Horizontal versus Vertical Foreign Direct Investment: Evidence from U.S. Multinationals

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ABSTRACT

Using firm-level data, we document a new set of facts on the motives for foreign direct investment. We find that the majority of affiliates are horizontal in nature, selling most of their output to unaffiliated parties in their host countries; most affiliates do not trade with other parties within the corporation. We show that the input-output coefficient between the industries of operation of the parent and the affiliate—a characteristic commonly used to identify a vertical relationship—is not related to the corresponding intrafirm flows of physical goods. We document that a key difference between horizontal and vertical affiliates is their size: Vertical affiliates are concentrated among a small number of large multinational corporations and, within them, only the largest affiliates engage in intrafirm trade.

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1 Introduction

Why do firms open foreign affiliates? Is it to sell goods in the foreign country? Is it to take advantage of cross-country factor price differences? Is it a combination of both? These questions lie at the center of an ongoing debate over the role of multinational firms in the global economy. We add to this debate by documenting a new set of facts about the vertical and horizontal activities of foreign affiliates of U.S. multinational companies.

Our data, collected by the U.S. Bureau of Economic Analysis (BEA) and drawn from the universe of U.S. multinational firms and their foreign affiliates, include a key—and unique—feature: An affiliate's sales are broken down by destination (the United States, the host country, or a third country) and by transaction type (the parent, another affiliate, or an unaffiliated party).

To characterize the role of foreign affiliates, we follow the extensive literature on the patterns of foreign direct investment (FDI), which has identified two primary motives for locating production abroad. On the one hand, a firm may want to locate production near consumers, replicating production abroad to save on transportation costs. This type of investment, known as *horizontal* FDI, is associated with trade in goods to parties outside of the firm.[1] On the other hand, differences in factor prices across countries motivate the foreign location of some stages of production. This type of investment, known as *vertical* FDI, is associated with trade in goods among affiliates within the firm.[2]

We document a striking pattern: There is very little intrafirm trade relative to the affiliate's total sales.[3] The median manufacturing affiliate ships 91 percent of its output to unaffiliated parties, mostly within its country of operation; the median affiliate shipment size to the parent is zero. In this regard, the foreign affiliates of U.S. multinationals are predominately horizontal.

An affiliate's purpose has often been interpreted according to the characteristics of its industry or country of operation. An affiliate operating in the same industry as its parent, or an affiliate located in a country that is similar to its parent's country, has been interpreted as a horizontal affiliate.[4] An affiliate operating in industries different from its parent's and in industries linked

[1] See Horstmann and Markusen (1992), Brainard (1997), Markusen and Venables (2000), and Helpman, Melitz and Yeaple (2004), among others. In an environment with uncertainty, see Ramondo, Rappoport and Ruhl (2013).

[2] See Helpman (1984), Antras (2003), Yeaple (2003), and Keller and Yeaple (2009).

[3] It is well known that intrafirm trade makes up a large share of total U.S. foreign trade (Bernard, Jensen and Schott 2009). However, we are measuring intrafirm trade relative to total affiliate sales, which we find to be quite small. That both of these statements are true reflects the fact that total U.S. foreign affiliate sales are much larger than U.S. trade flows: Total affiliate sales are 2.6 times larger than total U.S. exports and 1.6 times larger than U.S. imports. While intrafirm trade is large relative to total trade, total trade is small relative to the output of foreign affiliates.

[4] Fajgelbaum, Grossman and Helpman (2013), for example, assume that the set of affiliates operating in the same

to its parent's industries through the input-output matrix—what we call an *I-O linked* affiliate—has been interpreted as a vertical affiliate. Intuitively, a strong I-O link between the parent and affiliate would suggest a vertical relationship because one party produces goods that the other party uses as inputs for production. Hence, we would expect to observe shipments of physical goods between the two.

More than 90 percent of the affiliates in our sample are I-O linked to their parents. If we were to follow the existing literature, and use affiliate and parent industry data to classify our affiliates, we would conclude that vertical affiliates are the predominate type of U.S. foreign affiliate and that we should observe significant intrafirm trade associated with these vertical affiliates. Thus, our finding that there is very little intrafirm trade is quite surprising in this context. We further explore the relationship between I-O links and intrafirm trade, and we find that neither the presence nor the magnitude of an I-O link between the parent and the affiliate predicts the existence or the share of intrafirm trade in the affiliate's total sales.[5]

Our findings are similar to those in Atalay, Hortacsu and Syverson (2014), which studies the domestic operations of U.S. multi-plant firms. The authors find that I-O links between affiliates located within the United States are not associated with significant intrafirm shipments, which, in general, are a very small fraction of the firm's activities. In our international data, we find a similar pattern. However, the lack of intrafirm trade across borders should be even more surprising than the lack of intrafirm trade within the United States. Factor price differences—the theoretical motivation for vertical FDI and the intrafirm trade that accompanies it—are much larger across countries than across U.S. cities.

Atalay et al. (2014) suggest that their findings are related to the boundaries of the firm being determined by the transfer of capabilities, and not by the transfer of physical goods. Strong I-O links between two industries may signal the use of a common set of intangible inputs; this may be the case internationally, as well. In the international-trade and multinational-firm literature, these intangibles have been formalized as knowledge capital (Markusen 1984), technology capital (McGrattan and Prescott 2010), managerial ability (Bloom and Van Reenen 2007; Garicano and Rossi-Hansberg 2006), and core capabilities (Bernard, Redding and Schott 2011).[6]

industry as their parents are horizontal affiliates.

[5]We do find, as in Alfaro and Charlton (2009), that an I-O link between the industries of the affiliate and the parent predicts both the existence and the size of the affiliate.

[6]The transfer of intangible goods within the firm is not exclusive to the multinational-firm literature. A large management literature has developed a knowledge-based view of the firm, focusing on a key form of intangible goods—ideas. See, for example, Grant (1996), Kogut and Zander (1992), and Singh (2005).

If intrafirm trade is not related to what parents and affiliates produce, which variables are the best predictors of the affiliate type? We find that the size of the affiliate and the size of the multinational corporation to which it belongs, measured by total sales or employment, are key predictors of the affiliate's type.[7] Vertical activities are concentrated in large multinational corporations, and within them, affiliates that ship goods within the firm are, on average, larger than those that ship most of their output to unaffiliated parties. There are relatively few of these large, vertical affiliates in the data.

The skewness of intrafirm trade towards large corporations is reminiscent of the skewness in the distributions of other international activities. Manufacturing exports are found to be concentrated in large firms (Bernard and Jensen 1995), and multinational activities are concentrated among even larger firms (Helpman et al. 2004).

The observed concentration of intrafirm trade in large firms is consistent with theories of the firm that are based on economies of scale in production. In Grossman, Helpman and Szeidl (2006), for example, production of inputs for the entire multinational firm is concentrated into a few vertical affiliates, exploiting these economies of scale. Affiliates created to supply a foreign market—as an alternative to exporting, in order to avoid transportation costs—are relatively small. The model predicts that a small number of large affiliates ship goods within the firm, while numerous smaller affiliates operate to serve local markets.

Our work fits into a broader literature that studies the intrafirm trade of multinational firms. Working at the affiliate level, Borga and Zeile (2004), Hanson, Mataloni and Slaughter (2005), and Feinberg and Keane (2006) analyze the country- and industry-level determinants of parent-to-affiliate shipments. Bilir, Chor and Manova (2013) focus on the impact of host country financial conditions on the affiliate's sales to affiliated and unaffiliated parties. A second branch of the literature analyzes, as we do, affiliate-to-parent trade, but uses data aggregated to the country-industry level (e.g., Carr, Markusen and Maskus 2001, Antras 2003, and Yeaple 2006); our findings are largely consistent with this literature.[8]

Finally, our findings are related to the empirical literature that documents the growing importance of trade associated with the fragmentation of production across countries.[9] While trade in

[7] Hanson, Mataloni and Slaughter (2001) also includes a measure of affiliate size in an analysis of intermediate-good trade from the parent to the affiliate.

[8] Several studies have used the related-party trade data from the U.S. Census Bureau (e.g., Nunn and Trefler 2008, Bernard, Jensen and Schott 2009, and Costinot, Oldensky and Rauch 2011) to address the determinants of trade between U.S. parties and their foreign counterparts. These studies also use data aggregated to the country and industry level.

[9] See, among others, Feenstra (1998), Hummels, Ishii and Yi (2001), Yi (2003), Hanson et al. (2005), Grossman and

intermediate goods is a large part of world trade, our findings show that much of this trade does not occur within the boundary of the firm. Our findings do not exclude, however, multinational-firm configurations that involve unrelated parties in some stages of production interacting with different affiliates of the same firm, possibly in different countries and industries. Indeed, capturing the complexities of global production chains requires detailed surveys of affiliates and parents. The BEA data, unlike other comprehensive surveys available, provide detail on the nature of affiliate shipments, allowing us to characterize in much more depth some aspects of these global production chains.

The remainder of the paper is organized as follows. Section 2 describes the data, and section 3 describes the patterns of the affiliates' activities observed in the data. Section 4 analyzes the relationship between I-O links and intrafirm trade, as well as the relationship between those I-O links and the presence and magnitude of FDI activities. Section 5 presents evidence on the importance of firm size in characterizing the role and activities of affiliates within the corporation. Section 6 analyzes the relationship between intrafirm trade and industry and country characteristics. Section 7 presents robustness results, and in section 8, we discuss our findings and make some concluding remarks.

2 Data and Definitions

Our firm-level data are collected by the U.S. Bureau of Economic Analysis for the purpose of producing aggregate statistics on the operations of multinational companies.[10] These data cover the universe of U.S. parents and their foreign affiliates in the benchmark year 2004.

Parent and affiliate data are reported at different levels of aggregation. Parent data consolidate all U.S.-located company operations that are part of the fully consolidated firm. Affiliates do not typically consolidate. Some exceptions are made for affiliates of the same parent—these affiliates may report in a consolidated manner if they are located in the same country and in the same four-digit industry. Affiliates never consolidate across countries.

Detailed data on an affiliate's operations must be reported if the affiliate's sales, assets, or net income (loss) are greater than $10 million. Of the 42,547 affiliates, 25,464 are large enough

Rossi-Hansberg (2007), Bernard et al. (2009), Fally (2011), and Johnson and Noguera (2012a, 2012b).

[10]The other source of data on U.S. affiliated-party trade is the U.S. Census Bureau's related-party trade database, which is based on transaction-level data at the country-industry level. The BEA data, by contrast, are based on firm-level data, making them suitable to answer the questions we ask in this paper. Two important differences between the two data sources are: (1) while the Census data record the industry of the transacted good, the BEA data records the industry of the transacting parties; and (2) the Census data include transactions carried out by U.S. affiliates of foreign multinationals. Nevertheless, as Ruhl (2013) shows, the two datasets are broadly consistent at the aggregate level.

to report.[11] The reporting threshold is low: Reporting affiliates account for 99 percent of total affiliate assets and sales. Columns 1 and 2 in table 1 report sales and employment for the universe of affiliates and the subset of affiliates that report.

Within the set of reporting affiliates, we take our sample to be all of the majority-owned affiliates (an affiliate whose parent owns more than 50 percent of the affiliate), who have sales, assets, or net income (loss) of more than $25 million, and who operate—and are owned by a parent who operates—in a manufacturing industry. Only the majority-owned affiliates that cross the $25 million threshold are required to report data on intrafirm trade. Column 6 of table 1 reports the statistics for our sample. The 4,911 affiliates in our sample account for almost 80 percent of reported affiliate sales and 90 percent of reported affiliate sales to the parent. Further details regarding the sample construction are in the appendix.

We focus our analysis on manufacturing industries because, outside of manufacturing, retail- and wholesale-based affiliates account for almost all of the affiliates that engage in intrafirm trade (service-based affiliates do not engage in merchandise trade in a meaningful way). Our focus on manufacturing is guided by the theoretical literature on the multinational firm, which is concerned almost exclusively with the choice of production location rather than distribution channels. The existing empirical studies of multinational activities also restrict their analyses to manufacturing, so, by doing so ourselves, we maintain comparability with the literature.

Our main results are made possible by a classification of affiliate sales broken down by transaction type. In the data, an affiliate's sales can be directed to: (i) the parent; (ii) unaffiliated U.S. parties; (iii) local affiliates; (iv) local unaffiliated parties; (v) affiliated parties in neither the U.S. nor the host country (what we call *third countries*); and (vi) unaffiliated parties in third countries. These variables are summarized in panel 1 of table 2.

The affiliate-level data are very skewed, which is evident from the difference between the median and mean values of the variables reported in table 2, panel 1. The average share of total sales to unaffiliated parties is 73 percent, but the median affiliate sells 91 percent of its output to unaffiliated parties. When affiliates are sorted by their share of total sales to local unaffiliated parties, we find that the median affiliate sells 66 percent of its total output to local unaffiliated parties, while the mean drops to 57 percent. Note that the median affiliate in these two cases is not

[11] For affiliates below the threshold for reporting on an affiliate survey form, the parent reports a few data items, including affiliate sales and employment. Additionally, we do not consider the 2,606 affiliates with "carry " data (i.e., affiliates whose data were extrapolated from a previous survey); they represent eight percent of total reporting affiliate sales. None of the data used in our analysis are imputed data.

the same affiliate: The median affiliate changes as we change the sorting variable. A similar figure characterizes the worldwide activities of U.S. multinational corporations. Eighty-seven percent of the median corporation's international sales is to unaffiliated parties (panel 3). From now on, we refer to "the median affiliate" with the understanding that it is the median affiliate with respect to the variable being studied.

Parents and affiliates report sales in each of their seven largest industries. These industries are classified according to the International Surveys Industry (ISI) classification, which is roughly equivalent to the 2002 North American Industry Classification System (NAICS). Based on these data, the BEA assigns a primary industry to each parent and affiliate, which is typically the industry with the largest share of total sales.[12] In our sample, affiliates span a total of 74 four-digit manufacturing industries (see table 1, column 6).

Panels 4 and 5 in table 2 describe the activities of the affiliates in terms of their industries of operation. The median foreign affiliate operates in only one four-digit industry. Larger affiliates are more diversified: The employment-weighted average number of industries per affiliate is 1.58. Even so, the weighted-average share of total sales accounted for by the primary industry is 0.92. The median parent operates in two industries, and the employment-weighted average share of sales in the primary industry is 0.74. Recall, however, that the parent is the consolidation of all domestic operations, while affiliates are generally not consolidated. This may overstate the extent of affiliate specialization relative to the parent. Consolidating the affiliates of a parent within a country creates a strictly comparable country-level affiliate. Doing so does not change the results much: The median country-level affiliate still operates in one industry, and the share of sales in the primary industry falls by eight percentage points, to 0.84. The median parent operates in two countries, but larger parents cast wider nets: The weighted-average number of countries of operation is 21.1.

A few remarks are in order. First, affiliate shipment data do not contain an industry identifier for the good being shipped. The lack of shipment-level industry classification, however, should not limit our analysis since the overwhelming majority of affiliates produce in a single industry and, hence, have only one four-digit product available to ship to related and unrelated parties.[13]

Second, within the "third countries" category, we know neither the identity of the individual affiliate in that country nor the identity of the countries to which the affiliate is shipping. In

[12] See the appendix for more detail on how BEA assigns the primary industry.

[13] Nevertheless, in our robustness results, we exploit the multi-industry information provided by parents and affiliates.

some cases, the data differentiate among Europe, Latin America, Africa, Middle East, Asia, the Pacific, and Canada, but our analysis does not exploit this disaggregation because only very large majority-owned affiliates (those with sales, assets, or net income (loss) of more than $150 million) are required to report in this way.

Finally, sales are reported on a "shipped" basis: The data reported represent the physical flow of goods and not an accounting convention. The shipments data reflect the buyer and seller in the transaction and are not affected by the use of a third-party shipping company.

2.1 Definitions of Affiliate Activity

Traditional models of vertical FDI assume that a parent creates an affiliate in order to carry out some stages of the production process: Production involves intrafirm flows of goods between the parent and the affiliate, or among foreign affiliates that specialize in different stages of production. In contrast, models of horizontal FDI are based on the assumption that a parent creates an affiliate to replicate its activities and to sell to the host country and nearby third countries.

We depart slightly from the literature and define affiliates' activities exclusively by the destination of their sales. We define *vertical activities* as sales to affiliated parties. Among intrafirm sales, we differentiate between sales to the parent and sales to other affiliates within the same multinational corporation. We define *horizontal activities* as sales to unaffiliated parties. We consider two types of horizontal activities: affiliate sales to local unaffiliated parties (*local-horizontal activities*) and affiliate sales to unaffiliated parties located in other countries, including the United States (*export-platform activities*).

The richness of the data allows us to identify production chains inside the boundaries of the firm, but the data are unable to capture a vertical chain once the intermediate goods leave the multinational corporation. For example, suppose that a U.S. multinational corporation has a foreign affiliate that produces the first stage of the product and ships it to an unrelated party that completes production and then ships the finished product to the parent. The affiliate is, in this case, part of a vertical production chain. The data, however, will account for the first transaction as sales to an unaffiliated party, and the second transaction will show up as an import to the parent from an unaffiliated party.

While the data have limitations, the BEA benchmark surveys still offer the most complete description of multinational activity available. In the next section, we present some key facts concerning the activities of foreign affiliates of U.S. multinational firms and their connection with

the rest of the multinational corporation.[14]

3 Patterns of Affiliate Activity: What do Affiliates Do?

It is well known that intrafirm trade represents a large fraction of U.S. trade. This is also the case for our sample of U.S. affiliates abroad: In 2004, 70 percent of total affiliate sales made outside of their host countries were made to affiliates within the corporation.[15] These aggregate statistics, however, mask what individual affiliates actually do, as well as the substantial heterogeneity across them.

For a striking majority of affiliates, shipping goods *within* the corporation is not their primary activity: The median affiliate reports that only nine percent of its sales are to other parties within the corporation. Moreover, the median affiliate's sales to its parent is zero and rises to only four percent of its total sales when we consider the subset of affiliates with positive sales to its parent (see panels 1 and 2 in table 2).

What do foreign affiliates do? Most affiliates sell locally, to unrelated parties. The median affiliate shipment to unaffiliated parties as a share of total sales is more than 90 percent and consists mainly of sales in its country of operation (66 percent, see panel 1 in table 2).

Figure 1 further explores this feature of the data. This histogram plots the distribution of affiliates by their share of total affiliate sales to unaffiliated parties, for the entire sample and for parent-affiliate pairs in the North American motor vehicles sector (affiliates in ISI 3361–3363 located in either Canada or Mexico). Sixty-five percent of affiliates sell more than 80 percent of their output to unaffiliated parties, and 25 percent of the affiliates do not report any intrafirm trade, either with the parent or with any other affiliated party. The group of affiliates located in the North American motor vehicles sector is often held up as an example of the importance of intrafirm trade, but even for this group, the bulk of affiliate sales is directed to unrelated parties outside the multinational corporation. In tables 3 and 4, we provide summary statistics by sector and geographical region. No other industry has, on average, more than 40 percent of affiliate output sold within the firm. Sales to affiliated parties, as a share of affiliate sales, reach a high of 33 percent in the Middle East. Export-platform activities are the most relevant for Europe, where

[14] Other countries have surveys on the foreign activities of their multinational firms (e.g., Norway, Germany, and France), but the information about the activities of the affiliates abroad is scarce. In general, these surveys record only the affiliate's country of operation.

[15] As table 1 shows, total affiliate shipments are the sum of sales to the parent, to U.S. unaffiliated parties, and to third-country affiliated and unaffiliated parties, while total intrafirm shipments refer to the sum of sales to the parent and to third-country affiliated parties.

22 percent of affiliate sales are directed to non-local unaffiliated parties, while local-horizontal activities, being pervasive in all regions and industries, predominate in Latin American countries.

The concentration of intrafirm trade in a small number of large foreign affiliates results in the small share of intrafirm trade in total sales in the median and mean affiliates in our sample. The average intrafirm flow is larger when weighted by the size (as measured by employment) of the affiliate: While the mean shipment from the affiliate to related parties is 27 percent of total affiliate sales, the weighted-mean shipment increases to 33 percent, evidence that the affiliates engaging in intrafirm trade are larger. The skewness of intrafirm shipments can be seen in figure 2a where we plot the cumulative share of intrafirm trade against the cumulative share of affiliates. We see affiliates engaging in intrafirm trade only at the very top of the distribution, and more so when we consider only shipments to the parent.

3.1 The Corporation

In the previous section, our unit of analysis was the affiliate. In this section, we aggregate the data to the corporation level to see—in an admittedly simple way—how the use of intrafirm global production chains varies across U.S. multinational corporations. At this level of aggregation, we can ask: How pervasive are vertical and horizontal activities across and within corporations? Are vertical activities clustered into a few corporations? If so, which types of corporations?

For each parent, we construct a *composite foreign affiliate* that is the sum over all of the parent's foreign affiliates.[16] For example, the intra-corporation trade share ("to any affiliated party") is the sum of affiliated-party sales made by the parent's foreign affiliates, divided by the sum of the total sales made by the parent's foreign affiliates. In panel 3 of table 2, we report the summary statistics for the composite foreign affiliates. Broadly, the results from the individual affiliates in panel 1 still hold: For the median corporation, sales to unrelated parties account for almost 90 percent of its total sales, while intra-corporation sales account for 13 percent of total foreign sales, five percentage points higher than the median affiliate in panel 1. The most striking difference between panel 1 and panel 3 is the importance of export-platforms: While the median affiliate ships nothing to unaffiliated parties outside of its host country, the median composite foreign affiliate ships 14 percent of its total sales to unaffiliated parties outside of its host country.

The histogram in figure 1b provides further detail about corporation-wide sales to unrelated parties. The distribution is less skewed than the affiliate-level distribution—to be expected given

[16] We do not include the parent's sales because these data are available for only a subset of the parents in the sample.

the aggregation—but even so, 30 percent of corporations direct more than 95 percent of their entire foreign sales to parties outside the corporation itself. The Lorenz curves in figure 2b, analogous to the ones in figure 2a, show that intrafirm trade is still concentrated at the top of the distribution. The skewness of the distribution is not as dramatic as for individual affiliates but is, nevertheless, substantial: While 20 percent of affiliates account for 75 percent of the shipments to other affiliated parties within the corporation, 40 percent of corporations account for the same share of shipments within the boundaries of the firm. Vertical activities seem to be present in only one third of U.S. multinational firms.

4 Input-Output Links, Ownership, and Intrafirm Trade Flows

In the previous section, we documented that very few affiliates send goods to their parents. For most U.S. foreign affiliates, intrafirm trade accounts for a small share of their production, suggesting that most FDI is not undertaken to promote vertical specialization within the firm but, rather, to serve the market of operation. In this section, we focus on the affiliate's industry of operation and its link with the parent's industry, and we analyze the relationship between such links and the affiliate's activities.

We find that most parent-affiliate pairs operate in upstream or downstream industries, in the sense that the output of one industry is a direct input into the other; we say that these parent-affiliate pairs have an *input-output link*, or an *I-O link*. We find, however, that the I-O link between the parent and the affiliate—often used in the literature as a proxy for vertical FDI motives—is not a good predictor of the type of activity carried out by the foreign affiliate. This finding suggests that the multinational corporation does not own affiliates in upstream or downstream industries with the purpose of facilitating the transfer of goods along the production chain.

4.1 Do I-O Links Predict FDI Activity?

We characterize the input-output links between industries using the direct requirements table for the United States in 2002.[17] In that table, an observation is a commodity-industry pair, and the direct requirements coefficient, denoted by dr_{ij}, specifies the value of inputs from industry i needed to produce one dollar of output in industry j. The commodities and industries are defined using

[17]Implicit in our use of the U.S. input-output matrix is the assumption that U.S. parents and their foreign affiliates have the same input-output relationships (i.e., the same production functions) as two firms operating in the United States. Technology transfer is a frequently cited benefit of multinational firms, so it seems natural to assume that foreign affiliates are characterized by U.S. technologies. Moreover, input-output matrices in OECD countries are not very different from those in the United States (Antras, Chor, Fally and Hillberry 2012; Jones 2011).

the Input-Output industry classification, which we map into the BEA NAICS-based ISI classification. There are 77 manufacturing industries in the classification.

In figure 3a, we summarize the characteristics of the direct requirements matrix. The axes are the ISI industry codes (manufacturing codes lie between 3111 and 3399): The x-axis is the using industry (downstream), and the y-axis is the producing industry (upstream). The size of a bubble is proportional to the size of the direct requirements coefficient for the industry pair. It is clear from the figure that most industries require inputs from similar industries: The entries in the direct requirements matrix tend to be largest on or near the diagonal.

In figure 3b, we plot the distribution of industry pairs for parent-affiliate pairs in our data. In this figure, the size of a bubble is proportional to the number of observations in that industry pair. Although we consider only the primary industries of the affiliate and the parent, this is hardly restrictive: As reported in table 2, the median affiliate operates in one industry, and the share of sales in the primary industry is 1.00 for the median affiliate and 0.98 for the median parent in our sample.

Inspecting the figure, it is clear that most parents own affiliates on, or near, the diagonal. Combining figures 3a and 3b suggests that, in the data, parents own affiliates in similar industries and that these industries are important producers of intermediate inputs for each other. The average value of the direct requirements coefficients in the I-O matrix is only 0.005, and 49 percent of the industry pairs do not have an input-output relationship, $dr_{ij} = 0$.

Let x be the primary industry of the affiliate, a, and let z be the primary industry of the parent, p. In the parent-affiliate data, the average direct requirements coefficient jumps to 0.072 when we consider the parent to be upstream, dr_{zx}, and 0.069 when we consider the affiliate to be upstream, dr_{xz}. The number of parent-affiliate industry pairs whose direct requirements coefficient is zero is less than ten percent.

The relationship suggested by figures 3a and 3b are confirmed formally by estimating a linear probability model,

$$D(FDI_{xzc}) = \beta_U dr_{xz} + \beta_D dr_{zx} + F_{xc} + \epsilon_{xzc}. \tag{1}$$

The unit of observation is a triplet, xzc, that refers to the affiliate's primary industry, the parent's primary industry, and the affiliate's country of operation. The variable $D(FDI_{xzc})$ equals one if we observe at least one affiliate in the triplet xzc, and zero otherwise. The regression includes affiliate industry-country fixed effects F_{xc}, which account for any regularity in the affiliate's primary

industry and host country. Our sample contains 104 host countries and 77×77 possible industry pairs, yielding a total of 616,616 possible combinations, most of which display no multinational activity.

For those xzc triplets for which there is some multinational activity, we complement the estimation of the linear probability model with a log-linear specification,

$$\log(FDI_{xzc}) = \alpha_U \log dr_{xz} + \alpha_D \log dr_{zx} + F_{xc} + \epsilon_{xzc}. \tag{2}$$

We measure multinational activity, FDI_{xzc}, as either the number of affiliates or the total employment of affiliates in country c, industry of the parent z, and industry of the affiliate x. Again, we control for any regularity in the affiliate's industry and country of operation with F_{xc}, an affiliate industry-country fixed effect. The variables dr_{xz} and dr_{zx} correspond to the direct requirements coefficients between the (primary) industry of the parent and affiliate, with the affiliate in the upstream and downstream industry, respectively. The coefficients α_U and α_D capture the importance of I-O links as determinants of the number and size of foreign affiliates in a country and parent-affiliate industry pair.

The results are presented in table 5, columns 1-3. We observe affiliates in only $2,523$ of the $616,616$ potential industry-pair-country combinations. Therefore, the probability of observing an affiliate is very small ($0.0041 = 2,523/616,616$). The effects of the I-O links on the extensive margin, shown in column 1, are large: After controlling for industry and country characteristics, a ten-percent increase in both the upstream and downstream direct requirements coefficients from their averages increases the probability of observing FDI activity in a given xzc triplet by almost 0.5 percentage points, which implies a 90-percent increase in the probability of observing FDI activity in a xzc triplet.

Columns 2 and 3 report the effect of the I-O link on the intensive margin of FDI in equation 2, measured by the total number and aggregate employment of affiliates.[18] The increase in the average number of affiliates in a given industry-pair country triplet, when both dr_{xz} and dr_{zx} are increased by ten percent, is almost five percent; increasing the direct requirements coefficients by ten percent increases affiliate employment by more than six percent.

These results are consistent with those reported in Alfaro and Charlton (2009): We observe the bulk of parent-affiliate pairs in industries with a positive I-O link—those with a positive direct

[18] The dropped observations in column 3 are affiliates that report zero employees.

requirements coefficient. One limitation of our data is that our four-digit ISI classification is more coarse than the one used in Alfaro and Charlton (2009): There are 77 manufacturing industries, compared to the 459 manufacturing industries in the 1987 SIC. Regardless, their results hold, using our coarser classification.

4.2 Do I-O Links Predict Intrafirm Trade Flows?

Without data on the intrafirm flows of physical goods, the strong I-O links between parents and affiliates has been interpreted as evidence of vertical FDI. Intuitively, a strong I-O link would suggest a vertical relationship because one party produces goods that the other party typically uses as inputs for production; hence, one would expect shipments of physical goods between the parent and the affiliate. Our data on the observed intrafirm trade allow us to explore whether this is, in fact, the case: Does the presence of an I-O link materialize as vertical FDI—that is, in flows of goods from the affiliate to the parent? A preliminary glance at the data suggests that the answer is no. Table 6 reports the average affiliate's shipment to its parent as a share of the affiliate's total sales for two groups of affiliates: those with I-O links to their parents ($dr_{xz} > 0$) and those without I-O links to their parents ($dr_{xz} = 0$). The average affiliate shipments are very similar across the two groups. Both groups of affiliates seem to direct the bulk of their sales to unaffiliated parties—in particular, to local unaffiliated parties. It is worth noting, however, that the share of affiliates with shipments to the parent is 30-percent larger among the group with $d_{xz} > 0$ than the group with $d_{xz} = 0$.

As only 45 percent of affiliates report positive shipments to the parent, we first analyze the importance of these flows by estimating a linear probability model,

$$D(Flow_a^p) = \beta dr_{xz} + F_{xc} + \epsilon_{ap}; \tag{3}$$

and for those affiliates with positive trade flows to the parent, we estimate an ordinary least squares (OLS) specification,

$$\log(Flow_a^p) = \alpha \log dr_{xz} + F_{xc} + \epsilon_{ap}. \tag{4}$$

The variable $Flow_a^p$ denotes sales from affiliate a to its parent, p, as a share of the affiliate's total sales. In the linear probability model in equation 3, the dependent variable $D(Flow_a^p)$ equals one if shipments from affiliate a to the parent p are positive and zero otherwise. We measure the I-O link between an upstream affiliate and the downstream parent with the direct requirements

coefficient of the affiliate's primary industry in the production of the parent's primary industry, dr_{xz}. In equation 4, by taking $\log dr_{xz}$, we drop observations with zero direct requirements coefficients; only six percent of these observations, however, report positive intrafirm shipments to the parent. Both specifications include affiliate industry-country fixed effects, F_{xc}, to account for any regularity in the affiliate's country and industry of operation.

We report the estimates of equations 3 and 4 in columns 4 and 5 of table 5. The coefficient on the direct requirements coefficient is, in all cases, non-significant and small: The I-O link between the industries of the parent and affiliate predicts neither the existence nor the magnitude of shipments from the affiliate to the parent. Conditional on observing an affiliate, the industries of operation of the parent and affiliate are not informative about the affiliate's type of activity.

The linear probability model also provides a check that transfer pricing is not driving our results. Any measure of intrafirm trade may be contaminated by the nonmarket prices used to value within-firm transactions, a phenomenon known as *transfer pricing*. The concern here is that if transfer prices are biased downward, this could bias our estimates from equation 4 towards zero. The linear probability model avoids this issue: While transfer pricing may bias downward the value of trade reported, it is unlikely that a firm with positive intrafirm trade could report zero trade.

In section 7, we show that the results in this section are robust to different definitions of the I-O link and to the exclusion of on-diagonal parent-affiliate industry pairs. We also show that our results are not affected by selection bias.

5 Size and the Activity of Affiliates

In section 3, we showed that intrafirm trade is concentrated among a small number of large affiliates abroad, which explains why the average intrafirm shipment is larger than the median. In this section, we explore more formally the relationship among the size of the multinational corporation, the size of the affiliate, and the importance of vertical activities.

We begin with a non-parametric characterization of the connection between affiliate and corporation size and the importance of intrafirm trade. In the left panel of figure 4, we plot the kernel density of affiliate employment for affiliates that are above and below the median share of sales to affiliated parties, 0.09. As expected, the size distribution for affiliates with above-the-median intrafirm trade shares is shifted to the right of the size distribution of affiliates with below-the-median intrafirm trade shares. This is true not only for individual affiliates, but also for the multi-

national corporation as a whole: The right panel of figure 4 shows the size distribution, measured by employment, for corporations with a worldwide share of intrafirm sales above and below the median, 0.13.

We characterize the relationship between size and the types of affiliate flows parametrically by estimating the linear probability model in equation 3 and the OLS specification in equation 4, adding the size of the affiliate and the size of the parent (measured by employment), emp_a and emp_p, as well as the size of the corporation as whole, measured by the number of affiliates, $\#\text{affiliates}_p$, and global sales, $globalsales_p$, as additional controls.[19]

The estimates are shown in columns 1–4 of table 7. Larger affiliates are substantially more likely to ship goods to the parent: A ten-percent-larger affiliate, in terms of employment, is almost 0.8 percentage points more likely to ship goods to the parent (column 1). For those affiliates that report nonzero shipments to their parents, the size of the corporation, measured as the corporation's global sales, is positively and significantly associated with the share of affiliate sales to the parent (column 3). Conditional on observing sales to the parent, sales to the parent as a share of total sales does not significantly change with the size of the affiliate and decreases in the number of affiliates in the corporation and the size (employment) of the parent. Results in columns 1 and 3 also confirm our earlier finding that the direct requirements coefficient between the industry of the affiliate and industry of the parent does not predict the existence or the magnitude of intrafirm sales to the parent. Similar results are presented in columns 2 and 4, which replace parent and corporation controls for a full set of parent affiliate-country fixed effects.

We arrive at similar conclusions when analyzing affiliate sales to *all* affiliated parties, rather than restricting the analysis to shipments to the parent. These results are shown in columns 5–8 of table 7. Note that in this specification, we do not include the direct requirements coefficient as a control. Since the data on trade with affiliated parties do not specify the identity of the other affiliate, we do not have information on its industries of operation. The size of the affiliate, again, is a significant predictor of the extensive margin of intrafirm trade: A ten-percent-larger affiliate, in terms of employment, is almost 0.6 percentage points more likely to export to affiliated parties (column 5). The intensive margin of intrafirm sales does not significantly change with the size of the affiliate, but it depends strongly on the size of the corporation in terms of global sales. Again, the share of intrafirm trade decreases with the size (in terms of employment) of the parent, and

[19] Global sales are defined as the total foreign sales of the corporation (i.e., sales of the *composite foreign affiliate* defined in section 3.1).

the number of foreign affiliates in the corporation (column 7). These result do not change when parent fixed effects are included (columns 6 and 8).

The corollary to the finding that intrafirm trade is more likely to occur in large affiliates is that, within a multinational corporation, smaller affiliates, which represent the majority of our sample, are more likely to carry out horizontal activities. Correspondingly, horizontal activities are relatively more important in smaller multinational corporations, as measured by their global sales.

6 Additional Results

In this section, we report some novel results on how country and industry characteristics affect the existence and magnitude of intrafirm trade. To this end, we estimate equations 3 and 4 by replacing the affiliate country-industry fixed effects with a set of country and industry characteristics.

Our major departure from the previous empirical literature on vertical FDI is that our results focus on affiliate-level data—not country-industry aggregates—and on affiliate-to-parent shipments, both as a discrete variable (extensive margin) and a continuous variable (intensive margin), as a share of affiliate sales, not affiliate trade.

As country-level controls, we include: the host country GDP and GDP per capita from the Penn World Table 7.1, as documented in Aten, Heston and Summers (2012); the distance to the United States from CEPII, as documented in Mayer and Zignago (2011); a measure of the rule of law from Beck, Clarke, Groff, Keefer and Walsh (2001); the average years of schooling from Barro and Lee (2000); and the capital-output ratio from Klenow and Rodríguez-Clare (2005). Affiliate-industry controls include the capital and skill intensity of the parent's primary industry, from the NBER-CES manufacturing industry database presented in Becker and Gray (2009), as well as the share of routine tasks in the industry from Costinot, Oldensky and Rauch (2011).

Our results in column 2 of table 8 show, consistent with the predictions of many vertical FDI theories, that the share of shipments to the parent, as share of the affiliate's sales, decreases with the geographical distance between the host country and the United States. This is also the case for the extensive margin in column 1: The probability of observing a flow from the affiliate to the parent decreases from 40 to 34 percent when the distance between the host country and the United States is doubled.

Conditional on being positive, the share of shipments to the parent is larger for affiliates lo-

cated in smaller and poorer countries. This result indicates, in line with the theory, that the magnitude of vertical FDI flows are larger when factor price differences between host and home countries are larger and when the size of the market where the affiliate is located is smaller. However, intrafirm shipments to the parent are more likely to be observed from affiliates located in larger and richer markets. The extensive margin of vertical FDI behaves differently from the intensive margin.

The schooling level of the host country is positively associated with both the extensive and intensive margins of intrafirm shipments to the parent, while the extensive margin is also positively and significantly associated with a higher capital intensity of the affiliate's industry. Both the capital intensity of the country and the industry of production of the affiliate are positively associated with more intrafirm shipments to the parent, as predicted in Antras (2003), but both coefficients are not significant. A higher share of routine tasks is also positively and significantly associated with a stronger intensive margin: An affiliate operating in an industry with a ten-percent-higher proportion of routine tasks has shipments to the parent that are 21 percentage points higher, as a share of its sales.[20]

Finally, related to our results in section 4.2, the I-O link between the industries of the affiliate and the parent is not significantly associated with shipments from the affiliate to the parent; in the case of the extensive margin (column 1), the coefficient becomes significantly negative.

7 Robustness

We explore the robustness of the results reported in section 4.2 to the exclusion of parent-affiliate pairs that operate in the same industry, to different measures of the I-O link between the affiliate and the parent, and to selection bias. We find that our baseline result still holds: The I-O link between the industry of the parent and the affiliate is not associated with the presence or magnitude of intrafirm trade between those two parties.

7.1 Off-Diagonal Industry Pairs

The strong diagonal in the matrix of direct requirements coefficients, shown in figure 3a, introduces a source of ambiguity into the interpretation of our results. An affiliate operating in the same industry as the parent may be perceived as producing the same product as the parent, but, at the same time, the direct requirements coefficients for the diagonal elements are large. To avoid

[20]The result in Costinot et al. (2011) differs from ours, but the authors use Census related-party imports (which include trade that is not intrafirm) into the United States as a share of total U.S. imports at the country-industry level, as well as different industry controls such as R&D intensity.

this ambiguity, we report estimates of equations 3 and 4, including the interaction between the direct requirements coefficient with a dummy variable that equals one for observations in which the affiliate and the parent operate in the same (primary) industry, and equals zero otherwise. Columns 1 and 3 in table 9 report our estimates of the augmented regression. Again, we find that the I-O link between the upstream industry of the affiliate and the downstream industry of the parent is not a significant predictor of flows of goods to the parent from the affiliate.

7.2 Alternative Measures of I-O Links

Our baseline I-O link measure is the direct requirements coefficient between the primary industries of the parent and the affiliate. As an alternative, we construct a measure of the I-O link between the parent and the affiliate that takes into account all of the industries of operation of both parties. We compute a sales-weighted average of the direct requirements coefficients of all the possible combinations of parent and affiliate industries. Formally, let P be the set of all the industries in which the parent operates, and let A be the set of all the industries in which the affiliate operates.[21] Our new measure of the I-O link between the industries of the affiliate and of the parent, v_{ap}, is

$$v_{ap} \equiv \frac{\sum_{x \in A, z \in P} dr_{xz} \times sales_z^p}{total\ sales^a}, \tag{5}$$

where $sales_z^p$ corresponds to the parent's sales in industry z. In columns 2 and 4 of table 9, we report the results of estimating the baseline regressions in equations 3 and 4, using v_{ap} as our measure of the I-O link and adding the corporation and affiliate controls found in table 7. As table 2 reports, sales of parents and affiliates are very skewed towards their primary industry, so this measure of the I-O link is very similar to the direct requirements coefficient between the primary industries used in the baseline regressions. Not surprisingly, the estimates obtained when using this alternative measure are unchanged: I-O linkages are not significantly associated with the size and the existence of trade flows from the affiliate to the parent (columns 2 and 4 of table 9).

Lastly, we consider the robustness of our findings to the measure of I-O links used in Alfaro and Charlton (2009). Rather than using the direct requirements coefficient directly, Alfaro and Charlton (2009) create a discrete classification. An affiliate is

1. *horizontal* if A and P share any element, or $A = P$;

[21] We restrict the analysis to all four-digit industries in the manufacturing sector.

2. *vertical* if $dr_{xz} > 0$ for any $x \in A$ and $z \in P$, and $A \neq P$; and

3. *complex* if A shares any element with P, and $dr_{xz} > 0$ with $x \in A$, and $z \in P$ and $A \neq P$.

Columns 5 and 6 of table 9 report our estimates of equations 3 and 4 using this discrete classification. While horizontal parent-affiliate pairs have a lower probability of engaging in intrafirm trade relative to complex pairs (the excluded category), the vertical coefficient is not significant and is even negative.

7.3 Selection Bias

The effect of an I-O link on the intensive margin of intrafirm trade in equation 4 is estimated only for the selection of affiliates with positive shipments to the parent. In this section, we ask whether the average effect on the direct requirements coefficient on the intensive margin, presented in column 3 of table 7, is also representative of affiliates that report no shipments to the parent. To this end, we use the *identification-at-infinity* method proposed by Chamberlain (1986) and Heckman (1990), and applied by Mulligan and Rubinstein (2008).[22]

We follow Mulligan and Rubinstein (2008) and estimate, first, a probit equation in which the dependent variable is one if there is a positive trade flow from the affiliate to the parent, and zero otherwise. The estimated probability that an observation is positive is $\widehat{P}(Flow_a^p > 0|X)$, where X is the set of affiliate and corporation controls. Based on the probit results, we estimate the intensive margin regression in equation 4 on subsamples that include only the affiliate-parent pairs for which the estimated probability of observing positive shipments is above a threshold α: $\left\{a, p \mid \widehat{P}(Flow_a^p > 0|X) \geq \alpha\right\}$ for $\alpha = 0, 0.25, 0.50, 0.75$. Table 10 reports the results. For comparison, the table includes the sample defined by $\alpha = 0$, which corresponds to the full sample in the baseline regression, reported in column 3 of table 7. Our results hold for all the subsamples: The effect of the direct requirements coefficient on the share of vertical activities remains insignificant.

8 Concluding Remarks

Our findings can be summarized in three main points. First, intrafirm trade in goods is not the main activity of the majority of foreign affiliates of U.S. multinational manufacturing firms. This finding is analogous to that of Atalay et al. (2014) for domestic U.S. multi-plant firms. Second, without data on the types of sales of the affiliate (i.e., within and outside the corporation), the

[22] The identification-at-infinity method has an important advantage over the traditional Heckman (1979) two-step selection correction in that it does not require an exclusion restriction—i.e., a variable that affects participation without affecting the magnitude of the intrafirm trade.

characterization of foreign affiliates of multinational firms in terms of their activities and role within the corporation is an elusive task. The industry of operation of the parent and the affiliate *per se* is not informative in this respect: Horizontal and vertical activities are indistinguishable in terms of the affiliate's industry of operation. This reflects the fact that both vertical and horizontal affiliates operate in industries with strong I-O links to the parent's industry. Third, the affiliate's size is a better predictor of its role within the corporation: The largest affiliates within the corporation are more likely to ship within the firm, and, conditional on doing so, the importance of vertical activities increases with the global size of the multinational firm.

How do our findings square with the existing theory of the multinational firm? We see them as being consistent with two, unconflicting, views of the multinational firm advanced in the literature: the proximity-concentration tradeoff and the knowledge capital theory of the multinational firm.

The patterns we have documented suggest the presence of economies of scale consistent with the predictions of the *proximity-concentration tradeoff* (Grossman et al. 2006). Affiliates whose main purpose is to supply unaffiliated parties—the majority of affiliates in our sample—are relatively small and located in the destination market. When the main purpose of the affiliate is to supply other affiliated parties, the multinational corporation exploits economies of scale and minimizes the cost of its inputs: Production of inputs within the corporation is concentrated among a few large affiliates. This type of vertical activity is more important, as a share of global sales, for larger multinational corporations.

The fact that horizontal and vertical affiliates within the corporation operate in a similar set of industries is consistent with the *knowledge capital theory* of the multinational firm. Most industries require inputs from similar industries, and similar industries are the ones most likely to share common knowledge, expertise, or other intangibles. Consider, for example, the case of *Paint, Coating, and Adhesives (NAICS 3255)*, which uses *Resin, Synthetic Rubber, Artificial Synthetic Fibers and Filaments (NAICS 3252)* as its main input. Presumably, the production of the first set of products involves knowledge—about the quality of materials, demand, suppliers, and competitors—that is similar to the knowledge needed to produce the second set of products. Sharing these intangibles can be an advantage in the production of I-O linked goods, even in the absence of physical shipments between affiliates. This commonly required knowledge can be understood as the capacity to solve related problems, as in Garicano and Rossi-Hansberg (2006); the stock of technology capital—specific to goods of similar characteristics—as in McGrattan and Prescott (2010); "core

capabilities," as in Bernard et al. (2011); or the stock of knowledge capital that is a public good within the corporation, as in the seminal work of Markusen (1984). If this is the case, the firm may have comparative advantage in producing goods that are linked by I-O relationships, even in the absence of intrafirm trade in physical goods.

Our finding that there is very little cross-country fragmentation of the production chain *within* the boundaries of the firm raises a new set of questions to be explored in future research. For example, how do multinational firms use third-party suppliers? To what extent do these third-party suppliers interact with different parts of the same corporation? The challenge in answering these new questions is the need for even more detailed data on the activities of the multinational firm.

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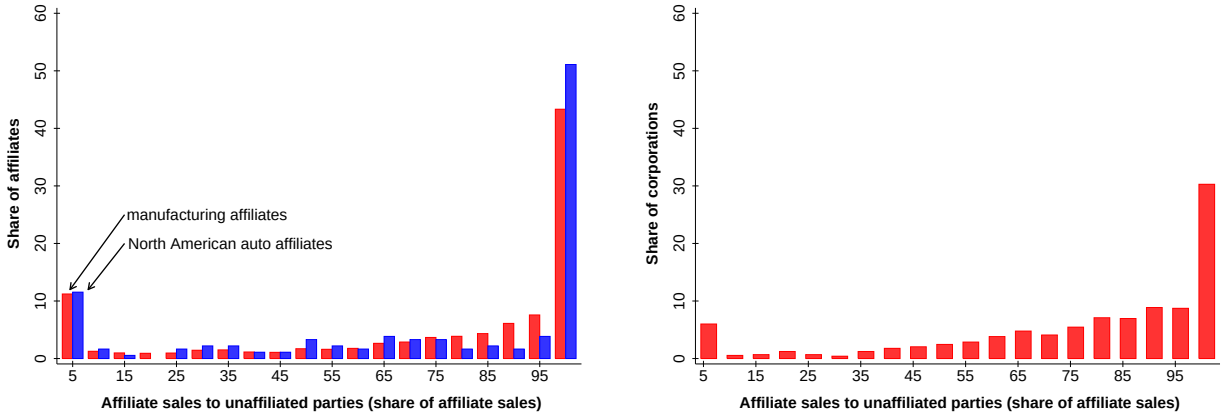
Tables and Figures

Figure 1: Distribution of affiliates by share of sales to all unaffiliated parties.

(a) Affiliates

(b) Corporations

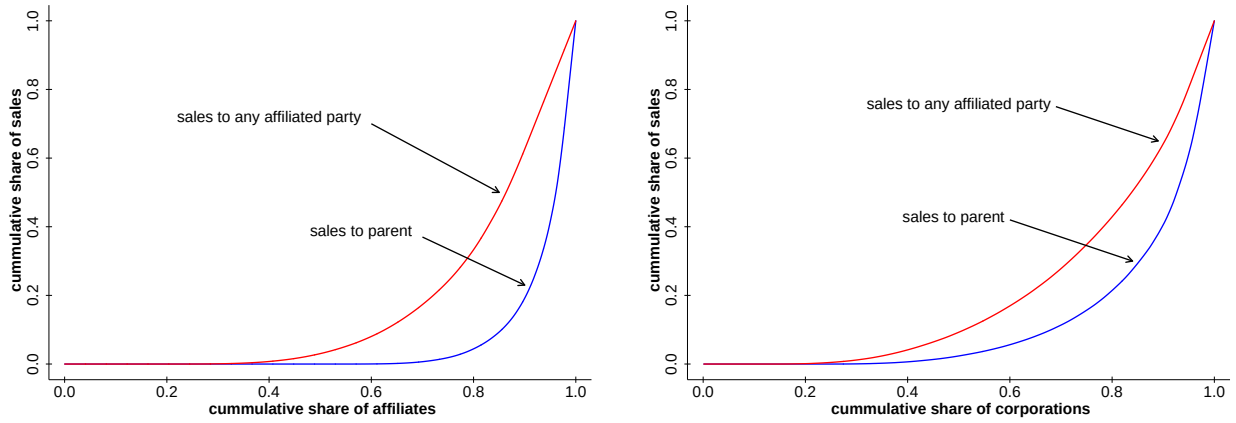


Notes: In *Affiliates*, the unit of observation is the individual foreign affiliate. In *Corporations*, the unit of observation is the sum of all foreign affiliates of a multinational parent.

Figure 2: Lorenz curve: shipments as a share of total sales.

(a) Affiliates

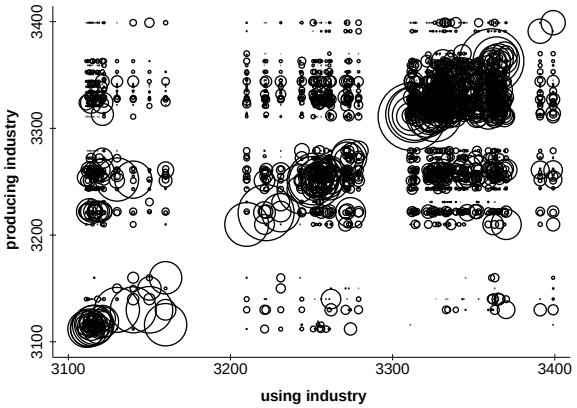
(b) Corporations



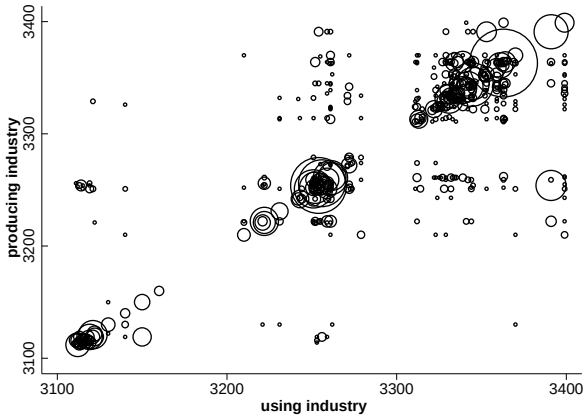
Notes: In *Affiliates*, the unit of observation is the individual foreign affiliate. In *Corporations*, the unit of observation is the sum of all foreign affiliates of a multinational parent.

Figure 3: Direct requirements coefficients and I-O links.

(a) I-O matrix industry pairs



(b) Parent-affiliate industry pairs

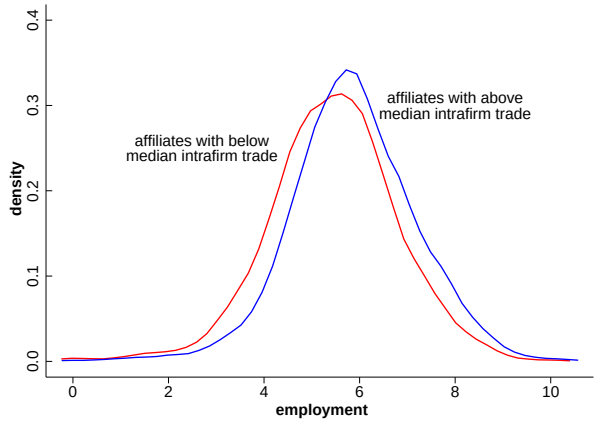


Left Panel: Direct requirements coefficients for industry pairs in 2002; bubbles are proportional to the size of the direct requirements coefficient. The direct requirements coefficient is the value of goods needed from the producing (upstream) industry in order to produce one dollar of output in the using (downstream) industry. Manufacturing industries only (international surveys industry codes 3111–3399).

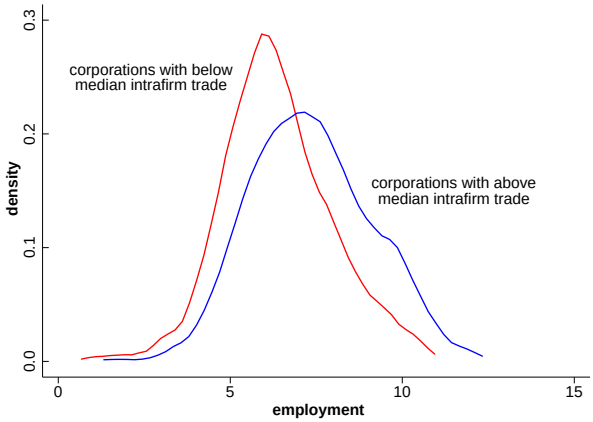
Right Panel: Frequency of the (primary) industries of parent-affiliate pairs; bubbles are proportional to the number of parent-affiliate pairs in a given industry pair.

Figure 4: Size distributions.

(a) Affiliates



(b) Corporations



Notes: In *Affiliates*, the unit of observation is the individual foreign affiliate. In *Corporations*, the unit of observation is the sum of all foreign affiliates of a multinational parent.

Table 1: Sample construction.

	Parent-affiliate in all non-bank sectors			Parent-affiliate in manufacturing		
	All (1)	Reporting (2)	$MOFA_{25}$ (3)	All (4)	Reporting (5)	Sample (6)
# Affiliates	42,547	25,464	14,351	13,163	8,174	4,911
# Parents	3,444	2,412	1655	1,458	1,049	733
Total parent employment	22,422	21,093	17,998	7,317	7,113	6,334
Total affiliate employment	10,445	10,149	7,230	4,646	4,530	3,310
Total parent sales	7,517,056	7,207,894	6,480,819	3,089,664	3,032,799	2,786,640
Affiliate sales	3,976,341	3,939,894	3,045,381	1,705,473	1,691,360	1,304,586
to parent	–	298,612	270,225	–	152,726	137,627
to unaffiliate in US	–	–	55,989	–	–	25,943
to local unaffiliate	–	–	1,718,548	–	–	657,165
to local affiliate	–	–	169,560	–	–	91,756
to affiliate in 3rd countries	–	–	462,698	–	–	253,115
to unaffiliate in 3rd countries	–	–	368,361	–	–	138,980
# Parent industries	197	192	181	76	76	74
# Affiliate industries	202	200	194	77	77	77
# Countries	200	173	159	150	124	104

Notes: Columns 1–3 include all nonbank parent-affiliate pairs, while columns 4–6 include only the parent-affiliate pairs in which the primary industry of both the parent and affiliate is in manufacturing. Columns 1 and 4 describe all affiliates of all parents. Columns 2 and 5 describe affiliates whose sales, assets, or net income (loss) is greater than $10 million. Columns 3 and 6 describe Majority-Owned Foreign Affiliates (MOFAs) whose sales, assets, or net income (loss) is greater than $25 million. Sales are expressed in millions of dollars. Employment is expressed in thousands of employees.

Table 2: Summary statistics.

	Mean (1)	Median (2)	Wt. Avg. (3)
Panel 1: Share of affiliate sales			
to any unaffiliated parties	0.73	0.91	0.67
to local unaffiliated parties	0.57	0.66	0.53
to non-local unaffiliated parties	0.17	0.00	0.14
to any affiliated parties	0.27	0.09	0.33
to non-parent affiliated parties	0.20	0.03	0.22
to parent	0.07	0.00	0.11
Panel 2: Share of affiliate sales, conditional on non-zero observation			
to any affiliated parties	0.35	0.20	0.40
to parent	0.16	0.04	0.20
to non-local unaffiliated parties	0.31	0.20	0.24
Panel 3: Share of composite foreign affiliate sales[†]			
to any unaffiliated party	0.78	0.87	0.76
to local unaffiliated party	0.53	0.54	0.57
to nonlocal unaffiliated party	0.26	0.14	0.19
to any affiliated party	0.22	0.13	0.24
to nonparent affiliated party	0.11	0.03	0.17
to parent	0.10	0.03	0.08
Panel 4: Number of			
industries per affiliate	1.43	1.00	1.58
industries per parent	2.54	2.00	3.72
countries per parent	5.42	2.00	21.14
Panel 5: Share of sales in primary industry			
affiliate	0.94	1.00	0.92
affiliate-country aggregate[‡]	0.90	1.00	0.84
parent	0.82	0.98	0.74

Notes: The sample includes 4,911 affiliates. Column 2 reports the average of the nine firms surrounding the median. In column 3, observations are weighted by affiliate employment. [†]An observation is the aggregate of all foreign affiliates of a parent. [‡]An observation is the aggregate of all the foreign affiliates of a parent in each country.

Table 3: Affiliate activities, summary by region.

	Number	Mean	Sd	p25	p50	p75
Vertical sales: share of affiliate sales to affiliated parties						
All	4911	0.27	0.34	0.00	0.09	0.42
OECD	3093	0.26	0.34	0.00	0.10	0.41
non-OECD	1818	0.27	0.36	0.00	0.08	0.43
North America	643	0.30	0.36	0.00	0.12	0.49
Latin American not Mexico	400	0.19	0.29	0.00	0.04	0.25
Europe	2668	0.28	0.34	0.00	0.12	0.44
Africa	93	0.22	0.37	0.00	0.01	0.26
Middle East	45	0.33	0.40	0.00	0.13	0.66
Asia	1062	0.25	0.35	0.00	0.05	0.39
Export platform sales: share of affiliate sales to non-local unaffiliated parties						
All	4911	0.17	0.27	0.00	0.00	0.24
OECD	3093	0.18	0.28	0.00	0.01	0.29
non-OECD	1818	0.14	0.25	0.00	0.00	0.15
North America	643	0.13	0.24	0.00	0.00	0.10
Latin American not Mexico	400	0.06	0.15	0.00	0.00	0.05
Europe	2668	0.22	0.30	0.00	0.04	0.39
Africa	93	0.10	0.23	0.00	0.00	0.09
Middle East	45	0.14	0.28	0.00	0.00	0.14
Asia	1062	0.10	0.22	0.00	0.00	0.06
Horizontal sales: share of affiliate sales to local unaffiliated parties						
All	4911	0.57	0.39	0.15	0.66	0.97
OECD	3093	0.55	0.39	0.14	0.61	0.96
non-OECD	1818	0.59	0.40	0.15	0.73	0.98
North America	643	0.58	0.39	0.16	0.70	0.96
Latin American not Mexico	400	0.75	0.33	0.61	0.90	1.00
Europe	2668	0.50	0.39	0.09	0.49	0.92
Africa	93	0.67	0.41	0.20	0.89	1.00
Middle East	45	0.53	0.45	0.01	0.69	0.99
Asia	1062	0.65	0.39	0.26	0.84	0.99

Notes: The percentiles (p25, p50, and p75) are the averages of the nine affiliates surrounding the percentile affiliate.

Table 4: Affiliate activities, summary by industry.

	Number	Mean	Sd	p25	p50	p75
Vertical sales: share of affiliate sales to affiliated parties						
All	4911	0.27	0.34	0.00	0.09	0.42
Food, beverage, tobacco	481	0.20	0.32	0.00	0.02	0.25
Textile and apparel	89	0.24	0.34	0.00	0.04	0.40
Chemicals	1203	0.24	0.34	0.00	0.06	0.34
Glass and Stone	84	0.17	0.25	0.00	0.06	0.23
Metal	104	0.23	0.33	0.00	0.05	0.31
Metal products	201	0.25	0.30	0.01	0.12	0.39
Machinery	485	0.36	0.36	0.03	0.21	0.67
Electronics	573	0.32	0.38	0.00	0.10	0.59
Electrical equip.	208	0.37	0.38	0.03	0.22	0.76
Transportation equip.	635	0.25	0.32	0.00	0.12	0.38
Other	848	0.26	0.34	0.00	0.09	0.42
Export platform sales: share of affiliate sales to non-local unaffiliated parties						
All	4911	0.17	0.27	0.00	0.00	0.24
Food, beverage, tobacco	481	0.08	0.18	0.00	0.00	0.05
Textile and apparel	89	0.18	0.28	0.00	0.00	0.30
Chemicals	1203	0.13	0.26	0.00	0.00	0.10
Glass and Stone	84	0.20	0.29	0.00	0.04	0.28
Metal	104	0.22	0.30	0.00	0.05	0.38
Metal products	201	0.20	0.28	0.00	0.07	0.29
Machinery	485	0.22	0.29	0.00	0.08	0.39
Electronics	573	0.20	0.31	0.00	0.00	0.34
Electrical equip.	208	0.19	0.27	0.00	0.02	0.31
Transportation equip.	635	0.24	0.30	0.00	0.08	0.42
Other	848	0.13	0.24	0.00	0.00	0.15
Horizontal sales: share of affiliate sales to local unaffiliated parties						
All	4911	0.57	0.39	0.15	0.66	0.97
Food, beverage, tobacco	481	0.72	0.37	0.50	0.94	1.00
Textile and apparel	89	0.58	0.39	0.21	0.58	1.00
Chemicals	1203	0.63	0.40	0.19	0.82	0.99
Glass and Stone	84	0.63	0.34	0.35	0.75	0.94
Metal	104	0.55	0.38	0.19	0.63	0.96
Metal products	201	0.55	0.37	0.19	0.60	0.90
Machinery	485	0.42	0.37	0.05	0.37	0.79
Electronics	573	0.49	0.41	0.03	0.46	0.96
Electrical equip.	208	0.44	0.37	0.04	0.38	0.79
Transportation equip.	635	0.51	0.37	0.14	0.51	0.87
Other	848	0.60	0.38	0.22	0.71	0.97

Notes: The percentiles (p25, p50, and p75) are the averages of the nine affiliates surrounding the percentile affiliate.

Table 5: I-O links, FDI activity, and intrafirm trade.

	$D(FDI_{xzc})$ (1)	$\log(\#\text{affiliates}_{xzc})$ (2)	$\log(\text{emp}_{xzc})$ (3)	$D(Flow_a^p)$ (4)	$\log(Flow_a^p)$ (5)
dr_{zx}	0.340^{***}	2.202^{***}	1.569	0.017	
	(0.015)	(0.819)	(1.396)	(0.217)	
dr_{xz}	0.296^{***}	4.150^{***}	7.398^{***}		
	(0.015)	(1.102)	(1.824)		
$\log(dr_{xz})$					0.010
					(0.054)
Affiliate industry-country FE	Yes	Yes	Yes	Yes	Yes
Obs.	$616,616$	$2,523$	$2,465$	$4,911$	$2,077$
R^2	0.055	0.563	0.663	0.415	0.552

Notes: Column 1 reports results from estimating equation 1; the dependent variable takes the value one if there is at least one affiliate in country c and affiliate industry x owned by a parent in industry z. Columns 2 and 3 report results from estimating equation 2; dependent variables are the number of affiliates or the aggregate employment of affiliates in affiliate industry x in country c owned by parents in industry z. Columns 4 and 5 report results from estimating the linear probability model in equation 3 and the log linear specification in equation 4, respectively, where $Flow_a^p$ is the share of affiliate $a's$ total sales shipped to the parent p. dr_{xz} is the direct requirements coefficient from affiliate industry x into the production of parent industry z. Robust standard errors, clustered by the country-main industry of the affiliate, are in parentheses. Levels of significance are denoted $^{***}p < 0.01$, $^{**}p < 0.05$, and $^{*}p < 0.1$.

Table 6: I-O links and intrafirm trade, summary.

	$dr_{xz>0}$			$dr_{xz}=0$		All
	All	$x=z$	$x\neq z$	All	$x\neq z$	
Number of affiliates						
total	4496	3103	1393	415	415	4911
with shipments to parent>0	2077	1425	652	139	139	2216
with shipments to affiliates>0	4149	2854	1295	370	370	4519
with shipments to local unaffiliated parties>0	3899	2689	1210	352	352	4251
Mean affiliate shipment as share of total sales						
to parent	0.07	0.08	0.05	0.06	0.06	0.07
to any unaffiliated party	0.73	0.73	0.74	0.74	0.74	0.73
to local unaffiliated parties	0.56	0.57	0.56	0.59	0.59	0.57

Notes: dr_{xz} refers to the I-O link between the primary industry of the affiliate, x, and the primary industry of the parent, z, with x being upstream.

Table 7: Intrafirm trade and size.

	$D(Flow_a^p)$		$\log(Flow_a^p)$		$D(Flow_a^V)$		$\log(Flow_a^V)$	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
dr_{xz}	-0.300	-0.021						
	(0.236)	(0.414)						
$\log(dr_{xz})$			-0.016	0.092				
			(0.055)	(0.158)				
$\log(\text{emp}_a)$	0.077^{***}	0.080^{***}	0.137	0.197	0.058^{***}	0.063^{**}	0.052	0.066
	(0.008)	(0.019)	(0.092)	(0.258)	(0.007)	(0.026)	(0.048)	(0.168)
$\log(\text{emp}_p)$	-0.030		-0.255^{*}		-0.031		-0.256^{**}	
	(0.022)		(0.145)		(0.022)		(0.081)	
$\log(\#\text{affiliates}_p)$	-0.007		-0.289^{**}		0.031^{**}		-0.162^{**}	
	(0.016)		(0.113)		(0.014)		(0.075)	
$\log(\text{globalsales}_p)$	0.005		0.327^{*}		0.011		0.443^{***}	
	(0.021)		(0.156)		(0.021)		(0.085)	
Affiliate industry-country FE	Yes	No	Yes	No	Yes	Yes	yes	Yes
Affiliate-country parent FE	No	Yes	No	Yes	No	No	No	No
Parent FE	No	No	No	No	No	Yes	No	Yes
Observations	$4,748$	$4,748$	$2,046$	$2,046$	$4,748$	$4,748$	$3,682$	$3,682$
R^2	0.448	0.899	0.561	0.857	0.421	0.915	0.464	0.903

Notes: The variable $Flow_a^p$ is the share of affiliate $a's$ total sales shipped to the parent; and $Flow_a^V$ is the share of affiliate $a's$ total sales shipped to all affiliated parties. The operator $D(X)$ is equal to 1 if $X > 0$ and 0 otherwise. dr_{xz} is the direct requirements coefficient of the primary industry of the affiliate (x) in the production of the parent's primary industry (z). emp_a and emp_p are the employment in the affiliate and parent. $\#\text{affiliates}_p$ is the number of foreign affiliates of the parent, p, and globalsales_p is the global sales of the corporation with parent, p. Robust standard errors, clustered by the country-main industry of the affiliate, are in parentheses. Levels of significance are denoted $^{***}p < 0.01$, $^{**}p < 0.05$, and $^{*}p < 0.1$.

Table 8: Additional results: Country and industry controls.

	$D(Flow_a^p)$	$\log(Flow_a^p)$
	(1)	(2)
dr_{xz}	-0.329^{***}	
	(0.118)	
$\log dr_{xz}$		0.014
		(0.030)
$\log(\text{emp}_a)$	0.081^{***}	0.146^{**}
	(0.007)	(0.068)
$\log(\text{emp}_p)$	-0.016	-0.077
	(0.014)	(0.094)
$\log(\#\text{affiliates}_\text{p})$	-0.024^{*}	-0.433^{***}
	(0.012)	(0.117)
$\log(sales_g)$	-0.014	0.170^{**}
	(0.014)	(0.070)
$\log(gdp_c)$	0.023^{*}	-0.223^{***}
	(0.013)	(0.075)
$\log(gdpl_c)$	0.061^{*}	-0.487^{*}
	(0.035)	(0.278)
$\log(dist_c)$	-0.060^{***}	-0.583^{***}
	(0.014)	(0.082)
$\log(law_c)$	-0.063	-0.790
	(0.069)	(0.665)
$\log(k_c/y_c)$	-0.016	0.170
	(0.080)	(0.461)
$\log(school_c)$	0.268^{**}	3.001^{*}
	(0.134)	(1.704)
$\log(k\_intens_x)$	0.100^{*}	0.166
	(0.050)	(0.556)
$\log(h\_intens_x)$	-0.185	-3.156
	(0.155)	(2.569)
$\log(routine_x)$	-0.040	2.167^{***}
	(0.076)	(0.627)
Obs.	4,497	1,970
R^2	0.095	0.114

Notes: The dependent variable $Flow_a^p$ is the share of affiliate $a's$ total sales shipped to the parent. The operator $D(X)$ is equal to 1 if $X > 0$ and 0 otherwise. Robust standard errors, clustered by the country-main industry of the affiliate, are in parentheses. Levels of significance are denoted $^{***}p < 0.01$, $^{**}p < 0.05$, and $^{*}p < 0.1$

Table 9: Robustness: Alternative Measures of I-O Links.

	$D(Flow_a^p)$		$\log(Flow_a^p)$		$D(Flow_a^p)$	$\log(Flow_a^p)$
	(1)	(2)	(3)	(4)	(5)	(6)
v_{ap}		0.195				
		(0.364)				
$\log v_{ap}$				−0.103		
				(0.122		
dr_{xz}	−0.454		−0.078			
	(0.310)		(0.089)			
$\log dr_{xz}$						
$\log(\text{emp}_a)$	0.077***	0.080***	0.130	0.097	0.080***	0.110
	(0.008)	(0.012)	(0.091)	(0.142)	(0.008)	(0.087)
$\log(\text{emp}_p)$	−0.027	−0.002	−0.257*	−0.198	−0.030	−0.282**
	(0.022)	(0.028)	(0.145)	(0.203)	(0.023)	(0.137)
$\log(\#\text{affiliates}_\text{p})$	−0.007	−0.002	−0.294***	−0.432***	−0.004	−0.230**
	(0.017)	(0.022)	(0.113)	(0.144)	(0.016)	(0.106)
$\log(\text{globalsales}_p)$	0.005	−0.031	0.343**	0.341	0.000	0.307**
	(0.022)	(0.029)	(0.156)	(0.221)	(0.022)	(0.150)
$D(diag)$	0.041		0.874			
	(0.042)		(0.791)			
$D(diag) \times dr_{xz}$	−0.098					
	(0.433)					
$D(diag) \times \log(dr_{xz})$			0.208			
			(0.259)			
horiz_{ap}					−0.090*	0.345
					(0.053)	(0.451)
vert_{ap}					−0.003	0.139
					(0.027)	(0.185)
Affiliate industry-country FE	Yes	Yes	Yes	Yes	Yes	yes
Obs.	4,748	2,899	2,046	1,264	4,700	2,157
R^2	0.448	0.478	0.562	0.607	0.449	0.555

Notes: The dependent variable $Flow_a^p$ is the share of affiliate $a's$ total sales shipped to the parent. The operator $D(X)$ is equal to 1 if $X > 0$ and 0 otherwise. v_{ap} is the direct requirements coefficients, weighted by industry sales, defined in equation 5. Robust standard errors, clustered by the country-main industry of the affiliate, are in parentheses. Levels of significance are denoted $^{***}p < 0.01$, $^{**}p < 0.05$, and $^{*}p < 0.1$.

Table 10: Robustness: Selection bias.

	$Flow_a^p$	$\log(Flow_a^p)$			
	Probit	$\alpha \geq 0$	$\alpha \geq 0.25$	$\alpha \geq 0.5$	$\alpha \geq 0.75$
	(1)	(2)	(3)	(4)	(5)
dr_{xz}	-0.806				
	(0.495)				
$\log dr_{xz}$		-0.016	-0.036	0.025	0.197
		(0.055)	(0.056)	(0.067)	(0.133)
$\log(\text{emp}_a)$	0.247^{***}	0.137	0.177^{*}	0.232^{*}	0.205
	(0.019)	(0.092)	(0.095)	(0.120)	(0.196)
$\log(\text{emp}_p)$	-0.108^{**}	-0.255^{*}	-0.244^{*}	-0.268^{*}	-0.152
	(0.045)	(0.145)	(0.140)	(0.146)	(0.273)
$\log(\#\text{affiliates}_\text{p})$	-0.053	-0.289^{**}	-0.290^{***}	-0.357^{***}	-0.190
	(0.035)	(0.133)	(0.105)	(0.116)	(0.217)
$\log(\text{globalsales}_p)$	0.051	0.327^{**}	0.306^{**}	0.386^{**}	0.227
	(0.046)	(0.156)	(0.151)	(0.166)	(0.360)
Affiliate industry-country FE	Yes	Yes	Yes	Yes	Yes
Obs.	$4,659$	$2,046$	$1,928$	$1,388$	428
R^2	0.169	0.561	0.560	0.541	0.600

Notes: The dependent variable $Flow_a^p$ is the share of affiliate $a's$ total sales shipped to the parent. The operator $D(X)$ is equal to 1 if $X > 0$ and 0 otherwise. dr_{xz} is the direct requirements coefficient of the primary industry of the affiliate (x) in the production of the parent's primary industry (z). emp_a and emp_p are the employment in the affiliate and parent. $\#\text{affiliates}_p$ is the number of foreign affiliates of the parent, p, and globalsales_p is the global sales of the corporation with parent, p. Robust standard errors, clustered by the country-main industry of the affiliate, are in parentheses. Levels of significance are denoted $^{***}p < 0.01$, $^{**}p < 0.05$, and $^{*}p < 0.1$.

A Data Appendix

A multinational firm's data typically span forms BE-10A, BE-10B(LF), and BE-10B(SF).[23] Form BE-10A records data on the consolidated parent, and form BE-10B (either the long or the short form) is filed for each reporting affiliate. The long form is filed for nonbank, majority-owned affiliates with sales, assets, or net income (loss) of more than $150 million, while the short form is filed for majority-owned affiliates with sales, assets, or net income (loss) between $25 million and $150 million. Minority-owned affiliates also file form BE-10(SF), but they complete only a subset of the survey. This subset of questions does not include the breakdown of the affiliates sales.

Intrafirm trade data are collected in several parts of the BEA surveys. We use the variable "affiliate's sales" broken down by transactor and destination, which are found in the response to, e.g., question 54 of survey form BE-10B(LF). The affiliate sales data contain sales of both goods and services. A subset of our affiliates (larger affiliates who complete the long-form survey) report sales of goods and services separately. In this subsample, sales are almost exclusively in goods.

Parents report sales in their ten largest industries of operation, and affiliates report sales in their seven largest industries. From these data, the BEA assigns each affiliate and parent a primary industry. This procedure is described in Bureau of Economic Analysis (2008, p. M–12). Briefly, the procedure begins with an affiliate's sales at the two-digit industry level. Within the two-digit industry with the greatest sales, the three-digit industry with the greatest sales is chosen. Finally, within the three-digit industry with the greatest sales, the four-digit industry with the greatest sales is chosen as the primary industry of the affiliate. This procedure ensures that a firm does not jump across major classifications when its data are considered in a more aggregate classification.

[23] The survey forms can be found at http://www.bea.gov/surveys/diasurv.htm.