomerative behavior.

## 5. Robustness

Before settling on this study's results we explore alternate specifications. Given the importance of the results in column 6 of Table II, which indicate inexperienced firms' propensity to collocate with others, we report results that parallel column 6's specification for several robustness checks in Table III.

Column 1, the benchmark specification, duplicates the results from column 6 of Table II. The other columns are robustness checks. First, in column 2, we eliminate any observations that were subsidiaries established by acquisition. While initially expecting that location of potential acquisition targets is not a tight constraint and therefore includes both greenfield investments and acquisitions, we now exclude acquisitions and repeated the specifications in Table II. The result from removing these 22 observations is very similar to those previously reported. Low-experience firms tend to collocate with competitors.

In column 3, we alternate definitions for those 93 observations where activity is missing. Initially when activity was missing, we assumed that these subsidiaries are for different activities, both for counts of own and others. Here we now assume that these subsidiaries are all same activity. The coefficient estimates are similar to column 1 except for "Cnt OTHERs' Prior—Same," which is not significant. This suggests that less experienced firms colocate only with competitors' different activity facilities instead of both same and different activity facilities.

In column 4, we introduce additional control variables: most of the state attributes used by Coughlin, Terza, and Arromdee (1991). For each state, beyond the ASCs and four control variables, we also included the states' population density, income per capita, miles of highways per capita, land available (the state size in square miles of land less federally controlled land), percent of population employed in manufacturing, percent unemployed, percent of unionized workers, and state's R&D intensity (total R&D expense of industry, academia, and government

5. Recall that the coefficient estimates have to be downweighted by $(n-1)/n$.

**Table III.**
**Japanese FDI Location Choice in the United States, 1980–98 (Robustness Tests)**

| | Dep. Var.: Prob (firm *i* chooses state *j*) | | | |
|---|---|---|---|---|
| | Benchmark (1) | Excluding Acquisitions (2) | Alternate Definitions (3) | Additional Controls (4) |
| Alternative-Specific Constants | included | included | included | included |
| State-Specific Time Trends | included | included | included | included |
| State's LAND Area | | | | −29.5768 |
| | | | | (25.252) |
| Population DENSITY | | | | −28.9018 |
| | | | | (24.939) |
| Per-Capita INCOME | | | | −26.1566 |
| | | | | (17.535) |
| HIGHWAY Miles Per Capita | | | | −4.9727 |
| | | | | (6.444) |
| % of Population Employed in MANUF | | | | 1.4319 |
| | | | | (7.291) |
| % UNEMPLOYMENT | | | | 1.7034 |
| | | | | (1.693) |
| % UNIONS | | | | −0.4545 |
| | | | | (0.946) |
| State R&D INTENSITY | | | | −0.7870 |
| | | | | (1.447) |
| Own-State-GDP | 0.7048 | 0.4344 | 0.2602 | 18.3783 |
| | (4.979) | (5.162) | (5.285) | (12.303) |
| Neighbor-States GDP | 7.7230 | 10.7563* | 5.7369 | 13.7871* |
| | (5.962) | (6.283) | (5.935) | (7.100) |
| Weekly WAGE | 17.3928** | 17.5990** | 16.8491* | 14.9977 |
| | (8.646) | (8.965) | (8.905) | (9.897) |
| Cnt of Establishments in SIC36 | −1.4542 | −0.4046 | −1.493 | 50.0453 |
| | (3.457) | (3.475) | (3.572) | (3.862) |
| Cnt OWN Prior Invest—Same | 8.6559*** | 8.6067*** | 7.9403*** | 8.7276*** |
| | (0.545) | (0.561) | (0.453) | (0.554) |
| Cnt OWN Prior Invest—Different | 4.5490*** | 4.4561*** | 2.0073*** | 4.6015*** |
| | (0.383) | (0.387) | (0.469) | (0.389) |
| Cnt OTHERS' Prior Inv—Same | 0.8950*** | 0.8975*** | 0.2262 | 0.8476*** |
| | (0.247) | (0.252) | (0.249) | (0.248) |
| Cnt OTHERS' Prior Inv—Different | 0.9913*** | 1.0191*** | 1.3773*** | 0.9980*** |
| | (0.262) | (0.267) | (0.221) | (0.265) |
| Cnt OTHRs' Prior—Same* Σ OWN | −1.2587*** | −1.1864*** | −0.7428*** | −1.2643*** |
| | (0.159) | (0.167) | (0.114) | (0.161) |
| Cnt OTHRs' Prior—Diffrnt* Σ OWN | −0.5858*** | −0.5695*** | −0.6657*** | −0.6093*** |
| | (0.141) | (0.143) | (0.110) | (0.143) |
| Observations | 10948 | 10200 | 10948 | 10948 |
| Log Likelihood | −234.5053 | −223.3445 | −214.100 | −232.3226 |
| Pseudo *R*-squared | 0.798 | 0.794 | 0.815 | 0.800 |

*, **, *** significant at 10%, 5%, and 1% level for two-tailed tests.
Standard errors below estimates.
Notes: Conditional logit models of location choice among 34 states by inward FDI (16 states are excluded, which never are chosen) by Japanese firms in the electronics industry. Note that variables reflecting count of investments vary by firm and year in each of these 34 states. Alternative specific constants included.

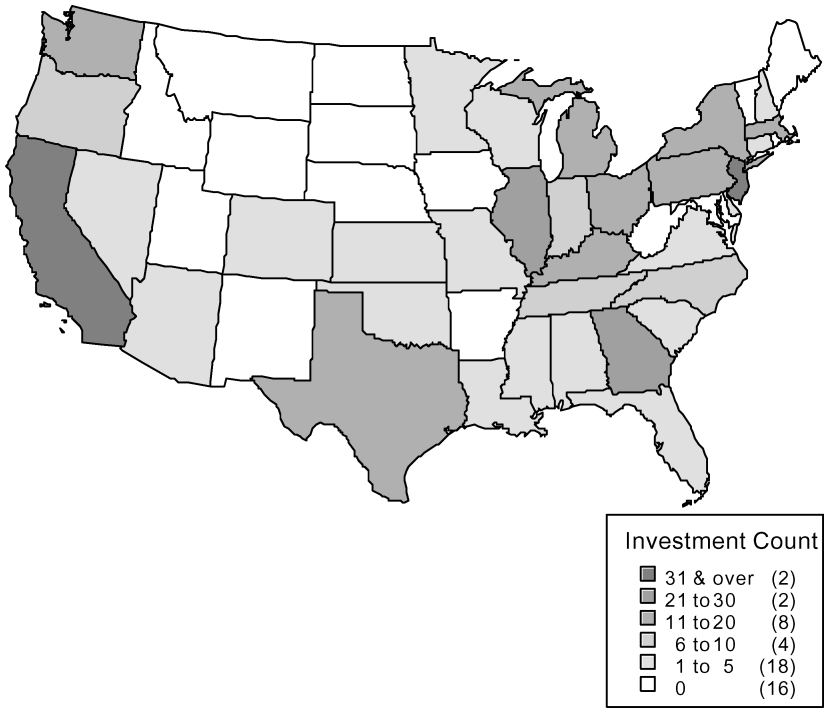


*FIGURE 1. STATE LOCATIONS OF JAPANESE FOREIGN INVESTMENT IN THE UNITED STATES, 1980–1994*

scaled by state GDP). All of these measures vary by state and year. The results from including these additional controls remained very similar to those previously reported.

## 6. Conclusions

We examine where within a host nation firms choose to locate with a focus on firms' tendency to replicate each others' location choice—whether they agglomerate. Firms agglomerate when attracted to similar factors and in the presence of externalities: benefits from increasing returns, lower costs, and/or spillovers. We ask whether and how this tendency is a function of firm traits. The specific traits we investigate originate from recognizing that firms invest multiple times in the same host nation. Such sequential investment means that firms already may have their own subsidiaries in certain locations within the host. By locating proximately to their own subsidiaries, subsequent investments could share physical infrastructure and local knowledge

already developed by the firm. This raises the question of whether firms tend to agglomerate with their own or with other firms' subsidiaries. That investment occurs sequentially also suggests that firms vary in their experience within the host country. Those with little experience—few of their own subsidiaries—may have to rely on concentrations of competitors' subsidiaries for infrastructure and spillovers.

For Japanese electronics firms establishing subsidiaries in the United States from 1980 to 1998, we find that firms are drawn to states with more Japanese subsidiaries. Separating the Japanese subsidiaries into those owned by the same firm versus by competitors, firms are more likely to locate where they had invested before while being indifferent to locations of their Japanese competitors. Agglomeration tends to occur within firms rather than between. Further disaggregating subsidiaries by their activity—sales/distribution, manufacturing, or research—indicates that prior presence of both same activity and different activity subsidiaries is attractive, though presence of same activity subsidiaries is more attractive. While suggestive of within-firm agglomeration benefits, a likely explanation for the attractiveness of same-firm subsidiaries counts is unobserved state traits a firm initially finds attractive that also draw subsequent investment. Finally, we find that whether other Japanese firms' subsidiaries are attractive is a function of a firm's own experience. While experienced firms prefer locations without other Japanese competitors, inexperienced firms are the opposite—being attracted to others' subsidiaries. This suggests that between-firm agglomeration is important for firms that already do not have a substantial presence in the host. Early-on firms seek beneficial spillovers from competitors; as firms gain experience, the competitive effect of proximity grows in prominence and eventually dissuades collocation.

While other explanations exist, our results illustrate the importance of firm heterogeneity in determining both whether firms agglomerated and with whom. Less experienced firms tend to imitate other firms' location choices; more experienced ones agglomerate with themselves. Less experienced firms have more to gain from agglomeration. The possibility of benefiting from others' infrastructure and knowledge spillovers makes locating with others attractive. These findings raise questions about the evolution of agglomeration—initially might most firms collocate, but with time as locations grow more crowded, do more experienced firms choose to break away? Does the economic landscape follow this evolutionary pattern, and might it be conditional on certain industry traits?

A key limitation is our empirical setting in which we examine a single manufacturing sector. This sector with its low transportation costs

and high-scale economies is well suited for demonstrating agglomeration behavior and thus for separating agglomeration into within-versus-between firms. As more data become available, additional analysis on industries that vary in their transportation costs, scale economies, and value-chain links would be illuminating. Is within-firm agglomeration the norm or a function of certain industry traits?

Overall, this paper illustrates the benefits from drawing upon different, though related, literatures; in this case the literature on new economic geography and the literature exploring firm strategic behavior. New economic geography highlights important industry conditions affecting firms' location choice. In turn recognition of firms' differential traits suggests important contingencies and, in this case, refines our view of the phenomena. Injecting firm strategic considerations and the corresponding firm heterogeneity into other related areas may yield similarly interesting results.

## Appendix. Variable Definitions and Sources

| | Coverage | Source |
|---|---|---|
| FDI Transaction Characteristics | | |
| Cnt OWN Prior Investments | 1980–98 | Toyo Keizai (Japanese Overseas Investment) |
| Cnt OWN Prior Invest—Same | 1980–98 | Toyo Keizai (Japanese Overseas Investment) |
| Cnt OWN Prior Invest—Diff | 1980–98 | Toyo Keizai (Japanese Overseas Investment) |
| Cnt OTHERS' Prior Invest | 1980–98 | Toyo Keizai (Japanese Overseas Investment) |
| Cnt OTHERS' Prior Inv—Same | 1980–98 | Toyo Keizai (Japanese Overseas Investment) |
| Cnt OTHERS' Prior Inv—Diff | 1980–98 | Toyo Keizai (Japanese Overseas Investment) |
| Investment Motive | entry yr | Toyo Keizai (Japanese Overseas Investment) |
| State Characteristics | | |
| Own-State GDP | 1980–99 | Bureau of Economic Analysis (Regional Accnts Data) |
| Neighbor-States GDP | 1980–99 | Bureau of Economic Analysis (Regional Accnts Data) |
| Average Weekly WAGE | 1985–97 | Bureau of Labor Statistics |
| Cnt Establishments SIC 36 | 1980–96 | Census of Manuf/County Business Patterns |

## References

Cantwell, John, 1989, "Technological Innovation and Multinational Corporations," Oxford, UK: Basil Blackwell.

Chang, Sea Jin and Philip Rosenzweig, 2001, "The Choice of Entry Mode in Sequential Foreign Direct Investment," *Strategic Management Journal*, 22, 747–776.

Coughlin, Cletus C., Joseph V. Terza and Vachira Arromdee, 1991, "State Characteristics and the Location of Foreign Direct Investment within the United States," *Review of Economics and Statistics*, 73, 675–683.

Fujita, Masahisa and Jacques-Francois Thisse, 2002, *Economics of Agglomeration: Cities, Industrial Location, and Regional Growth*, Cambridge, UK: Cambridge University Press.

Head, Keith, John Ries and Deborah Swenson, 1995, "Agglomeration Benefits and Location Choice: Evidence from Japanese Manufacturing Investments in the United States," *Journal of International Economics* 38(3–4), 223–247.

——, —— and ——, 1999, "Attracting Foreign Manufacturing: Investment Promotion and Agglomeration," *Regional Science and Urban Economics* 29(2), 197.

Knickerbocker, Frederick, 1973, *Oligopolistic Reaction and Multinational Enterprise*, Cambridge, MA: Harvard University Press.

Kogut, Bruce and Sea Jin Chang, 1991, "Technological Capabilities and Japanese Foreign Direct Investment in the United States," *Review of Economics and Statistics*, 73, 401–413.

Krugman, Paul, 1991, "Increasing Returns and Economic Geography," *Journal of Political Economy* 99(3), 483–499.

McFadden, Daniel, 1974, "Conditional Logit Analysis of Qualitative Choice Behavior," in P. Zarembka (ed.), *Frontiers in Econometrics*, New York: Academic Press, 105–142.

Shaver, J. Myles, Will Mitchell and Bernard Yeung, 1997, "The Effect of Own-Firm and Other-Firm Experience on Foreign Direct Investment Survival in the United States, 1987–92," *Strategic Management Journal* 18(10), 811–824.

Song, Jaeyong, 2002, "Firm Capabilities and Technology Ladders: Sequential Foreign Direct Investments of Japanese Electronics Firms in East Asia," *Strategic Management Journal*, 23, 191–210.

Venables, Anthony, 1996, "Equilibrium Locations of Vertically Linked Industries," *International Economic Review* 37(2), 341.

Yamawaki, Hideki, 1991, "Exports and Foreign Distributional Activities: Evidence on Japanese Firms in the United States," *Review of Economics and Statistics* 73(2), 294.