AGGLOMERATION BENEFITS AND LOCATION CHOICE: EVIDENCE FROM JAPANESE MANUFACTURING INVESTMENT IN THE UNITED STATES

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ABSTRACT

Recent theories of economic geography suggest that firms in the same industry may be drawn to the same locations because proximity generates positive externalities or "agglomeration effects." Under this view, chance events and government inducements can have a lasting influence on the geographical pattern of manufacturing. However, most evidence on the causes and magnitude of industry localization has been based on stories, rather than statistics. This paper examines the location choices of 751 Japanese manufacturing plants built in the U.S. since 1980. Conditional logit estimates support the hypothesis that industry-level agglomeration benefits play an important role in location decisions.

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I INTRODUCTION

Firms in the same industry tend to cluster in particular regions. While this observation is not novel, it has become the basis for a number of recent formal models. Economists have proposed agglomeration effects in the form of both pecuniary and technological externalities to explain industry localization. However, empirical work in this area has yet to establish the pervasiveness of externalities based on geographical proximity. Furthermore, we have little idea of the distances over which such effects operate. The recent influx of hundreds of new manufacturing plants from Japan into the U.S. provides a unique opportunity to study the location decision. It also raises the new issue of whether agglomeration effects, to the extent that they exist, operate on a nationality-specific basis.

Empirical information on these issues is particularly important for the design of policies aimed at attracting manufacturing investment. For instance, if agglomeration is at least partly nationality-specific, a locality with a sparse U.S. manufacturing base might find it easier to develop its manufacturing sector by attracting foreign affiliates than by attracting U.S. investment. Moreover, the existence of agglomeration externalities that spill across official borders will alter the payoffs of local governments competing for investment.

This paper estimates a location choice model using data on Japanese investors who established new manufacturing plants in the United States. We find that the Japanese ventures do not simply mimic the geographical pattern of U.S. establishments in their industry. Instead, initial investments by Japanese firms spur subsequent investors in the same industry or industrial group to select the same states. We argue that this pattern of location choice supports an agglomeration-externalities theory of industry localization rather than a theory based on interstate differences in endowments of natural resources, labour, and infrastructure. Moreover, we find that the geographic extent of manufacturing agglomeration does not end at state borders;

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the attractiveness of a state increases with the level of industrial activity in neighbouring states.

Theoretical analysis has developed various explanations for manufacturing agglomeration. The early work of Marshall (1920) provides three compelling reasons for spatially concentrated industries: Localization provides a pooled market for workers with specialized skills, facilitates the development of specialized inputs and services, and enables firms to benefit from technological spillovers. Recent papers by David and Rosenbloom (1990) and Krugman (1991a, 1991b) have constructed formal models to analyze and extend these concepts.

There have been few empirical studies of agglomeration effects. H   rson (1986) examines data for the United States and Brazil and finds strong evidence that industry localization raises factor productivity. Glaeser et al (1992) do not find a positive relationship between industry concentration and city employment growth. Instead, they attribute city growth to industry diversity and competition. They posit that the lack of dynamic agglomeration effects may arise because their sample consists of mature industries.

Previous studies of the investment location decision generally use a measure of aggregate manufacturing activity as an explanatory variable. Recent studies of this type include Wheeler and Mody (1992), Woodward (1992), Coughlin et al (1991), and Schmenner et al (1987). They find that firms are drawn to regions with heavy manufacturing activity. The few studies of industry-level location choice have focused on a limited set of industries. Carlton's (1983) study of domestic firms and Luger and Shetty's (1985) study of foreign firms find evidence of industry-level effects in three specific industries. Smith and Florida (1992) study the investments of Japanese auto-related parts suppliers and show that they tend to locate near Japanese assembly plants and prefer areas with greater aggregate manufacturing activity. Past studies do not . quately distinguish between endowment and industry-level agglomeration effects. Manufacturing activity is likely to be correlated with a number of unmeasured factors favourable to

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specific locations: thus, the coefficient measuring the attractive power of manufacturing activity partly captures the effect of unobserved endowments.

This study contributes to understanding industry agglomeration in a number ways. We explicitly account for state-specific effects (including overall manufacturing activity) by employing state-specific constants. This should capture a number of sources of unobserved variation between states. Our study comprises investments in 225 different 4-digit manufacturing industries. For each investment, the geographical pattern of U.S. establishments in its industry serves as a control for industry-specific location factors. We argue that Japanese deviations from this pattern suggest agglomeration effects. In addition we examine whether members of Japanese industrial groups—known as *keiretsu*—tend to cluster geographically. Since these affiliations often involve the subcontracting of components and other less tangible ties, a tendency for their members to cluster would offer additional evidence of agglomeration. Finally, we allow the attractiveness of a state to depend on its own industry clusters as well as those in bordering states.

The organization of the paper is as follows. Section II presents several theoretical accounts of agglomeration externalities and the alternative theory that we refer to as *endowment-driven* localization. Section III describes our research design, the main hypothesis we test and alternative hypotheses we consider. Section IV discusses the data set and the construction of agglomeration measures. Presentation of econometric results follows in Section V. This section employs a simulation to assess the strength of the estimated agglomeration effects. We conclude with a summary of the major results and a discussion of their potential policy implications.

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II THEORIES OF LOCALIZATION

Localization, the geographic concentration of particular industries, could arise through a variety

of mechanisms. The general category we are interested in, agglomeration effects, includes all

economies that are an increasing function of the number of nearby firms. The cumulative loca-

tion choices that constitute the process of agglomeration allow accidents of history to influence

the long-run geographical pattern of industry. Local expansion of a sector sows the seeds for

further expansion by increasing the supply of the factor that made the location attractive in the

first place, rather than simply bidding up the price of a given stock. Theoretical attempts to

formalize agglomeration effects have focused on three mechanisms that would yield such positive

feedback loops: inter-firm technological spillovers, specialized labor, and intermediate inputs.

The vague and general concept of technological spillovers is probably the most frequently

invoked source of agglomeration effects. Useful technical information seems to flow between

entrepreneurs, designers, and engineers in a variety of industries. A large part of the spillovers

between foreign-owned firms may include the flow of experience-based knowledge on how to

operate efficiently in a given state.[1] Physical proximity may enhance knowledge flows by mak-

ing casual communication less costly. Since technological spillovers are usually impossible to

measure, we know little about the geographical extent of these spillovers, the degree to which

they operate within industries versus between industries, and the extent to which they flow

between firms of different national origins. While the prosperity of the high-technology cluster

in Silicon Valley and the high-fashion cluster in Milan may arise from local knowledge spillovers,

less ephemeral stories involving specialized labour and parts may play equally important roles.

As indicated by Marshall, localized industry creates a pooled market for workers with spe-

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[1] Examples of such information would include experiences with meeting local government regulations, adopting
to the local climate and labour force, and low-cost transportation options.

cialized skills. This attracts workers for two reasons. First, as argued by David and Rosenbloom (1990), if the fortunes of individual firms are not perfectly correlated, the spatial concentration of industry is advantageous to laid-off workers who will be able to find new jobs with other firms. Hence, an increased number of firms reduces the likelihood that a worker will suffer a long bout of unemployment. This reduced risk will ultimately benefit the firms as well by increasing the supply of specialized labour and reducing the risk premium embodied in the wage. Rotemberg and Saloner (1990) propose what could be seen as a complementary effect. Workers in a given location will be more inclined to invest in industry-specific human capital if they feel confident of their ability to appropriate the benefits. A monopsony situation might allow the employer to capture the benefits instead. Thus, by mitigating the hold-up problem, agglomeration generates the development of more industry-specific skills.

Krugman (1991b) argues that the combination of scale economies and moderate transportation costs will encourage the users and suppliers of intermediate inputs to cluster near each other. Such agglomerations reduce total transportation costs and generate large enough levels of demand to warrant efforts to produce highly specialized components. This will attract assemblers which in turn encourages new arrivals and additional specialization.

The "just-in-time" inventory system employed by many Japanese manufacturers raises the total cost of transporting parts because it requires flexible and punctual deliveries. Due to the importance this system places on reliability and trust, it may also encourage specialization in the form of long-term relationships. These arguments suggest that agglomeration effects will exert a particularly strong influence on Japanese manufacturers as they attempt to transplant their production systems to North America.

While recent theoretical work has concentrated on agglomeration models of industry localization, a simple alternative hypothesis, *endowment-driven* localization, draws on traditional

trade theory. The latter theory argues that industries will concentrate in regions with favorable factor endowments. For instance, sawmills might congregate in a particular state to take advantage of its abundant supply of high quality timber. A broad view of factor-endowments would include man-made inputs whose supply is not affected by the output of any particular industry.

In both theories of localization, firms in the same industry cluster geographically; however, only in the presence of agglomeration externalities does the clustering *add* to the attractiveness of the location. For instance the existence of an immobile and exogenously supplied input would tend to attract investment from industries that use that input intensively. However, as firms congregate, the location becomes less attractive since competition among users bids up the price of the input. A corresponding phenomena could occur on the demand side if exogenous forces had promoted the concentration of downstream demand for a particular industry. These considerations suggest an important difference between the theories: agglomeration benefits could result in two states with identical endowments receiving very different shares of the investment in any particular industry. This study will estimate the magnitude of industry-level agglomeration effects and assess their importance in location decisions.

III Research Design

We model the location decision of Japanese manufacturing plants as a conditional logit problem where the dependent variable is the state chosen by each investor. Following the method employed in earlier studies such as Carlton (1983) and Bartik (1985), we exploit McFadden's (1974) result that logit choice probabilities may be derived from individual maximization decisions if unobserved heterogeneity takes the appropriate form. We assume that each investor chooses the state that would yield the highest profit. Profits depend on the availability of inputs

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that enter in the firm's production function which include agglomeration effects stemming from nearby economic activity of similar firms. Idiosyncratic shocks, denoted ϵ_{js}, also affect profits but they are not observed by the econometrician. As derived in the appendix, the profitability of state s for investor j may be represented as

$$\theta_s + \alpha_{US} \ln A_{js}^{US} + \alpha_J \ln A_{js}^J + \alpha_G \ln A_{js}^G + \epsilon_{js}, \tag{1}$$

where θ_s captures the attractiveness of state s to the "average" (or representative) investor and A_{js}^{US}, A_{js}^J, and A_{js}^G are agglomeration variables measured as counts of U.S., Japanese, and Group (keiretsu) establishments. Each measure varies across investors, j, since investors differ by industry, keiretsu membership, and time of entry. The state effect reflects infrastructure, the prices of variable inputs such as labour, raw materials, and energy as well as any other state characteristic important to the average Japanese investor.

McFadden (1974) demonstrated that if, and only if, ϵ_{js} is distributed as a Type I Extreme Value independent random variable the probability that state s will yield investor j the highest profits among all the states in choice set S is given by the logit expression,

$$\Pr(js) = \frac{\exp(\theta_s + \sum_{i \in A} \alpha_i \ln A_{js}^i)}{\sum_{\ell \in S} \exp(\theta_\ell + \sum_{i \in A} \alpha_i \ln A_{j\ell}^i)}, \tag{2}$$

where $A = \{US, J, G\}$. Maximum likelihood techniques use these probabilities to estimate the state-specific constants and agglomeration coefficients.

Our use of state effects contrasts with the approach taken by previous studies of location decisions in manufacturing in which the authors explicitly included state characteristics such as wages, unionization rates, energy prices, and access to a major port.[2] The problem with

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[2]Friedman et al (1992) is a recent example. It provides a tabular summary of results from previous work.

that approach stems from the near impossibility of selecting and correctly measuring all of the relevant infrastructure and input price information that affect location decisions. Omitted sources of attractiveness would almost certainly induce a correlation between the error term and the agglomeration variables. State effects can include influences on the location decision that are particularly difficult to measure, ranging from the strength of the work ethic in a particular state to the quality of its golf courses.

While θ_s captures the attractiveness of state s to the average investor, unobserved characteristics of choosers can still make some states closer substitutes in the eyes of certain investors. Suppose that the parameters of the production function vary across industries but are constant for investments in the same 4-digit industry. In this case, firms in industries with high factor intensities will choose states with abundant endowments of those factors. For priced inputs, low prices will indicate abundance. This suggests that industry-level agglomeration variables will be correlated with the unobserved factor conditions pertaining to that industry that constitute the error term in our model. With a large enough data set, featuring multiple investments in each industry, this problem could be resolved by including state-industry-specific constants. However, since our sample of 751 investments includes plants in over 200 different 4-digit industries, this strategy is not feasible.

The use of a sample of new foreign investors—the Japanese influx during the 1980s—provides an alternative strategy for separating agglomeration and endowment effects. The geographical distribution of U.S. establishments in a particular industry should incorporate all the relevant information on the abundance of endowments used intensively in that industry. Significant drawing power of prior Japanese investment, after controlling for the U.S. pattern, should provide an indication of agglomeration effects.

The empirical investigation distinguishes between alternative explanations for Japanese loca-

tion patterns that deviate from those of U.S. firms in the same industry. In addition to Japanese-specific agglomeration effects, there are two primary explanations for distinctive Japanese patterns. The first is that Japanese firms cluster in the same states regardless of industry for fundamental reasons, i.e. Japanese investors might choose a state because they want to be on the Pacific coast, or in a low-unionization state or near major population centers. These effects would be captured by the state-specific constants. A second possibility is that Japanese investors concentrate by industry due to systematic forms of heterogeneity that make particular locations intrinsically attractive for certain types of Japanese investment. For instance, if a subset of investors, such as auto firms, rely disproportionately on intermediate inputs, they would exhibit preference for states with superior transportation facilities. We attempt to weed out such potential sources of uncontrolled-for inter-industry variation by testing the robustness of our formulation to deletions of particular regions from the choice set and industries from the investor set.

IV DATA

The data employed in this paper come from a survey of Japanese manufacturing investments in the United States conducted by the Japan Economic Institute. For each plant in the sample we know the year it began operations, the identity of the parent firm or firms, and the products it manufactures. Since most policy discussion focuses on efforts to attract new (also known as "greenfield") investments, we excluded acquisitions from the sample.[3]

Our estimation includes investments that began operations after 1979. The previous investments are used to form the Japanese agglomeration levels as of the beginning of 1980. The

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[3]The location model for new investment probably differs in important ways from the model for acquisitions. Since acquisitions involve changes in ownership rather than the creation of new establishments, they have ambiguous effects on our agglomeration measures. Furthermore, while new ventures may locate wherever they want, acquirors are limited to the current locations of potential targets.

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smaller estimation window reduces potential variation in relative infrastructure levels and factor prices. Also, since the character of Japanese direct investment may have changed over time, this reduces unobserved heterogeneity. Finally, the use of the later data allows for a closer match with our U.S. data which was drawn from the 1982 and 1987 censuses. The post-1979 sample contains over 80% of Japanese manufacturing investments in the United States.

Figure 1 depicts the geographical pattern of all greenfield Japanese investment. Below each value for Japanese investment we give the percentage of U.S. establishments in that state in 1982. Since the U.S. sample is constructed from the same set of 4-digit industries as the Japanese sample, we would expect the upper and lower numbers to match very closely if there were no special influences on the location of Japanese investment.

A number of states received no Japanese investment at all. The data in Figure 1 reveals that those states—namely Delaware, Idaho, Montana, New Mexico, North and South Dakota, Rhode Island and Wyoming—are quite unpopular with U.S. manufacturers as well. Conditional logit requires that all choices be selected at least once. Consequently we removed those states from the choice set. We further reduced the choice set by removing states (Hawaii, Louisiana, Maine, Minnesota, New Hampshire, Utah, Vermont and West Virginia) which received fewer than 3 investments after 1979. This reduces the number of estimated parameters by 8 while reducing the sample by only 9 observations. Given the independence from irrelevant alternatives assumption built into the logit specification, the reduction in the choice set should not affect the other parameter estimates.

We estimate the effects of four types of agglomeration variables on the location choice. In each case agglomeration is measured as a count of establishments the year before the venture began operations. We selected establishr t counts, rather than production or employment levels,

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Figure 1: The Geographical Distribution of **Japanese** and *U.S.* Manufacturing Establishments*
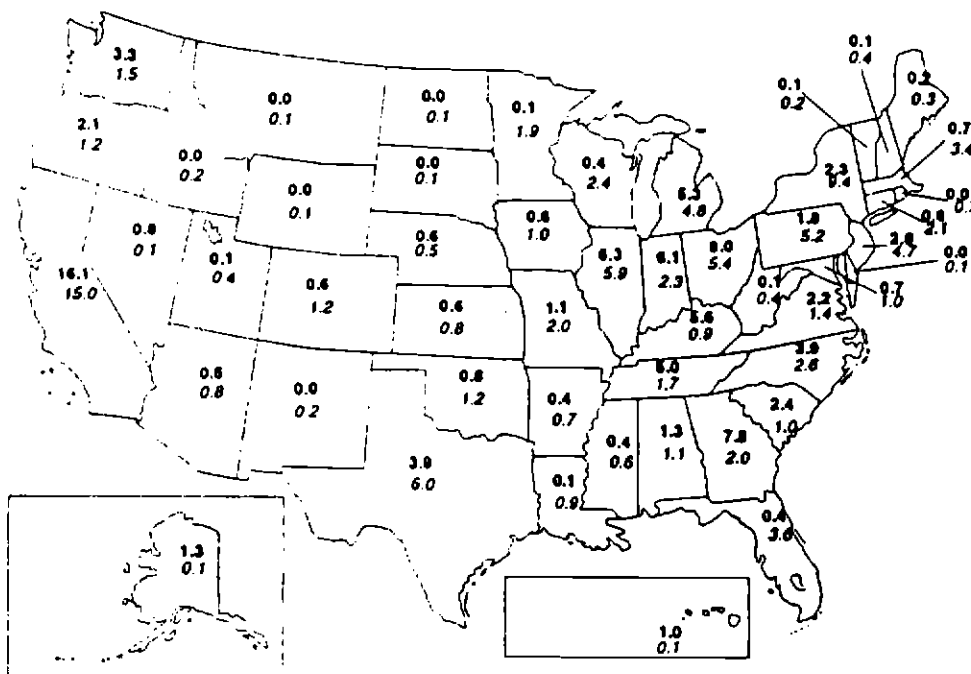
*: Figures expressed as percentages of the Japan total of 900 greenfield investments and the U.S. total 1982 stock of 229,292 manufacturing establishments. U.S. figures based on 1982 Census of Manufacturing Data for all 4-digit SIC industries that received some greenfield Japanese investment.

because that allowed us to construct equivalent measures of Japanese and U.S. agglomeration.[4]

The following list defines the four types of agglomeration effects investigated in this study.

U.S. activity: A_{js}^{US} Number of establishments in same 4-digit SIC. Investments that began operations between 1980 and 1984 (inclusive) are matched to 1982 Census of Manufacturing counts. Later investments are matched to the 1987 Census.

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[4]Data confidentiality in the U.S. Census of Manufacturing results in establishments being the only variable which is available for every state in every 4-digit SIC industry. There is a slight difference between the Japanese and U.S. establishment counts. The U.S. data puts each establishment in one industry. We have data on multi-product Japanese plants which does not indicate the primary SIC of the plant. It seems reasonable that a firm producing two products would care about the activity in both industries in each state. Hence, we count each product line as a separate plant for calculating the relevant agglomeration variables. Note, however, that we model multi-product plants as single choosers in the estimation.

Japan-based activity A_{js}^J. Number of plants operating in same 4-digit SIC in the year before investment j began operations. Source: *Japan Economic Institute 1990 Updated Survey*.

Industrial Group member activity A_{js}^G. Number of establishments in same manufacturer-led *keiretsu*. Group affiliations were compiled using *Kigyo Keiretsu Soran*, a publication of Toyo Keizai.

Border-State Activity: $\sum_{t \in B(s)} A_t^i$ where $i = US, J, G$. $B(s)$ is the set of states with borders on state s.

The two industry-level agglomeration variables (A^{US} and A^J) make use of the standard industrial classification tables. We employ the relatively detailed 4-digit level of disaggregation. These "industries" frequently lump disparate activities together but they may also separate closely related industries. We have found several cases where the use of standard classifications causes an understatement of Japanese industrial concentration. For instance, Japanese firms made 41 investments in industry 3089, "plastic parts, not elsewhere classified" However, 22 of those plants produced plastic parts for automobiles. Of the remaining 19 plants, 32% selected Georgia compared to 2% of all U.S. establishments in industry 3089. Machine tools provides a case where *insufficient* aggregation hides the extent of agglomeration. Five of thirteen Japanese makers of machine tools for metal cutting (SIC 3541), two of six makers of cutting tools (SIC 3545), and four of five makers of the numerical controls used for machine tools (SIC 3625) chose Illinois. While Illinois is relatively strong in each industry, it accounts for little more than 10% of the U.S. establishments in these industries.

The last two sources of agglomeration effects, industrial groups and activities in border-states require some additional explanation. With respect to A^G, we consider only industrial or "vertical" groups; i.e. those headed by large manufacturing companies whose members consist

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largely of component suppliers. Vertical linkages are likely to be strong in these groups which may motivate them to locate close to each other in order to access supplies and facilitate information exchange. We exclude bank-centered or "horizontal" groups which are largely defined by financial linkages and tend to behave more like diversified conglomerates. Since state borders are rather arbitrary boundaries for the extent of agglomeration effects, we created border-state variants of A^{US}, A^J, and A^G by summing the number of firms in adjacent states. These variables allow for the possibility that, for example, Indiana is attractive to widget manufacturers not only because of the widget producers there but also because of widget producers in Illinois, Ohio, Michigan and Kentucky.

V RESULTS

Table 1 presents the agglomeration coefficients generated by maximum likelihood estimation of equation (2). The estimation included state-specific constants which we omitted from the results table. Column (1) provides the benchmark model estimates where we test whether Japanese ventures emulate their American counterparts. This specification describes location choice when country-of-origin effects are absent or the case where the number of U.S. firms acts as a proxy for industry-specific endowment effects. The estimated coefficient reveals that Japanese firms locate in regions where there are a relatively large number of U.S. establishments in the same industry. If the error term is an independently drawn disturbance, the coefficient on $\ln A^{US}$ measures the impact of agglomeration on location choice. However, the endowment theory of localization (described in Section II) suggests that the error term, ϵ_{j}, in equation (1), will be correlated with A^{US}, in which case the coefficient on $\ln A^{US}$ will reflect endowment effects in addition to agglomeration economies.

Columns (2) and (3) reveal a "follow-the-leader" pattern of Japanese investment that is

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Table 1: Agglomeration Effects on Location Choice

	Dependent Variable: Location Choice				
	(1)	(2)	(3)	(4)	(5)
$\ln A_s^{US}$	0.600	0.505	0.502	0.490	0.476
	(0.060)	(0.060)	(0.060)	(0.060)	(0.061)
$\ln \sum_{\ell \in B(s)} A_\ell^{US}$	0.286	0.218	0.216	0.233	0.243
	(0.071)	(0.070)	(0.070)	(0.070)	(0.071)
$\ln A_s^J$		0.667	0.603	0.591	0.592
		(0.092)	(0.094)	(0.095)	(0.095)
$\ln \sum_{\ell \in B(s)} A_\ell^J$		0.449	0.405	0.362	0.363
		(0.093)	(0.094)	(0.096)	(0.096)
$\ln A_s^G$			0.768	0.749	0.749
			(0.131)	(0.131)	(0.131)
$\ln \sum_{\ell \in B(s)} A_\ell^G$			0.342	0.301	0.301
			(0.140)	(0.143)	(0.143)
$USGROWTH$					0.110
					(0.085)
Log-Likelihood	-2173.39	-2127.13	-2108.82	-2065.22	-2064.38
No. of Choosers	751	751	751	751	751
No. of Choices	34	34	34	34	34

Note: Conditional logit regressions estimated by maximum likelihood. Standard errors in parentheses. Alternative specific constants were employed in each estimation. Columns (4) and (5) were estimated with state-specific time trends as well. A_s corresponds to a stock of firms operating in state s at the beginning of the year when the relevant venture's began operations. It includes that venture. The superscripts J, US, and G refer to Japanese plants in the ventures 4-digit SIC, US establishments in the 4-digit SIC, and plants at least 50% owned by members of the parent company's industry group. $B(s)$ is the set of states that border state s. Hence, the summation is the aggregate stock in adjacent states.

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difficult to interpret as anything other than agglomeration effects. The location of Japanese investments is significantly influenced by the locations of previous Japanese investments in the same industry and/or *keiretsu*. The larger coefficients on the Japanese agglomeration variables suggest that the attractive effect of prior Japanese investment exceeds that of prior U.S. investment.[5] The large significant coefficient on $\ln A^G$ corroborates our hypothesis that supply relationships between Japanese firms and technological spillovers are stronger between members of the same industrial *keiretsu*.

Adding the Japanese industry and group counts significantly improves the explanatory power of the regression equation. The likelihood ratio test overwhelmingly rejects the hypothesis that the four Japan-specific variables (within-state and border-state A^J and A^G) have no explanatory power.[6] Moreover, including these variables detracts little from the significance of the U.S. variables. The following reasons cause us to believe that the estimated coefficients reflect more than simple correlation between location decisions and unobserved state industry endowments. To begin, we would expect the coefficients on the U.S. variables to capture this correlation. If the same unobservables were responsible for the estimated effect on Japanese counts, they would not result in the significant new information demonstrated by the likelihood ratio test. Moreover, we would expect the Japanese variables to share the measured effect of the U.S. variable in column (1) which they clearly do not.

We added the industrial group variable, A^G, in column (3) to determine whether vertical linkages might provide an additional impetus to Japanese firms' location decision beyond the draw of previous investments in the same industry. For example, a firm that produces plastic auto parts might be attracted to a state that has considerable auto production even if there were

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[5] A likelihood ratio test of the hypothesis that the U.S. and Japanese effects (within-state and border-state) are equal rejects at the 0.04 confidence level.

[6] The test statistic is 129 and the critical value for significance at the 0.005 level is 15.

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no concentration of plastic parts producers in that state. We also hypothesized that member firms might locate near each other to reap the benefits of shared information. Column (3) estimates show that group member activity provides a strong attractive force for investment decisions.

We tested analogous agglomeration measures which indicated border-state industry activity by U.S. firms, Japanese firms, and *keiretsu* members in addition to the within-state agglomeration variables. The statistical significance of all three border-state variables indicate that agglomeration externalities cross state boundaries, although, as one might expect, the magnitude of the effect declines. While anecdotal accounts suggest that agglomeration benefits operate over small geographic areas such as cities, our results suggest that they extend over greater distances. A group of states becomes collectively more attractive through the activity of each of its members. creating an industrial "cluster" that could extend for hundreds of miles.[7]

One potential problem for interpreting the effect of A^J is that the Japanese ventures, for the most part, started more recently than the American ones. Because most Japanese investments occurred later. it is possible that relative levels of infrastructure or factor prices changed from those prevailing at the time U.S. firms made their location decisions. The apparent Japanese agglomeration might then arise solely as a response to the new conditions faced by the Japanese firms when they made their investments.[8]

We allow for changes in the relative attractiveness of states by adding state-specific time trends.[9] This makes the model robust to trends affecting the relative attractiveness of a state in the eyes of the average investor. Column (4) displays estimates of the agglomeration elasticities

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[7] However, border-state activity is not always distant, as it may involve cities like St. Louis that straddle state borders.

[8] Relocation costs might generate the inertia implied by U.S. firms' decisions to remain in locations where environmental factors have become unfavorable. However, agglomeration effects could be at work as well.

[9] The appendix contains a derivation of these time trends showing what forms of change they can accomodate.

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when these state time trends are included. While a likelihood ratio test reveals that inclusion of

the time trends adds significant explanatory power (p-value=.005) to the specification, they do

not affect the magnitude or the significance of the coefficients on the agglomeration variables.

Therefore, although relative state attractiveness changed over the 1980s, the measured Japanese

agglomeration effects do more than reflect trends in the attractiveness of individual states.

To the extent that there are industry-specific effects, we need to provide a control for changes

that make a state more attractive during the sample period for certain industries but not

others. We employ a variable called $USGROWTH$ which is the growth rate in the number

of establishments in each industry-state between the 1982 and 1987 census.[10] The inclusion of

$USGROWTH$ should sharply diminish the significance of the Japanese agglomeration if the

latter variables simply reflect recent changes in industry-specific endowment effects. As shown in

column (5), $USGROWTH$ does not have a significant effect on location choice and its presence

has a negligible effect on the coefficients of the agglomeration variables.

V-A Interpretation of Coefficients

Interpreting the magnitude of the coefficient estimates is not straightforward in the logit model.

The ratios of the coefficients correspond to the ratios of parameters in the underlying production

function. Thus, in column (3), the elasticity of output with respect to border-state agglomera-

tion ranges between 43% and 67% of the elasticity with respect to within-state agglomeration.

The question remains whether the within-state agglomeration effects—0.50, 0.60, and 0.77—are

"large" numbers. One way to assess their magnitude is to express them as average probability

elasticities. The elasticity of the probability of a particular investor j choosing state s with

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[10] Definitions of industries changed in 1987. To make the 1982 and 1987 series compatible, we created composite industry definitions. For instance, 1977 SICs 2651 and 2654 became either SIC 2656 or 2657 under the 1987 classification system. For this case, we created a composite industry that is the sum of 2651 and 2654 for 1982 and the sum of 2656 and 2657 for 1987. $USGROWTH$ measures the growth rate of that composite industry.

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respect to agglomeration variable A^i can be calculated by differentiating equation (2).

$$E_{js}^i = \frac{\partial \Pr(js)}{\partial A^i} \frac{A^i}{\Pr(js)} = \hat{\alpha}_i (1 - \Pr(js)).$$

Summing over all choosers (j) and choices (s) we obtain the relationship between average probability elasticities and the coefficient estimate, $\hat{\alpha}_i$.

$$E^i = \sum_{j=1}^{N} \sum_{s=1}^{S} E_{js}^i = \hat{\alpha}_i \frac{S-1}{S}.$$

Since S, the number of choices. equals 34 in the estimations, elasticities can be obtained by multiplying the estimated coefficient by 0.97. The average probability elasticities indicate that for the average state increasing its stock of establishments in some industry by 10% would increase its likelihood of being chosen by a subsequent investor in that industry by 5% to 6%. Adding the very first Japanese plant in an industry raises the attractiveness of that state to other firms in the industry by 50%.

Thus far, we have shown that the coefficients we interpret as agglomeration effects are very significant *statistically* and that agglomeration appears to increase the attractiveness of a location by a respectable percentage. However, we have not answered the question which should be of great concern to policy makers: If financial incentives succeed in attracting an initial investment, will that set in motion cumulative effects that will be strong enough to have a substantial impact on the location choices of subsequent investments? To address this question, we used the estimated coefficients to simulate the consequences of state actions that attract investments.

Our simulation considers an hypothetical "representative" industry that initially has no Japanese investment and a 1000 U.S. establishments distributed across states in proportions

equal to those of the aggregate U.S. manufacturing sector (as portrayed in Figure 1). The simulation entails the sequential entry of 30 Japanese plants. Each one chooses a location based on state characteristics (including location decisions of previous investments) and a Type I Extreme Value independent random shock. This gives rise to a baseline allocation of investments across states. We compare this baseline to an alternative scenario in which the simulation assigns the first plant to a predetermined state and allows the following 29 investments to choose states in response to the exact same pattern of disturbance terms. This allows us to measure the long run impact for each state of attracting the first investment. We repeat the experiment 100 times and compute the average outcome.

Figure 2: The Long Run Payoff From Attracting an Initial Investment*
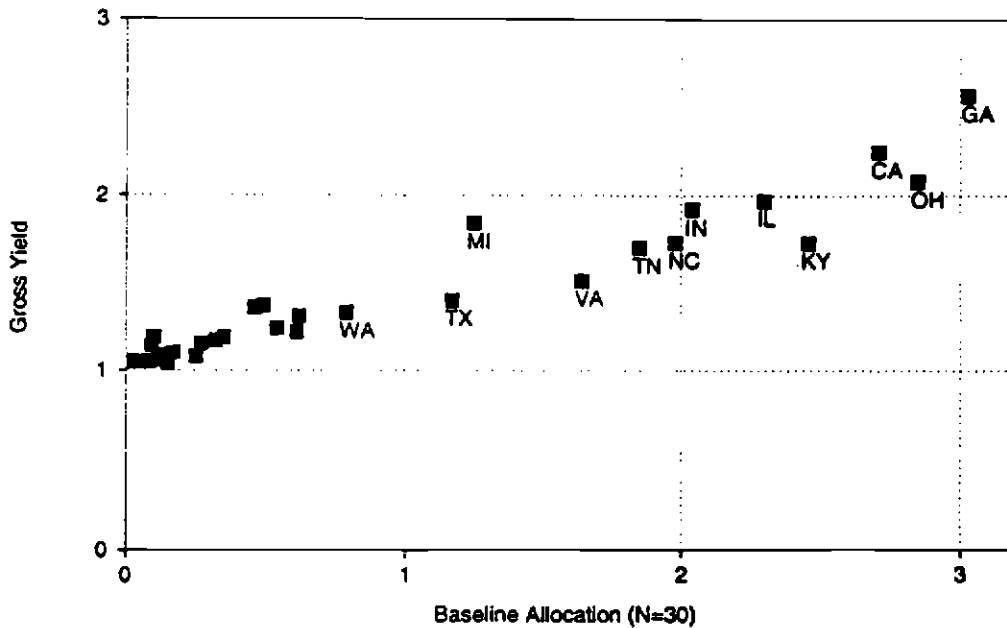
Baseline Allocation (N=30)

Figure 2 depicts the distribution of the 30 Japanese investments both in the presence and

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absence of state policies securing initial investments. The horizontal axis measures the number of investments in each state in the "baseline" case where the Japanese plants locate based on the state characteristics and a random error term. The vertical axis shows the gross investment yield of actions that ensure the first investor locates in a particular state. The gross yield includes the first investment plus any changes in subsequent location decisions resulting from assigning this investment to the state in question.[11] The figure indicates that states with manufacturing concentrations or estimated "desirable" state-specific effects such as Georgia, Ohio, and California attract the most investment, an average of about three investments each. Moreover, these states also receive the the highest gross yields. While the simulation reveals that state policies that attract initial investments usually lead to further investment in that state, subsequent investment related to agglomeration is fairly limited. Across the 34 states we consider, the gross yield on policies ensuring that the first of 30 Japanese investors locate a particular state is only 1.4 investments. For "attractive" states, the payoff is higher–2.57 for Georgia and 2.25 for California. Over the 100 trials, these states occasionally gained as many as 8 or 10 investments. On the other hand for "unattractive" states, attracting the initial investor yielded little beyond that particular investment.

V-B   Robustness Issues

Conditional logit estimation relies on the assumption of identical independent error terms in equation (1). If these assumptions are not met in the data, a violation of the independence of irrelevant alternatives (IIA) property will lead to biased estimates.[12] The inclusion of alternative-

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[11]In some trials, the gross yield for a particular state was zero or even negative. There were trials where the initial investment located in the state in question in the baseline case so the exercise yielded no net change. In other trials relocating the first investment alters ensuing contests for investment such that the state's competition for certain investments is made stronger and the state no longer attracts the investments that it did in the baseline case.

[12]The IIA property, which is necessary for unbiased conditional logit estimation, implies that the relative probability of choosing two alternatives (states) does not depend on the availability or characteristics of other

specific constant terms (state dummy variables) removes some forms of bias that might arise. Train (1984, p. 18-25) shows that adding alternative-specific constant terms—state effects in this study—allows for the use of a conditional logit specification in the presence of some forms of IIA violation. Specifically, our model is valid as long as investors have uniform perceptions of the substitutability between states. However, unobserved characteristics of the choosers might make some choices closer substitutes in the eyes of certain investors than other choices. Such unobserved heterogeneity will lead to a violation of IIA.[13] Consequently, the coefficient estimates will depend critically on the sample of choosers and choices. To investigate whether our results are robust, we reestimate the model using a variety of sub-samples, where each sub-sample is chosen to remove a potential violation of the independence assumption. We find that the coefficients on the parameters of primary interest remain remarkably stable.

We selected four groups of states to remove from the sample: the Pacific, the Rust Belt, the Sun Belt, and the South. In each of these regions, states might have certain characteristics in common that could lead to violations of the IIA assumption. Pacific states (Alaska, Washington, Oregon, and California) have lower transportation costs to Japan. Rust Belt states (Illinois, Indiana, Ohio, Michigan, Wisconsin, Pennsylvania, New Jersey, New York, Connecticut, Massachusetts, and Maryland) tend to have relatively high unionization rates and have a declining share of the nation's population. Sun Belt states (California, Arizona, Nevada, Texas, and Florida), on the other hand, have experienced rapid population growth over the last decade. Southern states (Georgia, South Carolina, Mississippi, and Alabama) have low unionization rates and have enjoyed rapid growth of manufacturing. The IIA problem does not arise from

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alternatives. For instance, in a choice between three states—A, B, and C—Pr(A)/Pr(B) is independent of the characteristics of state C. Suppose, however, that in reality investors uniformly view states C and B as close substitutes, while they regard A as substantially inferior to either. An unobserved improvement in C would increase Pr(A)/Pr(B).

[13]Conditional probit models allow for correlated error terms. However, they are computationally infeasible with such a large set of choices.

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the regional differences by themselves. If low unionization raised the attractiveness of Southern states to all Japanese investors, this effect would show up in the state-specific constants. Instead. the concern is that a subset of the investors have strong opposition (or attraction) to some characteristic common to a group of states. Since we generally cannot observe such sentiments, they will generate correlated error terms.

Table 2: Independence from Irrelevant Alternatives?

	Dependent Variable: Location Choice					
	No Pacific	No Rust	No Sun	No South	No Auto	No F/W
$\ln A_j^{US}$	0.466	0.383	0.469	0.595	0.508	0.455
	(0.069)	(0.070)	(0.066)	(0.066)	(0.068)	(0.062)
$\ln \sum_{\ell \in B(s)} A_\ell^{US}$	0.306	0.164	0.383	0.179	0.218	0.227
	(0.097)	(0.081)	(0.093)	(0.072)	(0.077)	(0.073)
$\ln A_s^J$	0.640	0.722	0.717	0.549	0.752	0.513
	(0.111)	(0.120)	(0.110)	(0.103)	(0.119)	(0.097)
$\ln \sum_{\ell \in B(s)} A_\ell^J$	0.248	0.438	0.310	0.440	0.340	0.407
	(0.105)	(0.123)	(0.108)	(0.101)	(0.123)	(0.094)
$\ln A_s^G$	0.893	0.567	0.941	0.822	0.172	0.771
	(0.134)	(0.199)	(0.138)	(0.141)	(0.266)	(0.130)
$\ln \sum_{\ell \in B(s)} A_\ell^G$	0.145	0.525	0.232	0.419	0.604	0.339
	(0.155)	(0.189)	(0.160)	(0.152)	(0.237)	(0.140)
Log-Likelihood	-1668.59	-1121.45	-1631.21	-1733.95	-1490.59	-2052.79
No. of Choosers	609	462	612	654	518	729
No. of Choices	30	23	29	30	34	33

Note: Conditional logit regressions estimated by maximum likelihood. Standard errors in parentheses. Coefficients for alternative-specific constants are not reported. Definitions of RHS variables can be found in the note below Figure 1. "No Pacific" excludes AK, CA, OR, and WA. "No Rust" excludes CT, IL, IN, MA, MD, MI, OH, PA, NJ, NY, WI. "No Sun" excludes AZ, CA, FL, NV, TX. "No South" excludes AL, GA, MS, SC. "Fish/Wood" refers to SICs 2091, 2092, 2421, 2426 and 2436.

The results of estimating the model with the restricted samples are shown in columns (1)-(4)

in Table 2. The statistical significance and approximate magnitude of U.S. and Japanese within-state industry-activity effects holds up well over four entirely different choice sets, although there is some variation in the estimates of the border-state effects. In particular, the within-state agglomeration measures retain the same levels of statistical significance across the four samples.[14] An alternative approach is to retain the full choice set while eliminating groups of similar investors. Columns (5) and (6) portray estimates after the elimination of ventures for which there are reasons to expect correlated error terms that will lead to violations of the IIA assumption: auto-related plants and plants involved in fish or timber processing.

Smith and Florida (1992) show that the location of large Japanese automobile assembly plants figured prominently in the location decisions of the over 200 subsequent investments by auto parts companies. While these clusters might indeed be partly attributable to Japanese agglomeration externalities, they also could be a source of correlated errors among states with assembly plants. Column (5) shows the results of estimated the model after eliminating auto-related investments.[15] Again, the results are generally robust to restriction of the sample. The within-state group variable does, however, become insignificant, suggesting that the estimated *keiretsu* effect arises primarily from activity in the auto industry.

The last restricted sample eliminates two industries that draw heavily on local natural resources. Japanese firms processing canned and frozen fish are heavily concentrated in Alaska whereas the corresponding U.S. industry was dispersed among various coastal states. Similarly, the concentration of Japanese lumber firms in Washington deviates from the U.S. industry pattern. We speculated that these Japanese ventures might be oriented towards exporting their

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[14] This approach to the IIA problem was inspired by formal test proposed in Hausman and McFadden (1984). We did not construct the test statistics because our use of alternative-specific constants causes the number of parameters to vary across specifications. Also, since their tests are only valid under the maintained assumption of IIA in the restricted choice set, we felt that it would be more instructive to view the reduced-sample estimations as informal tests of robustness.

[15] Auto parts investments span over forty 4-digit SIC codes. However, the product descriptions provided by the *Japan Economic Institute* generally make it clear which plants serve the auto industry.

products back to Japan. This unobserved intention could lead to correlated errors terms among states chosen by firms in these industries. Column (6) shows the result of eliminating ventures in canned and frozen fish and lumber industries from the sample. While the estimated coefficients on the within-state U.S. and Japanese counts fall somewhat, all the effects remain positive and significant.[16]

The coefficient estimates presented in Table 2 demonstrate that our primary results continue to hold, regardless of the imposed sample restrictions. Both U.S. and Japanese within-state manufacturing activity attract Japanese investment in the same industry. the most part, border activity also appears to be an attracting force. The group activity results, however, appear less robust to changes in the sample. In particular, they seem to disappear altogether with the removal of the auto-related investments. This finding could reflect the limitation of using group affiliation to represent vertical linkages for groups other than those headed by automobile producers. While firms in auto groups almost certainly produce related products, other group affiliations might be among firms who produce completely different products. For example, in the case of electronics, many group companies were created as spinoffs into new product lines and they have few actual business dealings with other group members.[17] The insignificance of group agglomeration in the non-auto sample also indicates that group companies may not need to locate foreign affiliates close to each other in order to facilitate information exchange.

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[16]The fact that 9 out of 12 Japanese wood-products manufacturers chose Washington or North Carolina is hard to reconcile with a resource-driven story given that Oregon and Virginia, which have large counts of U.S. establishments, received no Japanese investment. However, we wanted to make sure that this highly concentrated industry was not driving our results.

[17]See Gerlach (1993). A case in point is Fanuc which produces numerically controlled machine tools which differ substantially from the products of other members of the Fujitsu group.

VI CONCLUSIONS

The geographical distribution of Japanese investments in the 1980's demonstrates the importance of agglomeration economies in location decisions. Our estimates suggest that a state which experiences a 10 percent increase in any of our agglomeration measures increases its probability of future selection by 5 to 7 percent. This finding emerges even when we control for state effects, state time trends, and industry-level stocks and flows of U.S. investment. Japanese investors prefer to site their plants in areas where they find concentrations of previous Japanese investments in the same industry and, for auto-related firms, the previous investments made by *keiretsu* affiliates. These results do not arise through deliberate selection of industries thought to exhibit agglomeration effects. Instead, they figure prominently in a sample including a diverse set of industries. Even the exclusion of heavily localized industries such as autos and sawmills does not alter the basic findings. In addition, we confirm the hypothesis that state borders do not define the relevant economic boundaries for agglomeration effects; border-state activity has up to two-thirds of the attractive power of in-state activity.

Since Japan-specific agglomeration appears to exert a strong influence on location decisions, it suggests that neither natural resources nor specialized labour drive location choice by themselves. This is because those factors should be captured in the pattern of U.S. establishment agglomeration. Hence, the finding of strong attraction between Japanese firms points towards the importance of explanations involving intermediate inputs and pure technological spillovers.

In 1985 Kentucky offered an incentive package in excess of $300 million to attract a Toyota manufacturing plant. While states do not extend such massive packages frequently, substantial efforts to lure manufacturing investments are common. The question arises whether the results in this paper provide a rationale for policies of this kind. Agglomeration effects imply that any benefits received from attracting a single investment will be magnified by an increased

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probability of attracting subsequent similar investments. However, simulation results indicate that this subsequent investment may be small or negligible, especially for states that Japanese investors perceived as relatively unattractive. Furthermore, the winners in bidding wars between state governments may find that the price paid in terms of subsidies and added infrastructure may offset any gain derived from attracting a foreign manufacturer.

A   Appendix: The Conditional Logit Model of Location Choice

This appendix derives the profit function expressed in equation (1) and discusses the restrictiveness of the assumptions that underlie the empirical work.

The following three sets of variables enter the production function.

- Agglomeration Effects: A_i, Economic activity in an area that generates positive externalities for nearby firms engaged in similar activities.

- Infrastructure Measures: I_i, Inputs available *in fixed supply* to all firms located in the state, e.g. highway miles. port capacity, climate, research universities.

- Priced Variable Inputs: X_i, Input whose levels are chosen to minimize costs given the prices that prevail in each state, e.g. skilled and unskilled labor, raw materials, energy.

By assuming that the investor has a production function of the Cobb-Douglas form (where the inputs are defined in the body of the paper), we obtain a final specification that is linear in the parameters and where coefficient estimates can be interpreted as probability elasticities.

$$q = A_1^{\alpha_1} \cdots A_K^{\alpha_K} I_1^{\beta_1} \cdots I_L^{\beta_L} X_1^{\gamma_1} \cdots X_M^{\gamma_M} \exp(\mu). \tag{3}$$

The last term, μ, captures state- and investment-specific heterogeneity in total factor pro-

ductivity.

Define p as the output price, w_i as the price of variable input X_i, and let $\rho \equiv 1 - \sum_{i=1}^{M} \gamma_i$.
If inputs are set to minimize cost, and output is set to equate marginal cost with the output
price and $\rho > 0$, the profit function is

$$\pi = \left(\xi A_1^{\alpha_1} \cdots A_K^{\alpha_K} I_1^{\beta_1} \cdots I_L^{\beta_L} w_1^{-\gamma_1} \cdots w_M^{-\gamma_M} p \exp(\mu) \right)^{\frac{1}{\rho}}, \tag{4}$$

where ξ is a complicated function of the γ_i parameters.

Taking natural logs and multiplyiug by ρ we obtain

$$\rho \ln \pi = \ln \xi + \sum_{i=1}^{K} \alpha_i \ln A_i + \sum_{i=1}^{L} \beta_i \ln I_i - \sum_{i=1}^{M} \gamma_i \ln w_i + \ln p + \mu. \tag{5}$$

This equation specifies profits according to a form amenable to conditional logit estimation
as the profit associated with locating plant j in state s is a function of the characteristics of
the state. The firm chooses state s if the profits for locating there exceed those associated with
alternative locations. We drop $\ln \xi$ from the profitability equation since adding a constant to
the profits in each location does not affect the comparison of profits and consequently will not
affect choice probabilities.

Assume that infrastructure ineasures, I_i, and input prices, w_i, vary across states (*Choices* are
indexed by s) but not across investments(*Choosers* are indexed by j). In that case, infrastructure
variables and input prices can be combined into a single indicator of the attractiveness of state
s to the "average" (or representative) investor which will be denoted as

$$\theta_s \equiv \sum_{i=1}^{L} \bar{\beta}_i \ln I_{is} - \sum_{i=1}^{M} \bar{\gamma}_i \ln w_{is} + \ln \bar{p}_s + \bar{\mu}_s \tag{6}$$

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where the "upper bar" variables—$\tilde{\beta}$, $\bar{\gamma}$, $\bar{p}$, and $\bar{\mu}$—are the average of the N Japanese investments.

Now, profitability for investment j in state s depends on a state effect, the agglomeration activity related to j, and an error term.

$$\rho \ln \pi_{js} = \theta_s + \sum_{i=1}^{K} \alpha_i \ln A_{js}^i + \epsilon_{js} \tag{7}$$

The error term is defined as follows:

$$\epsilon_{js} \equiv \sum_{i=1}^{L} (\beta_{ij} - \bar{\beta}_i) \ln I_{is} - \sum_{i=1}^{M} (\gamma_{ij} - \bar{\gamma}_i) \ln w_{is} + (\ln p_{js} - \ln \bar{p}_s) + (\mu_{js} - \bar{\mu}_s) \tag{8}$$

This error term measures deviations from the average Japanese investor's input elasticities, output price, and total factor productivity in each state. The divergences from the average input elasticities are weighted by the corresponding factor price or infrastructure level in that state. If this error term is distributed as a Type I Extreme Value independent random variable, the parameters in equation (7) can be estimated using conditional logit.

We have assumed Cobb-Douglas production functions and a Type I Extreme Value error term, we believe our results will hold up under more general conditions. With respect to the production function, the Cobb-Douglas form is convenient because it yields a multiplicative profit function. However, our specification would remain appropriate in other forms as long as the profit function can be expressed as

$$\pi_{js} = g(\mathbf{W}_s, \mathbf{I}_s) h(\mathbf{A}_{js}) \exp(\epsilon_{js}),$$

where $g()$ and $h()$ are functions of the input prices, infrastructure and agglomeration variables: $\mathbf{W}$, $\mathbf{I}$, and $\mathbf{A}$. In that case, the state effect, θ_s in equation (2) will be an estimate of $\ln g(\mathbf{W}_s, \mathbf{I}_s)$

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and $\sum_{i=1}^{K} \alpha_i \ln A^i_{j\bullet}$ will correspond to a first-order logarithmic approximation of an arbitrary continuous function $h(\mathbf{A}_{j\bullet})$.

With respect to the error term, McFadden (1974) has demonstrated that the extreme value distribution, $F(\epsilon_{j\bullet}) = \exp[-\exp(-\epsilon_{j\bullet})]$, is the only one that will yield the logit form. However, Hausman and Wise (1978) found that the conditional probit, assuming an *independent normal* distribution, produces very similar results to the conditional logit.[18] Since the normal distribution is known to be a good approximation for a number of continuous distributions, this finding suggests the computational gains provided by the conditional logit formulation probably do not cause a major loss in robustness as long as the independence assumption is not violated.

The state-specific time trends are derived in the following manner. Denote the initial (1979) value of infrastructure variable or factor price i in state s as I^i_{s0} or w^i_{s0}. Assume that infrastructure and wages grew (or declined) at constant rates, ν^i_s and η^i_s, during the investment period (1980-1992). Then, for investment j that occurs in year t, $I^i_{j\bullet} = I^i_{0\bullet} \exp(\nu^i_s t_j)$, $w^i_{j\bullet} = w^i_{0\bullet} \exp(\eta^i_s t_j)$. Under these assumptions, equation (7) becomes

$$\rho \ln \pi_{j\bullet} = \theta_{s0} + \Delta\theta_s t_j + \sum_{i=1}^{K} \alpha_i \ln A^i_{j\bullet} + \epsilon_{j\bullet}$$

where $\Delta\theta_s \equiv \sum_{i=1}^{L} \beta_i \nu^i_s + \sum_{i=1}^{M} \gamma_i \eta^i_s$.

REFERENCES

BARTIK, TIMOTHY J., 1985, "Business Location Decisions in the United States: Estimates of the Effects of Unionization, Taxes and Other Characteristics of States," *Journal of*

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[18] The intuition behind the Hausman and Wise result is that the difference between two Type I Extreme Value error terms has the logistic distribution which resembles the standard normal.

Business & Economic Statistics,3, No. 1, 14–22.

CARLTON, DENNIS W., 1983 "The Location and Employment Choices of New Firms: An Econometric Model With Discrete and Continuous Endogenous Variables," *Review of Economics and Statistics* 65, 440–449.

COUGHLIN, CLETIS, 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*, 675–683.

DAVID, PAUL A. AND JOSHUA L. ROSENBLOOM, 1990" Marshallian Factor Market Externalities and the Dynamics of Industrial Location," *Journal of Urban Economics* 28, 349–370.

FRIEDMAN, JOSEPH, DANIEL A. GERLOWSKI, AND JONATHAN SILBERMAN. 1992, "What Attracts Foreign Multinational Corporations? Evidence from Branch Plant Location in the United States." *Journal of Regional Science* Vol. 32 No. 4, 403–418.

GERLACH, MICHAEL L., 1993, "Economic Organization and Innovation in Japan," Forthcoming in *Journal of Economic Behavior and Organization.*

GLAESER, EDWARD AND HEDI KALLAL. JOSÉ SCHEINKMAN AND ANDREI SCHLEIFER 1992, "Growth in Cities," *Journal of Political Economy* 100, no. 6, 1126–1152.

HENDERSON, J. VERNON, 1986, "Efficiency of Resource Usage and City Size," *Journal of Urban Economics* 19, 47–70.

HAUSMAN, JERRY AND DAVID WISE, 1978, "A Conditional Probit model for Qualitative Choice: Discrete Decisions Recognizing Interdependence and Heterogeneous Preferences." *Econometrica* 46, No. 2, 403–426.

HAUSMAN, JERRY AND DANIEL MCFADDEN, 1984, "Specification Tests for the Multinomial Logit Model," *Econometrica* 52, No. 5, 1219–1240.

KRUGMAN, PAUL R., 1991a, " Increasing Returns and Economic Geography," *Journal of Political Economy* 99, 483–499.

KRUGMAN, PAUL R., 1991b, *Geography and Trade*, Cambridge, MA: The MIT Press.

LUGER, MICHAEL I. AND SUDHIR SHETTY, 1985, " Determinants of Foreign Plant Start-ups in the United States: Lessons for Policymakers in the Southeast", *Vanderbilt School of Transnational Law* 18, 223–245.

MARSHALL, ALFRED, 1920, *Principles of Economics*, 8th ed., London: MacMillan.

MCFADDEN, DANIEL, 1974, " Conditional Logit Analysis of Qualitative Choice Behaviour," in ZAREMBKA, P., ed., *Frontiers in Econometrics*, New York: Academic Press, 105–142.

ROTEMBERG, J. AND G. SALONER, 1990, "Competition and Human Capital Accumulation: A Theory of Interregional Specialization and Trade," NBER Working Paper #3228.

SCHMENNER, ROGER W., JOEL C. HUBER, AND RANDALL L. COOK, 1987, "Geographic Differences and the Location of New Manufacturing Facilities," *Journal of Urban Economics* 21, 83–104.

SMITH. DONALD AND RICHARD FLORIDA, 1992, "Agglomeration and Industry Location: An Econometric Analysis of Japanese-Affiliated Manufacturing Establishments in Automotive-Related Industries," H. John Heinz III School of Public Policy and Management (Carnegie Mellon University) Working Paper.

TRAIN, KENNETH. 1985. *Qualitative Choice Analysis: Theory, Econometrics, and an Application to Automobile Demand,* Cambridge, MA: The MIT Press.

WHEELER, DAVID AND ASHOKA MODY, 1992, "International Investment Location Decisions: The Case of U.S. Firms," *Journal of International Economics* 33, 57–76.

WOODWARD, DOUGLAS P., 1992, "Locational Determinants of Japanese Manufacturing Start-ups in the United States", *Southern Economic Journal,* January, 690–708.