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Industrial groupings and foreign direct investment

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Abstract

We explore worldwide foreign direct investment (FDI) location decisions by Japanese manufacturing firms from 1985 through 1991. Our conditional logit estimates provide evidence that firms' location decisions are affected by membership in either vertical or horizontal *keiretsu*. Consistent with previous studies that stress agglomeration effects on firms' location decisions, we find that the stock of investment in a region by a firm's vertical *keiretsu* partners increases the probability of location. Further, we find that the recent flow of investment into a region by a firm's horizontal *keiretsu* partners increases the probability of investment to the region, providing evidence of networking effects.

Keywords: Multinational enterprises; Networking; *Keiretsu*; Agglomeration

JEL classification: F23; G3

1. Introduction

It has frequently been suggested that firms in the large industrial groupings of Japan and Korea, known, respectively, as *keiretsu* and *chaebol*, may behave differently than their US or European counterparts in a number of dimensions. A small set of papers in recent years have examined whether membership in such groupings affects firms' foreign direct investment (FDI) decisions, with a particular focus on the effect of *keiretsu* groupings on Japanese FDI activity.

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The majority of papers on this topic have examined the effect of vertical *keiretsu* groupings, where upstream suppliers are centered around a large downstream manufacturer. As detailed in Head et al. (1995), significant agglomeration externalities are likely to be present for firms in vertical *keiretsu* groupings. Suppliers work closely with downstream firms on designing specialized components and often provide just-in-time delivery of supplies. Thus, geographic proximity enhances the efficiency of such arrangements, giving firms incentives to locate their FDI in the same region. Head, Ries and Swenson (HRS) empirically examine Japanese FDI in the US and find that a greater existing stock of a Japanese firm's own vertical *keiretsu* partners in a particular US state makes that firm more likely to locate in that state as well. However, they find that this vertical *keiretsu* effect is largely due to the automobile sector and is no longer present when observations from this sector are excluded from their sample.[1]

The other major form of industrial grouping in Japan is the horizontal *keiretsu*. These are groupings of firms in often-unrelated industries that are centered on a large bank. There are three features of horizontal *keiretsu* that observers have pointed to as potentially important for economic behavior: (1) cross-ownership between partner firms, where a group bank holds a significant share of the group-member firms' equity, and these member firms hold substantial equity positions in each other; (2) potentially easier terms of credit for members from the *keiretsu*-affiliated bank, both due to a reduction in the costs of monitoring and the discipline of repeat financing; (3) organized meetings among major *keiretsu* firms often called Presidential Council meetings which potentially facilitate the exchange of information and the coordination of actions.

With respect to FDI activity, researchers have focused on easier credit terms as the feature of horizontal *keiretsu* that potentially leads to greater firm investment, including FDI. The employed tests examine whether membership in any horizontal *keiretsu* increases a firm's likelihood of FDI, since such membership should give the firm cheaper financing of such investment, ceteris paribus.[2] The evidence for these effects of horizontal *keiretsu* membership is much more mixed than for vertical *keiretsu*.[3]

In addition to mixed empirical results, a recent paper by Miwa and Ramseyer (2002) argues that economic effects stemming from the features of horizontal *keiretsu* described above are more myth than reality. They point out that the vast majority of financing by Japanese firms in *keiretsu* groupings comes from non-*keiretsu* financial institutions, and this share has been increasing over time. This runs counter to the notion that horizontal

[1] Belderbos and Carree (2002) perform a similar analysis to HRS, but do so using data on FDI into China by Japanese firms. As HRS found for Japanese automobile-related FDI into the US, Belderbos and Carree find significant positive effects of existing vertical *keiretsu* member presence on Japanese electronic firms' location decisions in China, which is consistent with an agglomeration externalities motivation. Other studies have found positive effects of vertical *keiretsu* groupings on Japanese FDI activity using alternative estimation strategies, including Belderbos and Sleuwaegen (1996), Kimura and Pugel (1995) and Ryan (2001).

[2] A horizontal *keiretsu* membership dummy is sometimes interacted with variables that measure how credit-constrained the firm may be, to see if membership is more beneficial for such firms in the *keiretsu*.

[3] Belderbos and Sleuwaegen (1996) find that horizontal *keiretsu* membership makes Japanese firms more likely to be multinational enterprises and that this membership effect is most significant for those firms that are credit constrained. Ryan (2001), however, finds only weak evidence for a horizontal *keiretsu* membership effect, whereas McKenzie (1997) finds no evidence that such membership affects the likelihood of FDI into various regions by Japanese firms.

keiretsu firms rely on their *keiretsu* bank for easier credit terms and may explain why previous studies have only found mixed evidence that horizontal *keiretsu* membership increases (foreign) investment.[4] Likewise, Miwa and Ramseyer show that cross-shareholding arrangements are much lower than one would expect, particularly between the non-financial members of these horizontal *keiretsu*. Finally, Miwa and Ramseyer dispute the notion that the Presidential Council meetings by executives of the *keiretsu*'s main members have any influence on behavior by members whatsoever, contending that "scholars who stress their importance have yet to produce a lunch club decision that much mattered" (p. 193).

Of the points raised by Miwa and Ramseyer, their argument against the effect of Presidential Council meetings is likely the weakest. Even if important collusive agreements among firms are not forthcoming from such meetings,[5] there is likely a high level of networking and information exchange that occurs when heads of member firms meet. Such networking connections may have a very substantial role in economic decisions and behavior, as evidenced by recent papers documenting a strong and significant effect of networking connections on international trade flows.[6] We find these papers compelling and suggest they serve to provide the obvious response to Miwa and Ramseyer (2002) criticism, which is to ask why such meetings take place if they serve no purpose. Additionally, a 2001 report by Japan's Fair Trade Commission based on surveys of horizontal *keiretsu* firms found that

> "The backbone of corporate groups is . . . [the] meeting of presidents of the companies in the same group. What are the benefits of such meetings? 'Exchanges of information' topped the list, followed by 'utilization of accumulated business expertise and know-how of affiliates.' (p. 8)

In this paper, we examine for the first time the potential effect of networking connections through *keiretsu* relationships on the FDI decisions made by Japanese firms. We hypothesize that if network effects are present then previous FDI activity by a firm's horizontal *keiretsu* partners into particular foreign regions will make FDI by the firm into these same regions more likely because this lowers the necessary costs of information acquisition. Thus, our focus is on whether region-specific horizontal *keiretsu* activity affects a firm's FDI location decisions. This contrasts with previous studies of FDI by horizontal *keiretsu* that has examined whether *keiretsu* membership per se affects a firm's decision to engage in FDI at all.

Similar to HRS, we estimate a Japanese firm's FDI location decision using a conditional logit framework. However, we introduce two important innovations. First, we sample FDI location decisions by Japanese manufacturing firms in the late 1980s and

[4] We do not find this argument persuasive. While the share of financing of *keiretsu* firms' investments by their group–member–bank may be small and falling, what is important is the financing of *marginal* investments. This may be precisely where the special relationship has greatest impact.

[5] Note that tacit collusive decisions are by their very nature difficult to observe. Thus, it should not surprise us if there are few known examples of obvious lunch club decisions that had an impact.

[6] Such papers include Greif (1993), Gould (1994), Head and Ries (1998), Rauch (1999) and Rauch and Trindade (2002). Rauch (2001) provides an overview of the theoretical and empirical work in this area.

early 1990s across all foreign regions of the world. Second, our sample includes both vertical and horizontal *keiretsu*. This allows us to examine the potential networking effects of horizontal *keiretsu*, while controlling for agglomeration benefits that are a strong feature of vertical *keiretsu* linkages.

We find that agglomeration externalities from vertical *keiretsu* are important considerations for Japanese investment location decisions worldwide. The stock of investment in a region by a firm's vertical *keiretsu* members increases the probability of the firm's location in that region. For example, our estimates suggest that the existence of investment by vertical *keiretsu* members of 500 employees or more in a region increases the firm's probability of location in that region by over 50%. The agglomeration impact of unrelated firm location by Japanese manufacturing firms in the same industry is also statistically significant, though less than half the magnitude of the vertical own-*keiretsu* effects. These agglomeration results are consistent with HRS, but importantly generalize these results for Japanese location decisions worldwide, not just for regions in the US. Additionally, our vertical *keiretsu* effects are robust to the exclusion of automobile-centered vertical *keiretsu*, which was not true for HRS.

We also explore and find supportive evidence for the idea that investment activity by related horizontal *keiretsu* members affects worldwide investment location decisions of Japanese firms. We find that recent (previous-year) investment activity by horizontal *keiretsu* partners leads to a greater probability of location in the same region by a firm.[7] For example, previous-year investment activity of horizontal partners of at least 100 employees increases a firm's likelihood of location in that region by over 20% on average. We attribute these effects to the networking and information sharing that occurs between members of horizontal *keiretsu*, as such information sharing can yield cost-savings to a newly locating firm. Consistent with this interpretation, we find such horizontal *keiretsu* effects are substantially larger for the Presidential Council firms in the most closely knit horizontal *keiretsu*—precisely where one would expect such information sharing to be the greatest. We further find that the horizontal *keiretsu* effects only occur with respect to recent investment activity, suggesting that information relevant for entry decisions depreciates with the age of the previous investments. These results provide the first systematic evidence for the networking effect of business groups on FDI decisions of which we are aware.[8] By examining the effect of recent investment activity by horizontal *keiretsu* members across regions, we better identify this networking effect, in contrast to previous studies that examined only whether membership in a horizontal *keiretsu* per se affects investment decisions.

The rest of the paper proceeds as follows. Section 2 outlines our empirical methodology that starts with the framework of HRS and modifies it to allow for the effects of networking and information-sharing on FDI location decisions. Section 3 describes our sample of investment decisions by Japanese manufacturing firms from 1985 through 1991 and construction of our agglomeration and networking/information variables. Section 4

[7] Previous year's investments presumably reveal the most up to date and thus useful information.

[8] Using empirical methods similar to Rauch and Trindade (2002) study of bilateral trade patterns, Tong (2001) finds evidence that greater ethnic Chinese networks increase FDI activity between countries. In contrast, we are examining network effects that occur through more formal business groups.

then presents out conditional logit estimates and sensitivity tests before a final section concludes.

2. Empirical methodology

We follow HRS in specifying a Japanese firm's FDI location decision as one that can be modeled using a conditional logit specification. Assuming production is Cobb-Douglas and that agglomeration externalities enter the production function in a multiplicative fashion similar to infrastructure and other inputs, then a firm's profitability for producing in a particular region is a log-linear function of the agglomeration measures, infrastructure measures and factor prices. Thus, the profitability of region r for investor j may be represented as

$$\theta_r + \alpha_i \ln A^i_{j,r} + \varepsilon_{j,r}, \tag{1}$$

where A^i represents agglomeration externalities from source i, θ_r represents region-specific effects and $\varepsilon_{j,r}$ is an error term. Region-specific effects are important as they control for a wide variety of potentially important characteristics of a region that are both difficult to measure precisely and are hard to observe, but none-the-less may make it more or less attractive to investors. Such characteristics range from infrastructure and input prices to labor force characteristics and amenities of the natural environment.[9]

HRS examines four sources of potential regional agglomeration externalities (A^i) in its empirical analysis: (1) from US domestic firms in the same four-digit Standard Industrial Classification (SIC) industry (A^{US}) in the region; (2) from other Japanese firms in the same industry (A^J) in the region; (3) from Japanese firms who belong to the firm's vertical *keiretsu* (A^G) in the region; and (4) from agglomeration in states that border the region (A^B). In our analysis, we include variables to measure the second and third agglomeration externalities in similar fashion to HRS. The first source of agglomeration (US domestic industry presence in a US region) is obviously not directly comparable because we are examining worldwide FDI activity of Japanese firms, not just the US component. An analogue to this first HRS agglomeration variable would be a proxy for domestic activity in the region/country for the same SIC industry. However, it is impossible to obtain comparable data on such activity across regions of the world for detailed four-digit SIC industries. Since our data span just 7 years, we initially assume that changes in such aggregate activity remain constant across regions and are then subsumed into the region effects. However, later we show that our estimates are robust to including region–year and region–industry effects as well. Examination of the fourth source of agglomeration externalities (effects from border states) is not a significant issue for our analysis because we examine Japanese investment into much more aggregate country/region groupings than HRS. Thus, we do not include such measures in our analysis.

[9] The investment decisions we examine will also span a number of years, so we initially assume that these region-specific variables are time-invariant. However, below we explore inclusion of region–year-specific effects.

Unlike HRS, our analysis examines not only agglomeration effects from vertical *keiretsu* relationships, but also the potential for networking effects associated with horizontal *keiretsu*. We hypothesize that networking connections with firms already in a particular region provide important investment information to an investing firm. This information can lower its costs of production in that particular region. For example, such information could allow the firm to better site its investment in a more cost-effective location and/or garner more favorable tax and regulatory treatment.[10]

Another source of cost-reducing information not explored by HRS is the firm's own experience. Shaver et al. (1997) find that FDI by firms into a region for which they have prior FDI experience is more likely to survive than FDI by first-time entrants.[11] They attribute these effects to informational spillovers that occur within the firm. Such within-firm informational spillovers should reduce the cost of operation in regions where a firm has prior experience and make such a location more attractive than others, ceteris paribus.

Given these considerations, we can modify Eq. (1) to include these two sources of networking/information spillovers, membership of a *horizontal keiretsu* and the firm's own experience:

$$\theta_r + \alpha_i \ln A^{\mathrm{J}}_{j,r} + \eta_i \ln A^{\mathrm{G}}_{j,r} + \beta_i \ln \mathrm{HK}_{j,r} + \gamma_i \ln \mathrm{PE}_{j,r} + \varepsilon_{j,r}, \tag{2}$$

where HK is a variable capturing the potential for information sharing through horizontal *keiretsu* relationships with other firms in region *r*, and PE is a variable measuring the firm's own previous experience in region *r*, which can provide evidence on intra-firm information sharing.

An important difference between agglomeration effects and networking/information effects is that while agglomeration effects clearly relate to stocks of related firms, information effects are likely more directly tied to recent flows of investment into a region, not stocks. With changing regulatory, tax and legal environments governing new investment, firms that have most recently invested in a region should have better current information for potential investors. Thus, our maintained hypothesis is that stock measures best capture agglomeration effects, and flow measures best capture information-sharing effects.

Given this, we expect the sharpest contrast between agglomeration (stock) and information (recent flow) effects to be with our horizontal *keiretsu* variable. With horizontal *keiretsu* members dispersed across often unrelated industries, agglomeration effects should be insignificant. Instead, the information/networking effects of horizontal *keiretsu* should be substantial. Given previous work, vertical *keiretsu* should have strong agglomeration effects, but certainly information/networking effects may be present as well. Industry effects, likewise, should have strong agglomeration effects, but information

[10] These are examples of how such information can lead to reductions in variable costs, since it is a production function that is the theoretical framework for the conditional logit specification we employ. Networking and information costs may also lower one-time fixed costs of FDI location as well. Our estimates may be capturing these one-time savings though we do not model them formally.

[11] In a related vein, Yu (1990), Kogut and Chang (1991), Hennart and Park (1994), Belderbos (1997) and Blonigen (2002) are examples of papers that have found that firms are more likely to invest abroad if they have previous FDI experience.

effects should be minimal between non-related competing firms. Information effects should be strong within the firm, though previous investment by the firm may contribute some agglomeration effects as well.

3. Data and variable construction

We use the publication, *Japanese Overseas Investment: A Complete Listing by Firms and Countries 1992/93* (English version) published by Toyo Keizai, for data on Japanese FDI and foreign affiliate activity.[12] This publication reports information from a census of all Japanese-owned subsidiaries as of 1991, and includes location, parent firm, establishment date, employment and type of investment (greenfield or acquisition).[13] This gives us a snapshot of worldwide Japanese FDI in 1991. However, given establishment dates of the affiliates and assuming no exits, we can construct a time series of Japanese FDI patterns over time. Of course, the further back in time, the greater the measurement error. Given these issues and the fact that the majority of total Japanese affiliate establishments occur during the wave of the late 1980s, we choose to limit our analysis to FDI location decisions by Japanese manufacturing firms from 1985 through the census year of 1991. This provides a tradeoff between analyzing a substantial sample of Japanese FDI location decisions and mitigating measurement issues.

We categorize investment locations during our sample into 11 countries/regions that comprise all possible world locations: the 9 major destination host countries, an all-other developed country region and an all-other less-developed country region. The nine major destination countries are Germany, Indonesia, Korea, Malaysia, Singapore, Thailand, Taiwan, the United Kingdom and the United States. With 1485 investment decisions in our sample from 1985 through 1991 across 11 possible destinations, our data consist of a total of 16,335 observations.

Table 1 reports the relative frequency of Japanese FDI established in the 11 locations. As can be seen from Table 1, the United States is the destination that receives the most Japanese FDI, accounting for 29.5% of total affiliates and 37.1% of foreign affiliate employment. Despite this, Japanese FDI is dispersed fairly widely across various destinations, with many top destinations in Southeast Asia.

To proxy for agglomeration effects, HRS uses counts of establishments/plants. One concern with counts is that it assumes comparable size of such establishment/plants. As Table 1 shows, average plant size in terms of employees can be quite different even at the aggregate country level, with a low of 187.4 employees per affiliate in Singapore to a high of 434.5 employees per affiliate in Germany. Given that the size of the affiliate likely affects the expected agglomeration and information effects from such an affiliate, we use the number of employees to proxy for agglomeration and information effects rather than

[12] We gratefully thank Keith Head and John Ries at the University of British Columbia for sharing their electronic version of these data.

[13] Survey data on Japanese affiliates are updated and published semiannually by Toyo Keizai. However, with the exception of the 1984 report, no other years provide an English version.

Table 1
Japanese industrial and electrical machinery investments from 1985 through 1991, by location

Country	Number of affiliates		Affiliate employees		Average plant size (in employees)
	Number	Percent of total	Number	Percent of total	
Germany	47	3.2	20,421	4.3	434.5
Indonesia	49	3.3	17,829	3.7	363.9
Korea	73	4.9	14,756	3.1	202.1
Malaysia	114	7.7	38,387	8.0	336.7
Singapore	53	3.6	9930	2.1	187.4
Thailand	171	11.5	49,753	10.4	291.0
Taiwan	106	7.1	23,430	4.9	221.0
United Kingdom	83	5.6	21,796	4.6	262.6
United States	438	29.5	177,090	37.1	404.3
Other developed countries	162	10.9	38,119	8.0	235.3
Other less-developed countries	189	12.7	66,115	13.8	349.8

counts of establishments/plants.[14] Thus, the number of employees by firms in the same four-digit SIC industry in the region r (excluding the firm itself) proxies for $A^{J}_{j,r}$and the number of employees by members of the firm's same vertical *keiretsu* in region r (again excluding the firm itself) proxies for $A^{G}_{j,r}$. Similarly for the information-related variables, the number of employees by members of the firm's same horizontal *keiretsu* (excluding the firm itself and any firms in the same industry) in region r proxy for $HK_{j,r}$ and the number of employees by the firm itself in region r proxy for $PE_{j,r}$.

Unlike HRS, we want to measure both information and agglomeration effects. Thus, we consider measures that include only the previous-year foreign affiliate activity (flows) to proxy for information effects and ones that measure the stock of activity to proxy for agglomeration effects.[15] We note that our stock measures are a cumulation of all investment prior to the year of observation and, thus, vary over time for the same region and firm.[16] As in HRS, we add one to these employment measures of agglomeration and/or information to avoid taking the log of zero.

The use of employee numbers (rather than counts of Japanese affiliates) to construct our regressors is not innocuous given that we must construct our panel of data from a single census year. In fact, it adds the further assumption that 1991 employee levels are the affiliates' employee levels for every year since its establishment to the earlier-stated assumption of no affiliate exits. This likely increases measurement error in our data and deserves discussion. First, as noted above, we restrict our sample to begin in 1985 to mitigate this problem to some extent, especially when using previous-year flow data for our information-related regressors. In fact, we get qualitatively similar coefficient

[14] Head and Ries (2002) also use the employment data from this database in similar manner to examine skill upgrading by Japanese firms when investing abroad.

[15] We also tried measures that examined the most recent 5-year activity, which predictably gave coefficient estimates that were somewhere between the 1-year flow and stock measures. We do not report these for the sake of brevity.

[16] For example, a stock variable for 1985 cumulates all previous years through 1984. The same stock variable for 1986 is the same except it also adds any activity from 1985.

Table 2
Summary statistics of regressors

Variable	Mean	Standard deviation	Minimum	Maximum
Stock measures				
Investment by vertical *keiretsu* members	0.819	2.254	0.000	9.362
Investment by horizontal *keiretsu* members	2.240	2.958	0.000	9.798
Investment by Japanese firms in same industry	3.624	3.826	0.000	10.121
Investment by firm	6.346	2.542	0.000	10.514
One-year flow measures				
Investment by vertical *keiretsu* members	0.231	1.113	0.000	8.407
Investment by horizontal *keiretsu* members	0.403	1.388	0.000	9.681
Investment by Japanese firms in same industry	1.456	2.412	0.000	8.628
Investment by firm	2.316	2.765	0.000	9.683

All variables are measured in numbers of employees and logged after adding the value of "1", to avoid taking the log of zero. Unit of observation is firm and region.

estimates to those reported below when we restrict our sample to just 1990 and 1991, the two most recent years of our sample, although the loss of observations inflates standard errors somewhat.

The use of stock data for our measures may be more problematic on this issue, as such measures obviously cumulate previous investment even before 1985. Again, the majority of Japanese FDI occurs during the years of our sample, and this means that the 1991 numbers are a reasonable approximation even for our stock measures, especially for the later years where the previous stock will include years in the late 1980s. We also note that our results with stock variables are robust to whether one uses counts of establishments or number of employee measures. Employee measures, however, always outperform counts-of-establishment measures in terms of the attained log likelihood and goodness of fit measures. Thus, our specifications below use employee measures.

We use *Industrial Groupings in Japan 1988/89*, published by Dodwell Marketing Consultants to categorize Japanese firms into *keiretsu*. There are six main horizontal *keiretsu* (DKB, Fuyo, Mitsubishi, Mitsui, Sanwa and Sumitomo) with two lesser horizontal *keiretsu* (IBJ and Tokai). There are a number of vertical *keiretsu*, largely centered around major electronics and automobile firms, including Hitachi, Matsushita, Nissan and Toyota. For horizontal *keiretsu*, the publication also lists which firms are Presidential Council members. This will allow us to examine in our analysis below whether the horizontal *keiretsu* effects on investment are larger for these firms, as one would expect if the networking information hypothesis is correct. Table 2 displays summary statistics for our regressors.

4. Results

As mentioned earlier, previous investments by our four identified sources (vertical *keiretsu* members, horizontal *keiretsu* members, other firms in the same industry and the firm itself) may have both recent information and agglomeration effects. Column 1 of

Table 3 shows conditional logit estimates of firm location when we measure each channel of previous investment in stocks, proxying for agglomeration effects. Column 2 of Table 3 presents estimates when we alternatively measure all four channels in previous-year flow, proxying for information effects that come through networking. And column 3 of Table 3 presents estimates where we include both stock and previous-year flow measures for all four channels. Region dummies are included in all three equations and a Wald test strongly supports their inclusion.

The results in column 3 for both stock and flow measures are almost identical to simply combining the coefficients from columns 1 and 2. In general, there is significant support for both agglomeration and information effects from recent investment by other firms in the industry and by the firm itself. Consistent with our ex ante expectations, the informational aspect of previous investment by the firm is about twice the magnitude of the agglomeration effect.

The previous-year flow of investment by horizontal *keiretsu* members affects current year location decisions in a statistically significant manner, providing the strongest evidence to date that networking effects influence FDI behavior. Consistent with our expectations, the stock of horizontal *keiretsu* members in a region has no significant impact on a firm's location decision, suggesting no agglomeration externalities. This makes sense given horizontal *keiretsu* members are generally distributed across unrelated industries. As one would expect, the informational effect of the firm's own recent

Table 3
Conditional logit estimates of the effect of previous-year investment by *keiretsu* members on a firm's location choice

Regressors	Previous investments measured in:			
	Number of employees			Threshold investment
Agglomeration (stock) variables				
Investment by vertical *keiretsu* members	0.119*** (0.033)		0.128*** (0.035)	0.599*** (0.190)
Investment by horizontal *keiretsu* members	0.023 (0.035)		−0.014 (0.038)	−0.233 (0.147)
Investment by industry	0.076*** (0.021)		0.066*** (0.022)	0.170** (0.083)
Investment by firm	0.041*** (0.013)		0.029** (0.014)	0.184* (0.098)
Information (1-year flow) variables				
Investment by vertical *keiretsu* members		0.001 (0.025)	−0.036 (0.026)	−0.181 (0.165)
Investment by horizontal *keiretsu* members		0.035** (0.016)	0.042** (0.018)	0.238*** (0.091)
Investment by industry		0.036*** (0.013)	0.022* (0.013)	0.154** (0.071)
Investment by firm		0.076*** (0.018)	0.058*** (0.019)	0.373*** (0.119)
Region dummies	Yes	Yes	Yes	Yes
Log likelihood	−3168.56	−3174.04	−3157.97	−3166.39
Chi-squared statistic	784.62***	773.68***	805.80***	788.98***
Pseudo R^2	0.11	0.11	0.11	0.11
Number of observations	16,335	16,335	16,335	16,335

Standard errors in parentheses. ***, ** and * denote statistical significance (two-tailed test) at the 1%, 5% and 10% levels, respectively.

investment experience is stronger than for the horizontal *keiretsu* effect, with a coefficient that is 40% larger than the magnitude of the horizontal *keiretsu* effect (0.058 versus 0.042).

In contrast to the horizontal *keiretsu* channel, the vertical *keiretsu* channel shows strong support for agglomeration effects, but no evidence for informational effects. Consistent with HRS, we find that the agglomeration effect from vertical *keiretsu* member investment is stronger than the agglomeration effect from investment by other Japanese firms in the same industry. In this way, our results generalize HRS' conclusions about the effect of agglomeration effects on Japanese FDI location to a sample that considers Japanese FDI to all world locations, not just regions in the United States. Interestingly, our vertical *keiretsu* effects are robust to excluding the automobile-centered *keiretsu*, with the coefficient in column 3 changing from 0.128 to 0.134 and remaining statistically significant at the 99% confidence level. This was not true with HRS' analysis of location in US regions, where vertical *keiretsu* effects were much smaller and statistically insignificant when excluding auto-related investments. It is surprising that there is no evidence that previous-year investment by vertical *keiretsu* members has any significant effect on firm location. One possible explanation is that vertical *keiretsu* members are so coordinated in their investment decisions due to strong production linkages that new investments into a region tend to generally occur all at roughly the same point in time.

As discussed, the coefficient patterns and statistical significance fit our *ex ante* expectations well. An important remaining question is whether these effects are economically meaningful and significant. It is not straightforward to interpret the magnitude of coefficient estimates in a conditional logit model. However, as shown in HRS, the average probability elasticity (over all choosers and location choices) for a given regressor can be expressed as the ratio, $(S-1)/S$, multiplied by the regressor's associated coefficient, where S is the number of location choices. Since there are 11 location choices in our specification, the elasticity of the probability of a location being chosen with respect to a regressor is the regressor's associated coefficient multiplied by 0.91. At first glance, this makes the elasticities associated with the coefficient estimates seem quite small and, indeed, they are significantly smaller than those reported by HRS. However, our use of employment data rather than counts of affiliates means that our regressors have significant variation as seen in Table 2. For example, a standard deviation increase in the horizontal *keiretsu* investment regressor (using 1-year flow data) represents an increase of 256% of the sample's mean value of this regressor. In fact, for all but one regressor (investment stock of other firms in the industry), the standard deviation is at least 100% of the mean. Thus, the marginal effects become reasonably substantial for a standard deviation change. For example, a standard deviation increase of previous-year investment by horizontal *keiretsu* members in an average region increases the probability of FDI location there by 5.3%. Similarly, there is a 14.6% increase in location probability for a standard deviation increase of previous-year investment in the region by the firm itself. Similar marginal effects for our standard agglomeration variables, vertical keiretsu and other industry stock are 26.2% and 23.0%, respectively.

One potential reason for fairly small elasticities is that there are a large number of observations with little or no previous investment and a smaller number of observations

where investment is relatively large. Thus, interpreting estimated elasticities as relating to a regressor distribution that is relatively continuous may be misleading. An alternative is to specify our regressors in a more dichotomous fashion. Another reason to explore such a specification is that agglomeration or information effects may be relatively inconsequential unless there is some minimum level of investment. In column 4 of Table 3, we specify our agglomeration and information variables as binary variables that take the value of "1" if the previous investment (flow or stock) in a regions was greater than a certain threshold and "0" if not. For previous-year flow measures, we use a threshold of 100 employees, whereas for investment stock measures we use a threshold of 500 employees. The pattern of coefficient signs and significance in column 4 is almost identical to those in column 3. A number of alternative threshold levels for both the flow and stock measure were tried and yielded qualitatively similar results.[17] Thus, our results are robust to this alternative specification.

However, the marginal effects are easily interpretable in this binary specification as the change in the probability of location in a region when the threshold investment level occurs. For example, if the previous-year investment flow into a particular region by a firm's horizontal *keiretsu* members was greater than 100 employees, the probability of location in that region by the firm goes up 23.8%. Previous-year investment greater than 100 employees by the firm itself raises the location probability 37.3%. Thus, the magnitudes of the marginal effects from this specification show that both the networking/information and agglomeration effects are economically quite significant.

4.1. Alternative specifications and robustness checks

In this section, we examine a variety of alternative specifications. As a baseline, column 1 of Table 4 presents estimates from a "best" specification that comes out of the previous analysis. We follow the specification in column 4 of Table 3, but drop the vertical keiretsu variable measured in previous-year flows and the horizontal keiretsu measured in previous investment stock, as these two variables are always insignificant. We continue to measure our variables using the thresholds mentioned above as this eases interpretation of the coefficients.[18]

We begin with an alternative specification regarding our main focus variable, the horizontal *keiretsu* variable measured in previous-year flows. We interpret the positive coefficient on this variable as evidence for information externalities due to networking connections. However, some horizontal *keiretsu* are considered to be more tightly organized than others, and, additionally, firms within horizontal *keiretsu* may vary in how closely connected they are with other firms in the group. Thus, we expect that networking/information effects are larger the more closely organized the horizontal *keiretsu* and the more closely connected the firm is to its horizontal *keiretsu*. Dodwell

[17] These alternative thresholds were 0, 50 and 250 employees for the flow measure, and 0, 250 and 1000 employees for the stock measure.

[18] Our results are qualitatively similar if we instead use employment measures for our variables and/or do not drop the mentioned variables.

Table 4
Conditional logit estimates of the effect of previous-year investment by *keiretsu* members on a firm's location choice

Regressors	Previous investments measured as threshold investment			
	Baseline	Presidential council differential	Region–year dummies	Region–year and region–industry dummies
Agglomeration (stock) variables				
Investment by vertical *keiretsu* members	0.543*** (0.182)	0.543*** (0.182)	0.543*** (0.183)	0.330* (0.201)
Investment by industry	0.170** (0.083)	0.168** (0.083)	0.177** (0.085)	
Investment by firm	0.183* (0.098)	0.183* (0.098)	0.201** (0.099)	0.073 (0.108)
Information (1-year flow) variables				
Investment by horizontal *keiretsu* members	0.209** (0.088)	0.101 (0.100)	0.030 (0.103)	0.042 (0.108)
Investment by horizontal *keiretsu* members× presidential council firm		0.438** (0.190)	0.398** (0.192)	0.377* (0.206)
Investment by industry	0.149** (0.071)	0.154** (0.071)	0.064 (0.074)	
Investment by firm	0.369*** (0.119)	0.360*** (0.119)	0.366*** (0.120)	0.197 (0.123)
Region dummies	Yes	Yes	No	No
Region–year dummies	No	Yes	Yes	Yes
Region–industry dummies	No	No	No	Yes
Log likelihood	−3168.20	−3165.46	−3082.72	−2855.55
Chi-squared statistic	785.36***	790.84***	956.32***	1410.66***
Pseudo R^2	0.11	0.11	0.13	0.20
Number of observations	16,335	16,335	16,335	16,335

Standard errors in parentheses. ***, ** and * denote statistical significance (two-tailed test) at the 1%, 5% and 10% levels, respectively.

Marketing Consultants (1990) indicates that of the eight horizontal *keiretsu*, the Mitsubishi, Mitsui and Sumitomo *keiretsu* are most closely connected (e.g., see discussion on pp. 44, 58 and 73). The other *keiretsu* were largely formed as more loosely connected groups after WWII.[19] Additionally, Dodwell lists the firms that participate in the Presidential Council meetings, generally the largest and most influential companies in the group.[20] This information allows us to examine whether the networking/information effects are larger for such firms and *keiretsu*. We do this by adding a term that interacts our horizontal *keiretsu* measure with a binary variable that takes the value of "1" when the firm is a Presidential Council member in one of the three "cohesive" horizontal *keiretsu* listed above.

[19] In contrast, the Mitsubishi, Mitsui and Sumitomo *keiretsu* are companies that were formerly organized as *zaibatsu* before WWII. These *zaibatsu* were powerful family enterprises that rose to prominence in Japan after the Meiji restoration in 1868. These *zaibatsu* were formally dismantled in the allied occupation after WWII, but were allowed to reorganize as *keiretsu* in the 1950s.

[20] As of 1988/1989, the Mitsubishi Presidential Council was comprised of 29 of the *keiretsu*'s 160 firms; the Mitsui Presidential Council was the top 24 of 120 firms and the Sumitomo Presidential Council was the top 20 of its 130 firms (Dodwell Marketing Consultants, 1990).

Column 2 in Table 4 provides results when we add this new interaction term to our base specification in columns 1 of Table 4. As expected, the coefficient on this interaction term is positive and statistically significant, with the coefficient indicating the extra networking/information effect that is enjoyed by these Presidential Council firms in these cohesive *keiretsu* groupings. The separate horizontal *keiretsu* coefficient is now reduced and statistically insignificant, suggesting that the networking effects are generally driven by this subset of firms. We interpret this as further evidence that a networking interpretation is appropriate for explaining the positive coefficient on the horizontal *keiretsu* investment measures.

One potential source of omitted variable bias in our estimates to this point is the effect of macroeconomic events, such as exchange rate movements and economic growth in the potential host country, which may affect the desirability of locations. A general way to control for this is to employ region–year-specific constants rather than just region-specific constants. Column 3 of Table 4 provides results when we add region–year-specific constants to our specification. Our estimates are quite similar from specifying region–year rather than region-only specific constants.

Another concern may be that there are other industry–region-specific factors that are important for location decisions, but that are not controlled for in our current specifications. This is particularly a concern since we do not have the data to control for non-Japanese investment in the industry and region as was done in HRS. This could be a source of omitted variable bias in our current estimates. To address this, the final column of Table 4 includes not only region–year, but also region–industry dummies. We use Toyo Keizai data to classify our firms into 30 (roughly two- and three-digit) industries, which yields 330 (30 industries∗11 regions) region–industry dummies. The reader will notice that we drop industry effects in this specification and this is because the inclusion of region–industry dummies precludes credible estimation of these industry effects. Clearly, the inclusion of region–year industry dummies leaves considerably less variation in the data to identify our *keiretsu* effects. Despite this, our results on the *keiretsu* variables (both the agglomeration effects of vertical and networking effects from horizontal) are robust to inclusion of these region–industry dummies. The magnitudes fall about 10–15%, but both variables are still statistically significant. We think this is perhaps the most compelling case for the robustness of these *keiretsu* variables in explaining FDI location.[21]

A final issue with any conditional logit estimates is the appropriateness of the assumption of the independence of irrelevant alternatives (IIA). The common way to evaluate this is to statistically test whether coefficient estimates are relatively

[21] Given a referee's comment, we also checked whether our results were sensitive to whether prior investments were greenfield or acquisition. Greenfield investment accounts for about 80% of our sample's observations. We reran our analysis where the agglomeration and information variables were constructed from previous greenfield FDI only. In terms of signs and significance, we get qualitatively identical results. The coefficients on our information variables (including horizontal keiretsu linkages) change very little. The magnitude of the sign on the vertical keiretsu agglomeration variable falls about 45%, but is still statistically significant at the 95% confidence level.

unchanged when various subsets of choices are excluded. For our sample, one obvious concern would be whether the parameters affecting location decisions are the same between the less-developed country (LDC) locations and developed country locations. However, Hausman tests fail to reject the null hypothesis of identical coefficients between an LDC sample and the full sample, affirming the IIA assumption.[22] Another obvious concern is the US as a destination choice, as it easily represents the most frequent location choice for Japanese manufacturing during the sample years. A Hausman test does not support the IIA assumption when one drops the US as a location choice. However, separate tests on a coefficient by coefficient basis, finds no significant difference in the vertical and horizontal *keiretsu* variables, the focus of our study, when comparing a specification that excludes the US to the full specification. Instead, the information effect of the firm's own experience and the industry-level agglomeration effects are almost twice as large for a specification excluding the US as a choice.

5. Conclusion

This paper finds evidence that Japanese business groups (*keiretsu*) provide networking and information externalities that affect the FDI location decisions of partner firms. Previous work on Japanese business groups and FDI decisions has focused on vertical *keiretsu*, showing that location of FDI by a firm in a particular region is positively correlated with the existing FDI in that region by members of the firm's vertical *keiretsu*. The results from these studies provide evidence of agglomeration externalities. We extend this literature to examine more closely the effect of horizontal *keiretsu*, large firms in primarily unrelated fields that are tied to a major bank and whose leaders systematically meet in Presidential Council or "lunch club" meetings. Such meetings provide opportunities for information-sharing and networking, which can affect these firms' economic activity, including their foreign investment decisions. In particular, such information-sharing may allow a firm to better navigate a foreign country's tax/regulatory environment and better site its plant, lowering initial setup costs, as well as operating costs. This would then make the firm's location in the region more likely.

Using a sample of all Japanese manufacturing investments from 1985 through 1991, we find evidence that recent FDI activity in a region by a firm's horizontal *keiretsu* members increases the probability of location in that region by the firm, even after controlling for other factors including sources of agglomeration externalities. As one would expect, this effect is much stronger for horizontal *keiretsu* firms that regularly participate in the Presidential Council meetings in the most closely knit horizontal *keiretsu* groups. A by-product of our analysis is that we confirm agglomeration

[22] We note that these Hausman tests are only with respect to our focus variables and not with respect to the region, region–year or region–industry dummies as the set of these region-specific constants change as we split the sample by regional subsets.

externalities of vertical *keiretsu* relationships found by previous studies, but for a choice set that encompasses locations across the world, not just within a particular country, such as the United States or China.

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