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Measuring network effects on trade: are Japanese affiliates distinctive?

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Measuring network effects on trade: are Japanese affiliates distinctive?

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This paper examines network effects on trade by comparing the trade patterns of foreign affiliates in the United States with the trade patterns of U.S.-owned firms. The evidence strongly supports the following hypotheses: 1) foreign affiliates behave differently from U.S. firms in their trade patterns; 2) in particular, foreign affiliates display strong home biases in their trade patterns; and 3) among the foreign affiliates, Japanese affiliates demonstrate by far the strongest home bias in their trade patterns. Controlling for income and distance effects, foreign affiliates from Canada, France, Germany, the Netherlands and Switzerland traded on average 17 times more with their respective home countries and those from the United Kingdom traded 30 times more with the United Kingdom, while Japanese affiliates traded a whopping 130 times more with Japan.

JEL classification: F14; F23

Keywords: Network effects; Foreign affiliates; Trade patterns

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1. Introduction

In recent years, economists have begun to describe and quantify the impacts of business and social networks on international trade. In an international environment where contracts are not always enforceable and product information is imperfect, relationships between buyers and sellers matter. In some countries and cultures, they seem to matter more than in others. While examples of such relationships or networks can be found throughout history (e.g., the 11th century Maghribi traders studied by Greif, 1993), most economists have focused on networks that impact trade today. Japanese *keiretsu* and overseas Chinese networks are often cited as

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contemporary examples of networks that may affect international trade, but empirical work measuring network effects is still limited.

Gould (1994), Head and Ries (1998), and Rauch and Trindade (2002) demonstrate the importance of network effects by examining the influence of immigrants on international trade. They find that immigrants have a statistically significant positive effect on bilateral trade between their countries of emigration and immigration. Rauch and Trindade specifically examine the trade effects of ethnic Chinese networks, as proxied by the product of ethnic Chinese population shares. They find that these networks increased bilateral trade both within Southeast Asia and for other country pairs.

Although many observers assert the importance of Japanese *keiretsu* for international trade, empirical work has focused almost exclusively on the potential for *keiretsu* to depress Japanese imports. Fung (1991) and Lawrence (1991) both find that the extent of horizontal and vertical *keiretsu* presence in an industry is negatively correlated with import penetration.[1] At the firm level, however, Ueda and Sasaki (1998) report that *keiretsu* firms import at least as much as non-*keiretsu* firms. Focusing on auto parts trade, Head, Ries and Spencer (2004) find that U.S. exports to Japan are lower for parts where vertical *keiretsu* are prominent in Japan. These papers leave open the question of how Japanese *keiretsu* might affect world trade beyond Japan's importing. Perhaps as importantly, none of them considers the possibility that Japanese business networks could extend beyond traditional *keiretsu* linkages.

This paper addresses both of these questions and compares the trade impacts of Japanese business groups to those of several other industrialized countries. Targeting all of these objectives involves some necessary tradeoffs. Rather than trying to cover world trade, I limit my

[1] Lawrence (1991) also finds that vertical, but not horizontal, *keiretsu* presence is positively correlated with industry exports.

attention to U.S. trade flows. I examine how networks, particularly Japanese networks, affect U.S. trade by comparing the trade patterns of foreign affiliates in the United States with those of U.S.-owned firms. I address the following research questions: Do foreign affiliates behave differently from U.S. firms in their trade patterns? Among affiliates, do network effects have a significant impact on trade? Has the strength of network effects changed over time? Do Japanese affiliates behave differently than the affiliates of other countries in terms of their trade pattern? Do Japanese affiliates appear to have particularly strong networks, and has the strength of these networks changed over time? What are the implications for trade and trade policy?

Theoretical work that links network effects to international trade includes Greif (1993), Rauch (1996), McLaren (1999), Kranton and Minehart (2001), Casella and Rauch (2002) and Greaney (2003). In Greaney (2003), network effects are modeled as a cost advantage in selling to buyers from the producer's own country. Asymmetry across countries in the strength of this network effect results in lower inward foreign direct investment (FDI), lower total imports but larger volumes of reverse imports[2] into the country with strong network effects (e.g., Japan). The model's predictions match observed asymmetric trade and investment flows that sometimes lead to U.S.-Japan trade friction.

This paper is an empirical complement to Greaney (2003) but does not limit its focus to Japanese networks alone. Here I measure the strength of network effects on the trade of eight industrialized countries' foreign affiliates operating in the United States. Network effects are estimated by examining the extent of affiliates' home bias in their exporting and importing activities, while controlling for income and distance effects. I find that the affiliates on average display strong home bias in their trade activities, and that Japanese affiliates display by far the highest level of home bias.

2. Data details

Other papers on network effects on trade have developed proxy measures of cross-border networks using immigration flows (Gould (1994), Head and Ries (1998)), population shares (Rauch and Trindade (2002)) or colonial ties and distance (Rauch (1999)). I use a more direct measure of network effects by disaggregating U.S. trade with eight trade partners into trade by American-owned firms versus trade by foreign affiliates located in the United States.[3] Networks between affiliates and suppliers or buyers in their home countries would tend to create a home bias in their trade patterns.

For affiliates' trade data, I use the Bureau of Economic Analysis' survey *Foreign Direct Investment in the United States*, which is conducted every five years. The most recent survey results available are for 1987, 1992 and 1997. The published survey results identify bilateral trade by affiliates' country of ultimate beneficial owner (UBO) for only eight countries—Australia, Canada, France, Germany, Japan, the Netherlands, Switzerland, and the United Kingdom. This allows for comparison of the trade pattern of Japanese affiliates to that of seven other industrialized countries' affiliates in the United States. For U.S. bilateral trade data, I use Statistics Canada's *World Trade Analyzer*. For the gravity model estimations, the IMF's International Financial Statistics provided GDP data and the "empirical investigations in international trade" website (formerly maintained by Jon Haveman, Ph.D.) provided kilometer distances between capitol cities.

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[2] Reverse imports are imports from overseas affiliates of that country's own firms.

[3] The distinction between American-owned and foreign affiliate follows the Bureau of Economic Analysis definition, where a foreign affiliate (or "U.S. affiliate of foreign direct investors") involves foreign direct investment (FDI). FDI occurs when "a single foreign person owns or controls, directly or indirectly, 10% or more of the voting securities or an equivalent interest". (Bureau of Economic Analysis, 1997)

3. Activities of foreign affiliates

Tables 1 and 2 show summary statistics on the activities of foreign affiliates by country of ultimate beneficial owner (UBO) in 1987 and 1997.[4] Since bilateral trade data for subsequent tables are available for only eight specific countries' affiliates, I focus on these countries along with presenting some regional totals in these tables. Japan stands out as early as 1987 for having the highest number of affiliates and these affiliates had the largest total assets, expenditures for property, plant and equipment, sales, and by far the highest level of participation in exporting and importing of any of the countries' affiliates. By 1997, Japanese affiliates maintained their lead in all of these categories and had surpassed Canadian and British affiliates in the number of companies consolidated and in gross property, plant and equipment. Again, the strongest difference between the Japanese affiliates and their other foreign counterparts is the much larger volume of exports and imports generated by the Japanese affiliates—$52.5 billion in exports and $120.7 billion in imports versus the next highest trade figures of $14.5 billion in exports for U.K. affiliates and $15.3 billion in imports for Canadian affiliates. This large gap might be explained by a preponderance of Japanese affiliates involved explicitly in trade activities (i.e., trading companies). To investigate this possibility, I next examine evidence on the importing and exporting patterns of the affiliates by industry.

Tables 3-6 help to clarify the reasons for the high level of trade conducted by Japanese affiliates. Tables 3 and 4 show U.S. imports of goods shipped to affiliates by industry in 1987 and 1997. In 1987, $68.2 billion or 93.9% of the imports of Japanese affiliates were shipped to affiliates involved in wholesale trade, particularly those engaged in motor vehicles and equipment trade (45.5%). Only German affiliates appeared similar in having a large share of their imports (71.5% or $12.3 billion) going to affiliates in wholesale trade, particularly to those

in autos and auto parts trade (53.9%). In contrast, only 5.8% ($4.2 billion) of Japanese affiliates' imports went to manufacturing affiliates, while 25.0% (German) to 60.3% (Australian) of the other eight countries' affiliates went to manufacturing affiliates in 1987. By 1997, the dominant importing role of Japanese wholesale trade affiliates had lessened somewhat, to 68.2% ($82.3 billion) of imports, with only 24.7% for autos and auto parts affiliates, while importing by manufacturing affiliates rose to 31.1% of the total.

Tables 5 and 6 show the pattern of exporting across industries by different countries' affiliates in 1987 and 1997. The trend seen in the importing activities of Japanese affiliates is repeated in their exporting activities. In 1987, Japanese affiliates in wholesale trade accounted for almost all exporting by Japanese affiliates ($19.2 billion of $20.4 billion, or 94.1%), while manufacturing affiliates accounted for only 5.5%. Wholesale trade affiliates in metals and minerals accounted for $10.2 billion or 50.0% of all exports, while farm-product raw materials affiliates added another 20.3%. In 1997, the export activities of Japanese wholesale trade affiliates were up to $35.1 billion but this represented only 66.7% of total exports. Japanese manufacturing affiliates exported $16.5 billion or 31.4% of the total.

To examine how important foreign affiliates' trade activities are relative to U.S. total trade, I disaggregate bilateral trade into affiliates' trade and U.S. firms' trade in Table 7. By far, foreign affiliates play the largest role in U.S. trade with Japan. In 1987, affiliates accounted for 61.6% of U.S. exports to Japan and 78.2% of U.S. imports from Japan, while the comparable figures for affiliates' share of total U.S. trade were 17.4% and 34.4%, respectively. In 1997, affiliates' share of U.S. exports to Japan was a much lower 47.4% while their import share from Japan was slightly higher at 82.7%. The shares for affiliates' in U.S. total trade were 19.2% and

[4] For the sake of brevity, results for the intermediate year, 1992, are not shown in the descriptive tables.

29.6%, respectively. Next to Japan, foreign affiliates played the largest role in U.S. imports from Germany (52.6%) and Switzerland (62.6%) in 1997.

The dominant role that foreign affiliates played in U.S. trade with Japan remains the largest outlier in Table 7. To connect these figures to the potential role of Japanese trading companies and/or intra-firm trade by Japanese multinationals, I need to identify what portion of U.S. trade with Japan is generated by Japanese affiliates in the United States, rather than by all foreign affiliates, as in Table 7. The first two columns of Table 8 answer this question. Japanese affiliates exported 51.2% of total U.S. exports to Japan in 1987 and 38.5% in 1997, much higher percentages than the 0.5% to 13.7% range for the selected other countries' affiliates. In importing, foreign affiliates accounted for even larger shares of bilateral trade with their individual home countries and Japanese affiliates again accounted for the largest shares. Japanese affiliates were responsible for 76.3% and 80.7% of U.S. imports from Japan in 1987 and 1997, while the next highest levels of affiliate control of importing from their home countries were the 51.5% and 47.0% figures attributed to German affiliates in 1987 and 1997.

By changing the denominator, the next two columns of Table 8 show the degree of home bias in the exporting and importing activities of the foreign affiliates. In 1987, Japanese affiliates had by far the highest degree of home bias in their exporting, at 77.3%. The next highest degree of home bias in exporting was only 30.7% for Canadian affiliates. In 1997, Japanese affiliates' home bias in exporting fell to 51.8%, just below the 52.3% posted by Canadian affiliates. Japanese affiliates had an extremely high degree of home bias in importing in 1987, 93.1%, although this was not too much higher than the home bias shown by West German affiliates (82.5%) and Canadian affiliates (73.4%). The home bias of Japanese affiliates

in importing fell to 81.1% in 1997, below that of Canadian affiliates (85.6%) but the Canadian affiliates face much lower transportation costs in importing from home.

The next two columns of Table 8 compare the home bias of affiliates with the trade pattern of U.S. firms. The numbers result from the following calculation:

$$\frac{X_k^{i=k}}{\sum_i X_k^i} \Big/ \frac{X_{US}^{i=k}}{\sum_i X_{US}^i}, \tag{1}$$

where X_k^i are the exports from (imports to) country *k* affiliates to (from) country *i* and X_{US}^i are the exports from (imports to) U.S. firms to (from) country *i*. The numerator represents the home bias of affiliates from country *k*. The denominator represents the tendency of U.S. firms to trade with country *k* among all other trade partners.

Any degree of network effects would tend to raise these ratios to levels above one, indicating that on average foreign affiliates have a greater tendency to trade with their particular home country than does a U.S. firm. Higher ratios indicate even larger divergences between the trading behavior of the foreign affiliates and the U.S. firms. In terms of exporting in 1987, Japanese and Swiss affiliates had the highest home bias divergence from U.S. firms' export pattern, with ratios of 14.9 and 15.2, respectively. The decline in Japanese affiliates' export home bias in 1997 is reflected in a lower ratio of 8.3, meaning Japanese affiliates on average favor Japan over other export destinations 8 times more than do U.S. firms on average. That year, Australian and Swiss affiliates posted higher ratios of 9.95 and 19.4, respectively. In importing, although Japanese affiliates displayed very high levels of home bias in importing in 1987 and 1997, their tendency to buy from Japan did not diverge as much from U.S. firms' importing patterns as did the home bias displayed by several other countries' affiliates. Five of the other seven countries' affiliates had higher ratios than Japan's 13.2 in 1987, and three had

higher ratios than Japan's 24.3 in 1997. Overall, the statistics in these two columns of Table 8 indicate tremendous divergence between the trade pattern of U.S. firms and that of foreign affiliates with respect to their home countries. This provides suggestive evidence of the strength of network effects in the activities of foreign affiliates in the United States.

The final two columns of Table 8 focus specifically on intra-group trade tendencies of affiliates, without regard to whether the other group firms are located in the home country or elsewhere. Japanese affiliates appear to have a somewhat higher intra-group export bias of 53.2% and 60.6% in 1987 and 1997 than do Canadian or European affiliates, which averaged between 17% and 50%. Japanese affiliates showed an even stronger preference for purchasing imports from within their corporate groups, 79.0% in 1987 and 79.7% in 1997. However, several of the other countries' affiliates showed even stronger intra-group biases in importing—West German (86.9%) affiliates in 1987, and Canadian (85.4%), German (80.7%) and Swiss (80.9) affiliates in 1997.

Overall, the descriptive statistics provide evidence that foreign affiliates have strong biases towards trade with their home countries. This evidence is consistent with a hypothesis that national business networks matter for international trade. The descriptive evidence is more mixed regarding the particular strength of Japanese networks. Japanese affiliates have much higher home biases in their exporting and importing activities than do most European affiliates. The high home biases in the trade activities of Japanese affiliates are matched only by Canadian affiliates, whose home trade biases are supported by low transportation costs. However, in comparing the trade patterns of the foreign affiliates to those of U.S.-owned firms, Japanese affiliates are not such outliers. Australian and a few European affiliates showed greater divergence in their trade patterns relative to U.S. firms than did Japanese affiliates.

4. Gravity model estimates of network effects

To further explore the role of networks in international trade, I adopt a gravity model to examine the determinants of U.S. bilateral trade involving foreign affiliates in the United States. For my gravity estimation, I adapt Feenstra's (2002) gravity equation to meet the needs of my data. Feenstra (2002) uses the following basic equation:

$$\ln\left(X^{ij}/Y^{i}Y^{j}\right)=\alpha\ln(dist1^{ij})+\beta_1\delta_1^{i}+\beta_2\delta_2^{i}+\varepsilon^{ij} \qquad (2)$$

where X^{ij} represents exports from country *i* to country *j*, Y^{i} and Y^{j} represent the GDP's of countries *i* and *j*, $dist1^{ij}$ is the distance between the two trading countries, and δ_1^{i} and δ_2^{i} are the source and destination dummy variables for country *i*. The country fixed effects are included to account for unobserved price indices for the countries.

The gravity equation in (2) typically is used to estimate bilateral trade for many different trade partners. Since I will be using survey data on foreign affiliates in the United States, my estimates of bilateral trade involve the United States as either the source or destination country for each observation. There is no particular advantage in normalizing all observations of the dependent variable by U.S. GDP, so I change the dependent variable to the natural log of bilateral trade divided by the non-U.S. source or destination country GDP (i.e., $\ln\left(X^{ij}/Y^{non-US}\right)$). I also change X^{ij} to X_k^{ij}, with the latter representing exports from country *i* to country *j* by affiliates with country of UBO *k*. Since the United States is involved in every trade observation, the trade distances ($dist1^{ij}$) are country specific for each of the other eight trade partners included, eliminating the need for country fixed effects. Adding in a vector *z* to represent the network variables of interest, my gravity specification becomes:

$$\ln\left(X_k^{ij}/Y^{non-US}\right)=\alpha(\ln dist1^{ij})+\beta z+\varepsilon_k^{ij}. \qquad (3)$$

Vector *z* includes two different variables designed to capture average network effects and country-specific network variables to capture extraordinary network effects. "HomeLink" is a dummy variable that takes on the value of one if the affiliates' country of UBO matches the trade partner. The coefficient reflects the tendency for the affiliate to trade with, either import from or export to, its home country. The "dist2" variable measures the kilometer distance between the affiliates' trade partner and their country of UBO. If the trade partner matches the country of UBO, dist2 takes on the value of one to avoid taking the natural log of zero. The HomeLink variable measures network effects in a discrete manner, while the dist2 variable measures it as a continuous variable. The dist2 variable is particularly noteworthy because it represents a new way of measuring networks effects that is completely separate from any type of trade costs since the observations do not involve trade between the affiliates' country of UBO and their trade partner.[5] An affiliate's most direct business network may be its link with its parent company or group in its home country, measured by the HomeLink variable. The affiliate may also be linked into the parent's business network, which presumably is strongest in the vicinity of the parent company and grows weaker as one moves further away from the parent location (i.e., the affiliate's country of UBO). A negative and significant coefficient on the dist2 variable would reflect the affiliate's tendency to trade less with buyers and sellers located farther away from its country of UBO.

Table 9 shows the gravity equation estimates for U.S. bilateral trade with eight major trade partners in 1997, the most recent survey year available. With eight countries of UBO and export and import data with eight trade partners, I have 128 potential observations for these regressions. Some of these observations were dropped because the trade data were suppressed to avoid disclosing the information of individual companies. In a few cases, observations where

[5] The author thanks Keith Head for this insight.

bilateral trade was reported as zero were dropped to avoid taking the natural log of zero. These data problems resulted in 118 observations for 1997, out of 128 potential observations. Column (1) in Table 9 shows that after normalizing each bilateral trade flow by the trade partner's income level, the trade distance (dist1) explains 95.8% of the remaining variation in the dependent variable. The -0.944 estimated coefficient implies that a 10% increase in distance between the United States and the source or destination country results in 9.44% less trade.

Adding the network variables further improves the fit of the gravity model, with highly significant estimated coefficients of the expected sign on these variables, as shown in Columns (2)-(4) in Table 9. Column (2) in Table 9 shows an estimated coefficient of 3.033 on the discrete HomeLink variable. This means that after controlling for distance and income effects, affiliates trade a tremendous 20.8[6] times more with their home countries than with other countries. Measuring network effects with a continuous variable, dist2, produced a significant coefficient of –0.323, as shown in column (3). In other words, a 10% increase in the distance between the affiliates' home country and the trade partner implies 3.77% less trade. To isolate the proximity effect from the home-link effect, the coefficient on dist2 is estimated again after dropping all observations of home-linked trade (i.e., where ln(dist2)=0). As one might expect given the strength of the home bias in affiliates' trade, the coefficient drops in both absolute value and significance. The newly estimated coefficient on dist2 is -0.144. The new estimate, however, reflects regional network effects that are *completely separate from* the home country trade bias of the affiliates. A 10% increase in the distance between the affiliates' home country and trade partner implies 1.44% less trade. For example, this would imply that British affiliates in the

[6] Derived by taking the exponent of the estimated coefficient.

United States will trade 10.8% more with France than with Switzerland since France is approximately 75.1% closer to the United Kingdom than is Switzerland.[7]

The last column in Table 9 adds to the basic gravity equation a Japan-network dummy variable, along with the HomeLink variable described above. The Japan-network dummy takes the value of one when trade involves Japanese affiliates exporting to Japan or importing from Japan. The estimated coefficient on Japan-network just misses the 5% significance level (at 5.2%), but is quite large. Allowing for a slightly generous interpretation of significance, the Japan-network coefficient suggests that Japanese affiliates tend to trade with their home country much more than do the affiliates from other countries. The positive, significant coefficient on the HomeLink variable can be interpreted as the average tendency among all affiliates to trade with their home countries. Controlling for distance and incomes, affiliates on average traded 16.14 times more with their home countries, while Japanese affiliates traded an *additional* 7.65 times more with Japan in 1997. Since these effects are multiplicative, Japanese affiliates traded 123 (16.14*7.65) times more with Japan than would be predicted based on income and distance. This result supports the hypothesis that Japanese affiliates tend to have particularly strong network links with their home country. The 1997 data also were used to check if adding a country-specific network dummy for any of the other seven countries of UBO would produce a significant coefficient, as in Japan's case, but no other significant coefficients were found.

Repeating the gravity estimates using 1987 and 1992 data produced very similar results to those reported in Table 9, so these results are not separately reported. However, the one difference in results is that the Japan-network coefficient is significant at the 1% level for these years. I pooled the data from all three years (n=333) and confirmed that there are no significant

[7] The following distances between capitol cities apply: 341 km. for the United Kingdom—France, 751 km. for the United Kingdom—Switzerland.

time trends in the coefficients. The results of the gravity model estimates with the pooled data are shown in Table X. Almost all of the networks variables are significant at the 1% level and of the expected sign. The results in column (2) show that affiliates on average traded 19.7 times more with their home countries than with other trade partners, controlling for income and distance effects. Columns (3) and (4) show estimated coefficients on the dist2 parameter with and without the influence of the home-linked observations. As expected, both the level of significance and the absolute value of the coefficient decline when the latter observations are dropped. However, the result in column (4) implies that a 10% increase in distance from an affiliate's home country means .84% less trade with that trade partner, having already controlled for trade distance and partner income.

Columns (5) and (6) of Table X show the Japan-network effect. On top of an average tendency by all affiliates to trade 14.4 times more with their home countries, Japanese affiliates traded an additional 9.86 time more with Japan, as shown in column (5). In total, Japanese affiliates traded 142.4 times more with Japan than would be expected based on income and distance alone. Using the pooled data, the seven other countries were tested for extraordinary network effects (i.e., beyond those captured by the HomeLink dummy variable). Two countries had results significant at the 1% level, while the others had no significant results even at the 10% level. The United Kingdom-network and Australia-network coefficients were estimated at 0.724 and -2.584, on top of HomeLink estimates of 2.995 and 3.104, respectively. This means that U.K. affiliates traded slightly more with the United Kingdom than the average affiliate home bias, while Australian affiliates traded substantially less with Australia than the average affiliate home bias. Since these two countries' affiliates, along with Japanese affiliates, deviated significantly in their home trade bias from the average, the last regression results in Table X report the gravity

model estimates when all three countries are included as country-specific network dummy variables along with the HomeLink dummy variable. These results show that foreign affiliates from Canada, France, Germany, the Netherlands and Switzerland tended to trade on average 17.5 times more with their respective home countries than would be predicted by distance and income alone, while Australian affiliates traded only 1.5 (17.46*0.087) times more with Australia. Controlling for distance and income effects, affiliates from the United Kingdom traded 29.5 (17.46*1.69) times more with the United Kingdom, while Japanese affiliates traded 129.7 (17.46*7.43) times more with Japan.

In sum, although the affiliates from all of the countries tended to trade more with their home countries than would be predicted by distance and income alone, the extremely strong tendency of Japanese affiliates to trade with Japan dwarfs the estimated network effects found for the other countries' affiliates. Japanese affiliates traded approximately 130 times more with Japan than expected, while most of the other countries' affiliates traded only 17 times more with their home countries. The only other affiliates with above average network strength were U.K. affiliates, which tended to trade with the United Kingdom about 30 times more than expected. These results support the conclusion that Japanese affiliates are distinctive in terms of the strength of their home trade bias.

5. Conclusions

Descriptive statistics and gravity model evidence support the conclusion that network effects strongly influence the trade pattern of foreign affiliates in the United States. Affiliates from all of the eight countries examined had much higher tendencies to trade with their home countries than did U.S. firms trade with those same countries. The home country bias was particularly strong for importing by many of the countries' affiliates. Using gravity equations

with both discrete and continuous variables to measure network linkages between affiliates and their home countries, I obtain coefficients that are highly significant and of the expected sign. Affiliates have a tremendously higher tendency to engage in trade with their home countries than with other countries. Controlling for distance, income and extraordinary home bias effects, affiliates on average tended to trade 17 times more with their home countries than with other countries, using the pooled data from 1987, 1992 and 1997.

Using a continuous variable to measure network effects, I find that affiliates tend to trade less with countries that are located further from their home countries. The distance between an affiliate's home country and its trade partner is introduced as a new method of measuring network effects that is completely separate from transportation and other trade costs. I find that a 10% increase in this distance lowers trade by 3.05% when a country's home trade bias is included or by 0.84% without this bias. The latter effect measures the tendency of foreign affiliates in the United States to trade with partners located close to their home country, after controlling for income and trade distance effects.

Both descriptive measures and gravity model estimates indicate that Japanese affiliates have an even higher tendency to trade with their home country than do the affiliates of the other seven countries. Using pooled trade data for years 1987, 1992 and 1997, I find that Japanese affiliates traded a whopping 130 times more with Japan than would be predicted by income and distance effects alone, while foreign affiliates from five of the other seven industrialized countries traded on average only 17 times more with their respective home countries. Affiliates from the United Kingdom were the only others to report a significant stronger-than-average home bias using the gravity model. They traded 30 times more with the United Kingdom than would be predicted by distance and income alone. Australian affiliates displayed a lower-than-

average tendency to trade with their home country, trading 1.5 times more than expected based on distance and income. I find no evidence to support a conclusion that the strength of network effects or Japan-specific network effects has changed over time.

Japanese affiliates in the United States are found to participate more in trade and to have stronger home bias in their trade pattern than do the other countries' affiliates. These results suggest that Japanese business networks have stronger impacts on U.S. trade than do the networks of other industrialized countries' multinational firms. Strong trade networks may enhance trade opportunities for network "insiders" but hinder them for "outsiders". This may lead to greater trade friction with countries that have stronger trade networks. This hypothesis regarding the potential link between trade networks and trade policy is not analyzed in this study. However, the results regarding the distinctive strength of Japanese trade networks may help in explaining Noland's (1997) finding that Japan is targeted disproportionately (after controlling for country size) in U.S. unilateral trade actions.

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Table 1
Selected financial and operating data of affiliates, by country of UBO, 1987

	Number of affiliates	Number of companies consoli-dated	Thousands of employees	$millions							
				Total assets	Gross property, plant, and equipment	Expendi-tures for property, plant and equipment	Sales	Net income	Compen-sation of employees	U.S. exports of goods shipped by affiliates	U.S. imports of goods shipped to affiliates
All countries	8,110	22,937	3,224.30	943,654	353,278	45,657	744,617	7,820	96,009	48,091	143,537
Canada	1,047	3,609	592.9	142,506	74,118	9,324	89,433	2,052	16,356	4,963	8,033
Europe	4,235	12,764	1,940.40	475,413	196,200	20,538	393,132	5,189	58,046	18,357	51,065
France	413	1,123	187.8	34,675	19,849	1,613	44,113	-11	6,141	5,422	4,330
W. Germany	1,039	1,946	366.6	61,168	27,126	3,731	74,259	-87	11,169	3,636	17,264
Netherlands	274	1,474	270.1	68,929	47,993	4,472	52,373	1,218	6,991	1,485	4,268
Switzerland	587	1,318	191.6	75,036	14,297	1,469	38,704	507	6,437	1,937	4,269
UK	1,015	5,024	647.4	159,525	67,088	7,140	131,233	2,610	18,862	3,735	10,622
L. America+	702	1,485	148.5	33,206	10,440	1,291	28,185	-388	3,841	1,761	5,461
Africa	60	184	22.6	8,847	8,086	526	6,244	286	883	497	811
Middle East	336	973	35.8	18,722	12,602	1,147	6,293	-828	987	253	342
Asia/Pacific	1,669	3,596	456	241,369	49,735	12,565	211,625	362	15,040	22,124	77,723
Australia	130	547	91.7	23,707	9,750	1,656	11,138	-46	2,368	210	504
Japan	1,159	2,355	303.2	200,386	32,950	9,587	186,812	401	11,098	20,413	72,564

Source: BEA (1987), Table A-2
Notes: "L. America+" refers to Latin America & Other Western Hemisphere

Table 2
Selected financial and operating data of affiliates, by country of UBO, 1997

	Number of affiliates	Number of companies consoli-dated	Thousands of employees	$millions								
				Total assets	Gross property, plant, and equipment	Expendi-tures for property, plant and equipment	Sales	Net income	Gross product	Compen-sation of employees	U.S. exports of goods shipped by affiliates	U.S. imports of goods shipped to affiliates
All countries	9,652	34,082	5,202	3,071,483	877,568	113,262	1,726,344	40,924	389,432	233,482	141,305	264,924
Canada	964	4,644	616	311,915	83,410	8,450	138,974	3,381	34,732	22,026	8,155	15,333
Europe	4,159	17,214	3,234	1,836,666	476,228	56,823	943,893	31,058	248,970	150,630	63,043	96,483
France	534	2,239	415	327,615	77,003	7,629	136,134	2,852	36,182	22,006	14,112	12,847
Germany	1,020	3,191	665	305,672	91,512	15,303	195,726	5,020	46,330	30,677	14,114	32,206
Netherlands	314	1,829	394	271,109	80,296	8,203	129,425	6,070	34,740	17,391	4,713	11,435
Switzerland	412	1,648	352	337,767	29,776	3,691	103,200	3,434	26,331	20,785	5,857	6,633
UK	946	5,890	981	462,654	148,864	16,015	256,693	11,536	78,289	43,024	14,461	15,309
L. America+	631	1,693	169	60,506	28,470	2,616	54,260	2,420	13,682	6,603	5,297	9,910
Africa	40	164	22.6	11,931	9,504	(D)	11,192	348	2,870	1,342	(D)	545
Middle East	316	989	95.2	29,543	20,436	1,585	25,280	1,175	7,481	2,556	757	5,552
Asia/Pacific	3,438	8,739	1,013.9	692,399	236,107	38,501	529,294	-429	74,541	47,395	62,201	136,151
Australia	135	835	81.2	54,923	18,289	2,004	26,932	-1,214	5,488	3,676	1,235	1,137
Japan	2,628	6,241	812.3	587,197	187,559	31,571	450,976	2,561	63,017	39,090	52,524	120,693

Source: BEA (1997), Table A-2
Notes: "L. America+" refers to Latin America & Other Western Hemisphere

Table 3
U.S. imports of goods shipped to affiliates, industry of affiliate by country of UBO, 1987 ($millions)

	All countries	Canada	France	Germany	Nether-lands	Switzer-land	UK	Australia	Japan
All industries	143,537	8,033	4,330	17,264	4,268	4,269	10,622	504	72,564
Petroleum	8,971	321	(D)	(D)	(D)	(D)	(D)	0	(D)
Petroleum and coal products manufacturing	5,964	0	(D)	0	(D)	0	(D)	0	0
Other	3,006	321	(D)	(D)	(D)	(D)	0	0	(D)
Manufacturing	24,546	4,274	1,773	4,312	1,443	1,632	3,339	304	4,195
Chemicals and allied products	5,200	(D)	300	1,505	(D)	756	1,080	1	74
Industrial chemicals and synthetics	3,468	(D)	31	1,432	86	(D)	662	0	56
Primary and fabricated metals	3,680	1,243	85	551	7	168	355	(D)	334
Machinery	7,634	556	331	1,356	(D)	355	356	2	2,253
Machinery, except electrical	2,876	(D)	(D)	526	34	(D)	197	2	711
Electric and electronic equipment	4,758	(D)	(D)	829	(D)	(D)	159	(*)	1,542
Other manufacturing	6,391	(D)	979	(D)	26	237	1,010	(D)	1,503
Wholesale trade	107,278	2,907	2,394	12,346	343	1,646	4,650	(D)	68,166
Motor vehicles and equipment	50,040	(D)	(D)	9,312	3	(D)	395	0	33,018
Professional & commercial equip. & supplies	6,581	126	3	649	(D)	120	23	0	5,481
Metals and minerals, except petroleum	15,382	685	418	936	(D)	(D)	242	(D)	10,782
Electrical goods	15,140	(D)	25	76	(D)	60	93	0	13,388
Machinery, equipment, and supplies	4,770	(D)	45	774	18	564	212	0	2,136
Other durable goods	3,024	105	117	95	24	310	247	(*)	1,511
Groceries and related products	3,637	(D)	(D)	25	0	(D)	1,004	0	246
Other nondurable goods	6,170	1,484	459	(D)	41	(D)	1,531	(D)	(D)

Source: BEA (1987), Table G-6

Note: Industries that contributed less than 2% to total exports shipped by all countries' affiliates (i.e., less than $2,871 million) were dropped from the table for the sake of brevity. An asterick "(*)" indicates a value between 0 and $500,000; a "(D)" indicates that the data have been suppressed to avoid the disclosure of data of individual companies.

Table 4
U.S. imports of goods shipped to affiliates, industry of affiliate by country of UBO, 1997 ($millions)

	All countries	Canada	France	Germany	Nether-lands	Switzer-land	UK	Australia	Japan
All industries	264,924	15,333	12,847	32,206	11,435	6,633	15,309	1,137	120,693
Manufacturing	105,242	7,027	8,646	12,572	7,628	3,309	11,169	582	37,528
Petroleum and coal products	10,882	(D)	3	2	(D)	0	(D)	0	(*)
Chemicals	16,257	588	1,308	4,777	842	2,112	4,707	(D)	783
Pharmaceuticals and medicines	7,710	(D)	417	(D)	7	(D)	(D)	(D)	129
Primary and fabricated metals	9,189	1,951	578	562	89	84	423	(D)	1,517
Primary metals	6,393	(D)	425	328	(D)	73	155	(D)	980
Machinery	6,974	70	24	2,104	103	367	261	77	2,464
Computers and electronic products	27,750	(D)	(D)	280	(D)	154	885	9	15,038
Communications equipment	6,751	(D)	(D)	(D)	0	(D)	(D)	8	3,460
Semiconductors & other electronic components	6,057	(D)	(D)	190	(D)	9	662	(*)	1,236
Transportation equipment	18,430	190	563	2,293	(D)	2	466	2	14,438
Motor vehicles, bodies and trailers, and parts	17,730	190	(D)	(D)	(D)	0	304	2	14,399
Wholesale trade	151,005	6,024	3,446	18,167	2,980	3,283	3,812	(D)	82,349
Motor vehicles & motor vehicle parts & supplies	49,781	(D)	3	13,484	(D)	(*)	24	(D)	29,871
Professional & commercial equipment and supplie	15,324	(D)	(D)	357	(D)	178	88	3	10,921
Electrical goods	25,580	(D)	257	223	204	66	187	5	18,875
Other durable goods	28,652	2,731	1,307	2,095	552	1,453	834	28	12,696
Petroleum and petroleum products	7,196	1	1	1	(D)	(D)	(D)	1	(D)
Other nondurable goods	24,472	1,362	(D)	2,007	845	(D)	(D)	(D)	(D)

Source: BEA (1997), Table H-6

Note: Industries that contributed less than 2% to total exports shipped by all countries' affiliates (i.e., less than $5298 million) were dropped from the table for the sake of brevity. An asterick "(*)" indicates a value between 0 and $500,000; a "(D)" indicates that the data have been suppressed to avoid the disclosure of data of individual companies.

Table 5
U.S. exports of goods shipped by affiliates, industry of affiliate by country of UBO, 1987 ($millions)

	All countries	Canada	France	Germany	Nether-lands	Switzer-land	UK	Australia	Japan
All industries	48,091	4,963	5,422	3,636	1,485	1,937	3,735	210	20,413
Petroleum	1,186	3	(D)	(D)	(D)	(D)	(D)	2	(D)
Manufacturing	15,487	4,042	937	2,798	707	770	2,631	107	1,126
Chemicals and allied products	6,849	(D)	181	1,376	149	450	750	(*)	235
Industrial chemicals and synthetics	5,654	(D)	(D)	1,280	(D)	(D)	675	0	93
Primary and fabricated metals	1,509	282	42	178	3	34	233	(D)	28
Primary metal industries	1,085	(D)	(D)	(D)	1	(D)	210	(D)	26
Nonferrous	980	(D)	(D)	18	0	(D)	205	(D)	18
Machinery	3,439	169	251	890	(D)	100	582	7	313
Machinery, except electrical	1,391	19	231	(D)	30	(D)	284	(D)	211
Electric and electronic equipment	2,048	151	19	(D)	(D)	(D)	299	(D)	102
Other manufacturing	3,173	(D)	455	352	(D)	117	973	(D)	393
Wholesale trade	29,165	459	4,249	536	332	1,068	659	47	19,203
Motor vehicles and equipment	3,111	(D)	(D)	189	1	0	2	0	(D)
Metals and minerals, except petroleum	11,007	72	(D)	192	(D)	(D)	(D)	(*)	10,213
Machinery, equipment, and supplies	1,058	64	15	43	(*)	32	60	(D)	379
Groceries and related products	1,418	(D)	(*)	9	1	(D)	309	0	656
Farm-product raw materials	9,753	(D)	(D)	(D)	(D)	(D)	0	0	4,150
Other nondurable goods	1,200	(D)	25	(D)	32	1	204	(D)	(D)
Other industries	1,075	448	(D)	(D)	(D)	19	(D)	53	(D)

Source: BEA (1987), Table G-3

Note: Industries that contributed less than 2% to total exports shipped by all countries' affiliates (i.e., less than $962 million) were dropped from the table for the sake of brevity. An asterick "(*)" indicates a value between 0 and $500,000; a "(D)" indicates that the data have been suppressed to avoid the disclosure of data of individual companies.

Table 6
US exports of goods shipped by affiliates, industry of affiliate by country of UBO, 1997
$millions

	All countries	Canada	France	Germany	Nether-lands	Switzer-land	UK	Australia	Japan
All industries	141,305	8,155	14,112	14,114	4,713	5,857	14,461	1,235	52,524
Manufacturing	71,251	4,585	7,210	10,633	4,278	4,815	11,999	749	16,513
Food	2,846	95	68	19	43	(D)	696	15	965
Chemicals	15,443	435	1,375	4,585	1,309	1,479	2,589	(D)	1,879
Basic chemicals	4,911	(D)	848	1,306	(D)	198	626	(D)	678
Pharmaceuticals and medicines	4,002	(D)	273	(D)	6	1,149	494	0	214
Primary and fabricated metals	5,236	924	408	355	21	167	488	(D)	838
Primary metals	3,183	(D)	(D)	186	(D)	154	66	(D)	602
Machinery	8,698	120	51	1,702	104	1,747	1,222	123	1,612
Computers and electronic products	14,238	(D)	(D)	211	(D)	533	960	4	4,834
Communications equipment	4,570	(D)	(D)	(D)	0	(D)	(D)	1	1,150
Semiconductors and other electronic components	2,848	24	86	70	(D)	5	460	(*)	909
Electrical equipment, appliances, and components	4,664	8	(D)	(D)	(D)	17	(D)	(D)	271
Transportation equipment	7,930	212	766	1,148	(D)	2	1,054	(*)	4,317
Motor vehicles, bodies and trailers, and parts	6,881	211	(D)	(D)	(D)	0	431	(*)	4,292
Wholesale trade	62,222	1,822	5,902	2,517	418	925	1,011	234	35,052
Motor vehicles and motor vehicle parts and supplies	4,816	(D)	1	(D)	1	(*)	39	2	3,336
Electrical goods	4,924	(D)	40	51	23	4	76	2	2,713
Other durable goods	14,684	422	309	929	158	162	450	(D)	6,856
Petroleum and petroleum products	5,902	(D)	(D)	(*)	(D)	(D)	3	(*)	(D)
Other nondurable goods	29,843	597	(D)	(D)	87	(D)	429	(D)	(D)
Other industries	4,623	(D)	(D)	(D)	0	(D)	(D)	(D)	92
Mining	3,859	1,541	(D)	(D)	0	(D)	901	(D)	(D)

Source: BEA (1997), Table H-3
Note: Industries that contributed less than 2% to total exports shipped by all countries' affiliates (i.e., less than $2,826 million) were dropped from the table for the sake of brevity. An asterick "(*)" indicates a value between 0 and $500,000; a "(D)" indicates that the data have been suppressed to avoid the disclosure of data of individual companies.

Table 7
Foreign affiliates' role in US bilateral trade, 1987 and 1997

($millions)

		1987				1997			
Source	Destination	Total trade	Affiliate trade	US firm trade	Affiliate share	Total trade	Affiliate trade	US firm trade	Affiliate share
US	Canada	69,890	4,169	65,721	0.0597	146,853	22,519	124,334	0.1533
US	France	10,008	826	9,182	0.0825	20,527	3,082	17,445	0.1501
US	Germany	13,247	2,164	11,083	0.1634	28,421	6,384	22,037	0.2246
US	Netherlands	7,206	1,181	6,025	0.1639	16,211	3,269	12,942	0.2017
US	Switzerland	2,887	617	2,270	0.2137	8,793	2,529	6,264	0.2876
US	UK	15,338	2,568	319	0.1674	39,508	6,181	2,612	0.1564
US	Australia	4,844	472	4,372	0.0974	12,924	1,709	11,215	0.1322
US	Japan	30,820	18,983	11,837	0.6159	70,749	33,549	37,200	0.4742
US	8-country sum	154,241	30,980	123,261	0.2009	343,986	79,222	264,764	0.2303
US	All	275,656	48,091	227,565	0.1745	735,357	141,305	594,052	0.1922
Canada	US	77,020	7,952	69,068	0.1032	185,676	25,475	160,201	0.1372
France	US	10,828	3,189	7,639	0.2945	19,529	6,921	12,608	0.3544
Germany	US	27,648	16,372	11,276	0.5922	45,379	23,868	21,511	0.5260
Netherlands	US	4,480	1,173	3,307	0.2619	7,430	2,783	4,647	0.3746
Switzerland	US	4,133	2,421	1,712	0.5857	8,278	5,181	3,097	0.6259
UK	US	18,060	4,754	13,306	0.2632	35,792	11,018	24,774	0.3078
Australia	US	3,200	849	2,351	0.2653	4,665	738	3,927	0.1582
Japan	US	88,573	69,266	19,307	0.7820	121,274	100,236	21,038	0.8265
8-country sum	US	233,942	105,976	127,966	0.4530	428,023	176,220	251,803	0.4117
All	US	416,975	143,537	273,438	0.3442	894,063	264,924	629,139	0.2963

Sources: BEA (1987) Tables G-24, G-30 and BEA (1997) Tables H-24, H-30 for affiliate trade data; World Trade Analyzer, Statistics Canada (1997) for bilateral trade data.

Table 8
Trade activities of foreign affiliates in the US

	Share of US exports to home** (%)		Share of US imports from home** (%)		Home** bias in exporting (%)		Home** bias in importing (%)		Export home bias rel. to US firms' export		Import home bias rel. to US firms' import		Intra-group export bias (%)		Intra-group import bias (%)	
	1987	1997	1987	1997	1987	1997	1987	1997	1987	1997	1987	1997	1987	1997	1987	1997
Country of UBO																
All countries													39.74	44.60	75.38	76.38
Canada	2.18	2.91	7.66	7.07	30.67	52.34	73.42	85.59	1.06	2.50	2.91	3.36	17.69	36.70	71.17	85.38
Europe	9.58	13.11	36.07	35.28	39.25	34.89	69.73	65.45	1.39	1.51	3.15	3.69	30.16	32.24	71.90	70.98
France	3.48	7.37	22.27	25.68	6.42	10.72	55.70	39.04	1.59	3.65	19.94	19.48	17.23	20.97	75.38	54.39
Germany*	8.30	11.01	51.50	46.97	30.23	22.18	82.48	66.18	6.21	5.98	20.00	19.36	37.98	37.29	86.88	80.71
Netherlands	4.07	3.26	15.78	29.49	19.73	11.20	16.57	19.16	7.45	5.14	13.70	25.94	50.24	48.86	39.53	56.95
Switzerland	10.19	13.65	44.15	44.18	15.18	20.49	42.75	55.13	15.22	19.43	68.27	112.00	30.46	40.07	76.32	80.93
UK	4.80	5.94	19.41	17.84	19.73	16.22	33.01	41.71	3.52	2.89	6.78	10.59	30.12	23.57	46.88	60.83
Latin America	0.75	1.39	8.93	5.18	13.52	40.46	64.42	74.59	1.07	1.75	5.67	3.94	23.57	34.25	60.45	69.82
Africa	0.70	(D)	3.27	1.15	8.45	(D)	46.12	37.25	3.65	(D)	15.45	15.57	8.25	(D)	40.44	43.12
Middle East	1.56	1.15	1.97	20.71	59.68	40.03	71.35	82.26	15.16	9.56	16.80	30.22	54.15	46.76	78.36	81.83
Asia/Pacific	25.04	18.14	42.41	35.84	85.45	65.05	96.85	89.98	3.91	2.35	2.75	2.74	54.67	59.87	79.52	79.52
Australia	0.52	1.80	4.53	7.07	11.90	18.79	28.77	29.02	6.20	9.95	33.46	46.50	13.33	19.68	39.68	48.28
Japan	51.18	38.48	76.30	80.73	77.27	51.83	93.13	81.11	14.85	8.28	13.19	24.26	53.23	60.62	79.04	79.72

Source: Author's calculations based on BEA (1987), Tables G24, G26, G30, & G32; BEA (1997), Tables H24, H26, H30 & H32; and World Trade Analyzer data.
*West Germany in 1987
**"Home" refers to the affiliates' country of UBO or a regional total.

Table 9
Gravity model results on foreign affiliates' trade by country of UBO with 8 major trade partners, 1997

	(1)	(2)	(3)	(4)	(5)
Independent variables:					
ln(Dist1)	-0.944**	-0.991**	-0.687**	-0.859**	-0.991**
	(0.018)	(0.016)	(0.036)	(0.078)	(0.016)
HomeLink		3.033**			2.781**
		(0.373)			(0.390)
		[20.76]			[16.14]
ln(Dist2)			-0.323**		
			(0.041)		
ln(Dist2) (drop home-linked observations)				-0.144^	
				(0.082)	
Japan-network					2.035^
					(1.036)
					[7.65]
Adj. R sq.	0.958	0.973	0.972	0.974	0.973
observations	118	118	118	102	118

Notes: Dist1 = distance between source and destination countries of trade;
Dist2 = distance between non-US source or destination country and affiliates' country of UBO;
HomeLink = a binary variable that takes on a value of 1 if the trade is between foreign affiliates and their home country;
Japan-network = a binary variable that takes on a value of 1 if trade is between Japanese affiliates and Japan;
^ indicates significance at the 10% level;
* indicates significance at the 5% level;
** indicates significance at the 1% level;
Standard errors shown in parentheses; exponent of coefficient shown in brackets.

Table 10
Gravity model results on foreign affiliates' trade by country of UBO with 8 major trade partners, pooled data for years 1987, 1992, 1997

	(1)	(2)	(3)	(4)	(5)	(6)
Independent variables:						
ln(Dist1)	-0.956**	-1.005**	-0.718**	-0.930**	-1.006**	-0.992**
	(0.011)	(0.009)	(0.021)	(0.043)	(0.009)	(0.008)
HomeLink		2.982**			2.670**	2.860**
		(0.211)			(0.219)	(0.185)
		[19.73]			[14.44]	[17.46]
ln(Dist2)			-0.305**			
			(0.024)			
ln(Dist2) (drop home-linked observations)				-0.084^		
				(0.046)		
Japan-network					2.288**	2.005**
					(0.579)	(0.489)
					[9.86]	[7.43]
UK-network						0.526**
						(0.177)
						[1.69]
Australia-network						-2.441**
						(0.223)
						[0.087]
Adj. R sq.	0.959	0.974	0.973	0.976	0.975	0.983
observations	333	333	333	285	333	333

Notes: Dist1 = distance between source and destination countries of trade;
Dist2 = distance between non-US source or destination country and affiliates' country of UBO
HomeLink = a binary variable that takes on a value of 1 if the trade is between foreign affiliates and their home country;
Japan-network = a binary variable that takes on a value of 1 if trade is between Japanese affiliates and Japan; UK-network and Australia-network variables are defined similarly;
^ indicates significance at the 10% level;
* indicates significance at the 5% level;
** indicates significance at the 1% level;
Standard errors shown in parentheses; exponent of coefficient shown in brackets.