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

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ABSTRACT

We use firm-level data from the Bureau of Economic Analysis to document a new set of facts regarding the behavior of U.S. multinational firms. First, we find that intra-firm trade is concentrated among a small number of large affiliates: The median affiliate reports no shipments to the parent, and directs the bulk of its sales to unrelated parties in its country of operation. In this sense, "horizontal" rather than "vertical" FDI seems to better capture the role of most U.S. affiliates abroad. Second, we find that multinational firms often own affiliates that operate in upstream or downstream industries, as defined by their industries' input-output coefficients. These input-output links, however, are not associated with intra-firm flows of physical goods. We conjecture that the comparative advantage of multinational companies lies in their ability to transfer intangible—rather than physical—inputs among production units.

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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? The answers to these questions lie at the center of an ongoing debate over the role of multinational firms in the global economy. Harrison and McMillan (2011) shows that the impact of multinational firms on domestic employment—the "shipment of jobs overseas"—depends crucially on the extent to which the multinational firm is shipping goods to be processed, and whether they are shipped to low-income or high-income countries. The sensitivity of trade and foreign direct investment to taxation and trade policy—such as the tax amnesty program for multinationals proposed as part of the stimulus package in 2011—varies greatly depending on the affiliate's purpose. In fact, almost any prediction regarding a multinational firm must be conditioned on the affiliate's *raison d'être*.

We revisit the evidence on the motives for foreign direct investment (FDI) by studying firm-level data collected by the U.S. Bureau of Economic Analysis (BEA). The detail regarding the data on intra-firm versus arm's-length transactions allows us to document several facts that are not visible in the aggregate data. Our main finding is that there is very little intra-firm trade. This suggests that most foreign affiliates are not created as parts of multistage production chains, but as outposts to produce and to sell to unrelated parties in local markets.

Our dataset covers the universe of U.S. multinational firms and their foreign affiliates, and includes measures of employment, sales, inputs, and their industries of operations. A key—and unique—feature of these data is that we observe an affiliate's sales broken down by destination (to the United States, to the host country, or to a third country) and by transaction type (to the parent, to another affiliate, or to an unaffiliated party). We also observe which inputs the affiliate sources from the parent and from unaffiliated parties.

The intra-firm flow of goods between U.S. parents and their affiliates is an important component of U.S. international trade, accounting for 20 percent of U.S. goods exports and 15 percent of U.S. goods imports.[1] We document that, behind these aggregate figures, there is substantial heterogeneity across affiliates. First, intra-firm trade is concentrated among a small number of large

[1] Readers familiar with Bernard, Jensen and Schott (2009) might find these numbers too small. The related-party trade reported in Bernard et al. (2009) includes trade between U.S. parents and their affiliates, as we do, but also includes trade between foreign parents and their U.S. affiliates, which we do not.

affiliates.[2] Second, for most U.S. multinational firms, intra-firm trade represents a small fraction of the affiliate's operations, both relative to their input costs and to their total sales. In 2004, the median manufacturing affiliate received none of its inputs from the parent firm, and sold 91 percent of its production to unrelated parties, mostly in the host country. Finally, almost 55 percent of affiliates report absolutely no shipments to their parent.

The extensive literature aimed at understanding the patterns of FDI has identified two primary motives for locating production abroad. On the one hand, a firm may want to locate production in the destination market to save on transportation costs; this mode is known as *horizontal* FDI. In this case, arm's-length exports and FDI are two alternative ways of supplying a foreign market.[3] On the other hand, the literature has pointed to differences in comparative advantage across countries as a motive for the foreign location of some stages of production; this mode is known as *vertical* FDI. In this case, intra-firm trade and FDI are complements.[4]

While the motives for creating foreign affiliates are more complex than the stylized horizontal and vertical modes described in the literature, the data suggest that, for most affiliates, the primary motive is best described as horizontal—affiliates sell mostly to local, unaffiliated parties.[5] Nevertheless, we find that foreign affiliates do not embody several characteristics that models of horizontal FDI consider to be important. In models of horizontal FDI, firms create foreign affiliates to replicate the production of the parent firm's good in the destination market: These horizontal affiliates are created to save the parent the costs of shipping goods. Two key predictions of these models are that: (1) foreign affiliates produce the same goods as the parent firm, and (2) foreign affiliates are more likely to exist in distant destinations because the cost of shipping goods is increasing in distance.[6]

In the data, however, we find that 37 percent of affiliates operate in industries different from the primary industry of the parent. We also find that, controlling for other destination country characteristics (e.g. size, income per capita, institutional quality), distance from the United States

[2]The skewness of intra-firm trade towards large corporations mimics the distribution of exports across U.S. firms found in Bernard and Jensen (1995).

[3]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 (2010).

[4]See Helpman (1984), Yeaple (2003b), and Keller and Yeaple (2009). Frameworks that combine the two motives for FDI are featured in Carr, Markusen and Maskus (2001), Yeaple (2003a), Grossman, Helpman and Szeidl (2006), Ekholm, Forslid and Markusen (2007), Ramondo and Rodríguez-Clare (2009), and Irrazabal, Moxnes and Opromolla (2010).

[5]The findings in Hanson, Mataloni and Slaughter (2005) and Feinberg and Keane (2006), who both use BEA firm-level data, also suggest that multinational firms have more complex integration strategies than simple horizontal and vertical strategies.

[6]New models are being developed that predict affiliates should be close to the parent. See, for example, Ramondo and Rodríguez-Clare (2009) and Irrazabal et al. (2010).

decreases both the likelihood of a parent owning an affiliate and the size (in terms of sales and employment) of existing affiliates.[7]

Not only do affiliates often operate in industries different than their parent, but, as characterized by the input-output matrix, the primary industries of operation of the parent and the affiliate are typically linked, in the sense that the output of one industry is an input into the other. When a parent produces an input into the affiliate's industry (or an affiliate produces an input into the parent's industry) we say that the parent and affiliate share an *input-output link*, or an *I-O link*. We find, as first documented by Alfaro and Charlton (2009), that the likelihood of a parent owning a foreign affiliate is higher for parent-affiliate pairs with stronger I-O links.[8]

Intuitively, a strong I-O link suggests a vertical FDI motive, and we would expect to see shipments of goods between the parent and affiliate. Surprisingly, the presence of an I-O link between the parent and the affiliate does not predict the existence and volume of intra-firm flows. In our empirical work, the coefficient that captures the effect of the I-O link between the parent and the affiliate on the trade flow between those two parties is virtually zero. This finding coincides with Hortacsu and Syverson (2009), which studies the domestic operations of U.S. multi-plant firms. They find that shipments between establishments owned by the same firm within the United States are surprisingly low. Moreover, they report that the sales of I-O linked establishments are, for the most part, to non-related parties located near the domestic affiliate.

In other respects, our empirical work confirms previous findings in the literature. First, intra-firm shipments into the United States are positively related to the income per capita of the host country, but negatively related to host country size and distance to the United States.[9] Second, we find that the income level of the host country and the distance to the United States are significantly and negatively related to the existence and the volume of exports from the U.S. parent to their affiliates.[10]

Given our findings, an important question arises: If moving goods along a vertical production chain is not the motive for foreign direct investment, then why do firms own affiliates linked

[7] Brainard (1997) and Carr et al. (2001) also find that distance has a negative effect on aggregate bilateral FDI flows from the United States.

[8] The findings in Alfaro and Charlton (2009) are based on information on ownership and industry of operation of parents and affiliates. Not having information on the intra-firm flows of physical goods, they interpret this input-output "closeness" between parent and affiliates as evidence of vertical FDI.

[9] See Yeaple (2006), Nunn (2007), Nunn and Trefler (2008), Bernard et al. (2009), and Costinot, Oldensky and Rauch (2011), among others. Most of the tests in these papers has been motivated by the work of Antras (2003) and Antras and Helpman (2004).

[10] See Borga and Zeile (2004), Hanson et al. (2005), and Yeaple (2006).

by input-output relationships? As suggested in Hortacsu and Syverson (2009) for U.S. domestic firms, we conjecture that the boundaries of the multinational firm are related to the transfer of capabilities within the corporation. Strong input-output requirements between two goods may signal the usage of a common set of intangible inputs. In the previous literature, these intangibles have been formalized as knowledge capital (Markusen (1984)), technology capital (McGrattan and Prescott (2010)), and managerial ability (Garicano and Rossi-Hansberg (2006) and Bloom and Van Reenen (2007)).

Consider, for example, the case of *Converted Paper Products (NAICS 3222)*—stationary and envelopes—which uses *Paper (NAICS 3221)* as its primary input. The production of these goods likely involves knowledge about the quality of materials, demand, suppliers, and competition that can be transmitted among the different units within the firm. Sharing these intangibles can be an advantage in the production of I-O linked goods, even in the absence of physical shipments between affiliates. Similarly, distance to the destination country may signal not only export costs, but also the degree of transmissibility of these intangible assets. This may be the case of *brands*, for example, which are recognized in markets that are closer to the parent firm. This interpretation has been adopted by Ramondo and Rodríguez-Clare (2009) and Irrazabal et al. (2010), which calibrate the transportability of intangible assets and productivity within the corporation as a function of the distance between the location of the parent firm and that of the foreign affiliate.

The remainder of the paper is organized as follows. Section 2 describes the data. Section 3 reports the importance of intra-firm flows for U.S. foreign affiliates. Section 4 presents estimates of the relationship between input-output linkages, ownership, and the intra-firm trade of foreign affiliates. Section 5 discusses the results. Section 6 performs some robustness analysis. Section 7 concludes.

2 The Data

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. These data cover the universe of U.S. parents and their foreign affiliates in the most recent benchmark year available, 2004. Parent and affiliate data are reported at different levels of aggregation. Parent data aggregate all U.S.-located company operations that are part of the fully consolidated firm. The data are more disaggregate at the affiliate level. Some affiliates of the same parent may report in a consolidated

manner if they are located in the same country and are in the same four-digit industry. Affiliates may never consolidate across countries.

Detailed data on affiliate operations must be reported if affiliate sales, assets, or net income (loss) are greater than $10 million. Of the 42,547 nonbank affiliates, 25,464 are large enough to report.[11] The reporting cutoff level is low: Reporting affiliates account for 99 percent of total nonbank affiliate assets and sales. Within the set of reporting affiliates, we are interested in two subsets of affiliates. The first subset is all of the nonbank affiliates of nonbank parents that are majority-owned (greater than 50 percent ownership by the parent) and who have sales, assets, or net income (loss) of more than $25 million. The second subset is all of the nonbank affiliates of nonbank parents that are majority-owned and who have sales, assets, or net income (loss) of more than $150 million. These cutoff levels are important since some of the variables used in our analysis are asked only of these two subsets of affiliates. In appendix table B1, we summarize the reporting cutoff levels for some of our variables of interest.

Our analysis focuses on manufacturing parents and affiliates.[12] Within manufacturing, reporting affiliates account for 98 percent of foreign affiliate sales. Majority-owned foreign affiliates (MOFA) with sales, assets, or net income (loss) of more than $25 million account for almost 80 percent of reported affiliate sales and 90 percent of reported affiliate sales to the parent. In what follows, we refer to this sample of affiliates as MOFA_{25}. In some of our calculations, we further restrict the sample to majority-owned affiliates with more than $150 millions in sales, assets, or net income (loss). This sample, which we refer to as MOFA_{150}, accounts for 65 percent of all manufacturing affiliate sales, and 81 percent of reported affiliate sales to the parent. Note that, MOFA_{150} is a strict subset of MOFA_{25}. Further details of the sample construction are reported in table 1.

For each affiliate and parent in our data, we observe sales disaggregated in various ways. In one breakout, 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). The BEA assigns to each parent and affiliate a primary industry based on these data.[13] When we need a broad categorization of a firm—to claim, for example, that a firm is in the manufacturing sector—

[11] For affiliates below the size threshold for reporting on an affiliate survey form, the parent reports affiliate sales, employment, and trade to and from the parent. Additionally, we do not consider 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.

[12] The main reason to focusing on manufacturing is that intra-firm trade occurs primarily in goods, not services.

[13] This procedure is described in Bureau of Economic Analysis (2008), page M–12.

we use this industry code. In our sample, affiliates span a total of 202 four-digit industries, and 77 industries when the sample is restricted to manufacturing (see table 1).

Affiliates are typically more focused on a core industry than the parent. On average, 84 percent of the parent's sales are in its primary industry of operation, compared to 96 percent for affiliates. In manufacturing, 85 percent of a parent's sales are in the primary industry, compared to 94 percent for affiliates (see panel 2 in table 2). This is not quite the correct comparison, however, because the data reported by the parents are an aggregate of all company operations of the fully consolidated firm located in the United States. This may make parents seem artificially more diversified than affiliates. For comparison, we also aggregate the operations of all the affiliates owned by the parent, by country. Using this comparable measure, affiliates are still more focused on a single industry than their parents: 91 percent of affiliate sales is concentrated in the primary industry of an affiliate. The data are very skewed: The median affiliate operates in a single industry, while larger affiliates (as measured by employment) operate in a larger set of industries (see panel 1 in table 2).[14]

Our main results are made possible by data broken down by the destination of an affiliate's sales. 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) related parties in neither the U.S. nor the host country (what we call *third countries*); and (vi) unaffiliated parties in third countries.[15] These variables are observed only for the affiliates in the MOFA_{25} sample and are summarized in panel 3 of table 2. For the very large majority-owned affiliates in the MOFA_{150} sample, we also observe the composition of goods shipments from the parent to the affiliate as being "for further processing," "capital goods," or "for resale."

Being able to observe the trade flows between parents and affiliates is a unique feature of these data that will allow us to say much more about how parents use (or do not use) affiliates to move goods across countries.

[14] This is important since our baseline results below are based on a measure of what we call an input-output link that takes into account the primary industries of the parent and the affiliate only.

[15] The data on shipments between the parent and the affiliates are not reported by industry. We do, however, know what fraction of the trade is in goods and in services. Additionally, within the "third countries" category, the data differentiate between a few regions (Europe, Latin America, Africa, Middle East, Asia, Pacific, and Canada). Our analysis does not exploit this disaggregation.

3 Patterns of Intra-firm Flows

Traditional models of vertical FDI assume that a parent creates an affiliate in order to carry out some stages of the production process, and that the home country remains the main destination market of the firm: Production involves intra-firm flows of goods between the parent and the affiliate, or among foreign affiliates who specialize in different stages of production. In contrast, models of horizontal FDI are based on the assumption that a parent creates an affiliate to produce in, and to sell to, the host country. If a parent-affiliate relationship is horizontal, we would expect to see little trade between related parties, and most sales of the affiliate directed to the market of operation. There are, of course, more complex motives for foreign investment that mix all these activities, but the relevance of intra-firm trade will provide information about the primary motive for establishing an affiliate.

Intra-firm trade accounts for a large share of U.S. exports and imports. In 2004, shipments from U.S. parents to their foreign affiliates accounted for 20 percent of U.S. exports of goods, and shipments from affiliates to their parents accounted for 15 percent of U.S. imports of goods. Restricting the sample to manufacturing firms, total affiliate shipments to the parent totaled $188,720 million, representing ten percent of total manufacturing affiliate sales, and 16 percent of U.S. manufacturing imports. Exports from U.S. parents to manufacturing affiliates abroad were $145,525 million. These intra-firm shipments in manufacturing accounted for 20 percent of U.S. manufacturing exports. Notice that these numbers imply a ratio of total affiliate sales to total U.S. manufacturing exports of 2.5 and a ratio of 1.5 for total affiliate sales to total U.S. manufacturing imports.

Behind these aggregate numbers, is substantial heterogeneity at the firm level. Intra-firm trade is concentrated among a small number of large affiliates abroad. As described in panel 3 of table 2, the median affiliate reports no shipments of goods to or from the parent, and ships 99 percent of its product to unrelated parties, mostly in the local market. In manufacturing, these figures are very similar: The median manufacturing affiliate does not report any shipments of goods to or from the parent, and ships 91 percent of its product to unrelated parties. The average intra-firm flow is larger when weighted by the size (as measured by employment) of the affiliate: While the mean shipment from the affiliate in manufacturing to all related parties represents 27 percent of total affiliate sales (column 4), the weighted-mean shipment increases to 33 percent (column 6), evidence that the affiliates engaging in intra-firm trade are larger. These statistics are further broken down by geographical region and broad industry in tables B2 and B3 in the appendix.

To visualize the skewness of intra-firm shipments, we plot Lorenz curves (the cumulative share of intra-firm trade by the cumulative share of affiliates) in figure 1. In each panel we plot the Lorenz curve for shipments from affiliates to parents, for parents to affiliates, and for shipments from the affiliate to any affiliated party. The pattern is clear: We only see parents and affiliates engaging in intra-firm trade at the very top of the distribution.

For a striking majority of affiliates, shipping goods *within* the firm does not seem to be the primary activity. We explore this feature of the data further in figure 2. This histogram plots the distribution of affiliates by the share of total affiliate sales to unaffiliated parties. We report this histogram for the entire sample, for parent-affiliate pairs in manufacturing, and for parent-affiliate pairs in the North American motor vehicles sector (affiliates in ISI 3361–3363 located in either Canada or Mexico). In the entire sample, more than 70 percent of affiliates sell more than 80 percent of their output to unaffiliated parties. The entire sample, however, includes service industries in which we should expect to see little trade regardless of the mode of FDI. When we restrict the sample to the manufacturing sector, about 65 percent of affiliates sell more than 80 percent of their output to unaffiliated parties. As we report in table 3, about 25 percent of the affiliates in our sample do not report any intra-firm trade, neither with the parent nor with any other related party.

The third group of parent-affiliate pairs in figure 2 is restricted to affiliates in the motor vehicle industries in Canada and Mexico. Even in this sub-sample, more than 40 percent of affiliates sell at least 80 percent of their output outside the boundaries of the firm, but almost 20 percent of affiliates ship more than 90 percent of their output to the parent or other affiliates, as a model of vertical FDI would predict. This industry, however, is an exception: No other industry has, on average, more than 40 percent of affiliate output sold within the firm. We report statistics for 11 broad industries in table B3.

The lack of intra-firm trade between the parent and its affiliates is particularly stark. Panel (b) in figure 3 contains a histogram of the share of affiliate sales shipped to the parent, and panel (a) contains a histogram of the share of affiliate total input costs received from the parent. Almost 90 percent of affiliates ship less than five percent of their output to their parent, and almost 90 percent of affiliates source less than five percent of their inputs from their parent. In fact, almost half of the affiliates report zero trade from their parent, as reported in columns 1 and 4 in table 3. Affiliates in the motor vehicle industry located in Canada and Mexico are more likely to source inputs from their parent, but these inputs still represent a relatively small fraction of the value of

inputs purchased by the affiliate.

The patterns evident in the data appear to be quite stable over time. The previous benchmark survey was conducted in 1999. We reproduce table 2 using the 1999 data in appendix table B4.

4 Input-Output Links, Ownership, and Intra-firm Flows

In the previous section we documented that very few affiliates send goods to, or receive goods from, their parents. For most U.S. foreign affiliates, intra-firm trade accounts for a small share of their production, suggesting that most FDI is not undertaken to promote vertical specialization, but rather, to serve the market of operation. In this section, we analyze the ownership structure of multinational firms in terms of their vertical integration. 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 linkage* or an *I-O link*. This finding, along with the dearth of intra-firm trade, suggests that, while multinational firms own affiliates in upstream and downstream industries, they do not do so with the purpose of facilitating the transfer of goods along the production chain.

4.1 Do I-O Links Predict Ownership?

We begin by determining which of our parent-affiliate pairs are I-O linked. We follow Alfaro and Charlton (2009) and Hortacsu and Syverson (2009), and base our classification on the industries in which each firm operates. We observe a parent in industry i and its affiliate in industry j. To what extent are industries i and j—and, by extension, parent and affiliate—dependent on each other for inputs into production?

To characterize the input-output relationships between industries, we use the direct requirements table for the United States in 2002. In the direct requirements table, an observation is a commodity-industry pair and the direct requirements coefficient, denoted by d_{ij}, specifies the value of inputs from industry i needed to produce one dollar of output in the industry j. The commodities and industries are defined using the Input-Output industry classification, which we map into the BEA NAICS-based ISI classification. There are 77 manufacturing industries in the classification. Of the 5,929 possible commodity-industry pairs, 51 percent of them are non-zero.

The direct requirements matrix is an important input into our measures of I-O linkages. In

figure 4a, 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 the largest on or near the diagonal.

We measure the strength of the input-output relationship between the parent and the affiliate through the input-output matrix. We consider an affiliate to be upstream vis-à-vis the parent, if the direct requirements coefficient between the producing (primary) industry of the affiliate and the using (primary) industry of the parent is positive, $dr_{ap} > 0$. Analogously, the affiliate is downstream if the corresponding direct requirements coefficient between the (primary) industries of the parent and affiliate is positive, $dr_{pa} > 0$. An I-O link between the (primary) industry of the parent and the (primary) industry of the affiliate is defined by either a positive dr_{ap}, or a positive dr_{pa}.

This simple measure suggests that most of the observed parent-affiliate pairs are related by I-O links. This is easy to see in figure 4b, where we plot the distribution of industry pairs in the MOFA_{25} sample. In this figure, the size of a bubble is proportional to the number of observations within the industry pair. Inspecting the figure, it is clear that most parents own affiliates on or near the diagonal. Combining figures 4a and 4b suggests that, in the data, parents own affiliates in similar industries, and that these industries are important producers of intermediate inputs for each other.[16] 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, i.e., $dr = 0$. In the parent-affiliate data, the average direct requirements coefficient jumps to 0.072 when we consider the parent to be upstream, dr_{pa}, and 0.069 when we consider the affiliate to be upstream, dr_{ap}. The number of parent-affiliate industry pairs with no I-O linkage drops to less than 10 percent.[17]

More formally, we investigate the extent to which I-O links are associated with the presence

[16] As noticed by Alfaro and Charlton (2009), an important share of these chains is unreported when the data are aggregated to three-digit SIC rather than four-digit SIC industry. That is, many parent-affiliate pairs operate in industries which share the same three-digit SIC industry, but have different four-digit SIC industries. Our four-digit ISI classification is more coarse than the one in Alfaro and Charlton (2009): There are 77 manufacturing industries compared to the 459 manufacturing industries in the 1987 SIC.

[17] Even when we restrict the sample to only include parents and affiliates operating in different (primary) industries (i.e., we exclude the diagonal of the I-O matrix), the average direct requirements coefficient is much larger than the I-O matrix averages: 0.027 and 0.018, for dr_{pa} and dr_{pa}, respectively. The number of parent-affiliate industry pairs with no I-O linkage is less than 30 percent in this case.

of multinational affiliates. Following Alfaro and Charlton (2009), we estimate a Tobit specification that accounts for the effect of I-O links on both the likelihood of owning affiliates and the number (or size) of them,

$$FDI_{apc} = \beta_U dr_{ap} + \beta_D dr_{pa} + \beta_c X_c + \beta_p X_p + \beta_{cp} X_c \times X_p + \epsilon_{apc}. \quad (1)$$

The unit of observation is a triplet, apc, that refers to the primary industry of the affiliate, the primary industry of the parent, and the affiliate's country of operation. We measure multinational activity, FDI_{apc}, in two ways: (1) the number of affiliates in country c, industry of the parent p, and industry of the affiliate a; and (2) the total employment of affiliates in country c, industry of the parent p, and industry of the affiliate a. Our manufacturing MOFA$_{25}$ sample spans 64 host countries and 77 $\times$ 77 industry pairs, for a total of 379,456 possible combinations, most of which display no multinational activity.[18]

The variables dr_{ap} and dr_{pa} 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 β_U and β_D indicate 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 vector X_c contains country-level controls: the host country GDP and GDP per capita from the Penn World Table 6.3, as documented in Aten, Heston and Summers (2009); 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 attainment from Barro and Lee (2000); and the capital-output ratio from Klenow and Rodríguez-Clare (2005). The vector X_p contains parent-industry controls: the capital and skill intensity of the parent's primary industry, from the NBER-CES manufacturing industry database from Becker and Gray (2009). Additionally, as it is customary in the literature, we include terms that interact the industry factor intensities with the host country factor supplies.

Columns 2 and 5 in table 4 present the baseline results for the number and total employment of affiliates. Larger upstream and downstream direct requirements coefficients between the primary industry of operation of the parent and the affiliate are found to be significant predictors of FDI activity. Moreover, comparing the pseudo R^2 in columns 1 and 2 (4 and 5 in the case of employment size), the explanatory power of the regression doubles when the I-O link measures

[18] There are 40 countries for which we do not have data on the control variables. These observations were dropped from the sample.

are added.[19]

The coefficients of the Tobit regressions are not straightforward to interpret as they combine both the effects of the probability of owning affiliates as well as their number and size. We observe affiliates in only $2,378$ of the $379,456$ potential industry-pair-country combinations. Therefore, the probability of observing an affiliate is very small ($0.006 = 2,378/379,456$) and the overall Tobit coefficients are, correspondingly, large. In particular, a ten-percent increase in the direct requirements coefficient from its average (0.07) implies a 60 percent increase in the average number of affiliates in a given industry-pair-country combination: The average jumps from 0.05 to almost 0.08.[20]

For employment, the unconditional effects are larger: A ten-percent increase in the direct requirements coefficient implies that, on average, employment increases from 3.4 employees in a given industry-pair-country combination to 33 employees.[21]

The effect of I-O links on multinational activity comes almost entirely from the extensive margin. The marginal effects on the intensive margins (i.e., the expected number of affiliates, provided that we observe at least one affiliate in the industry-pair-country triplet) are 2.05 and 2.01, for upstream and downstream affiliates, respectively: They imply that a ten-percent increase in the average direct requirements coefficient corresponds to an increase in the expected number of affiliates in a given industry-pair-country combination of only 0.4 percent. The marginal effects on affiliate employment conditional on the existence of an affiliate are small, as well. A ten-percent increase in the direct requirements coefficient, as described above, is associated with an increase in affiliate employment from 554 employees—the average across industry-pair-country triplets with a positive number of U.S. affiliates—to 584 employees, an increase of 5.4 percent.

The strong diagonal in the matrix of direct requirements, shown in figure 4a, introduces a source of ambiguity into the interpretations of our results. An affiliate operating in the same industry as the parent may be perceived as producing the same product as the parent, which would be consistent with horizontal FDI motives. The direct requirements coefficients for the diagonal elements are large, however, which is consistent with a vertical motive for FDI. To avoid

[19] Table 4 reports (McFadden-adjusted) pseudo R^2 which are increasing in the likelihood of the model.

[20] This is computed as $\overline{FDI}'_{apc} = \overline{FDI}_{apc} + (\beta_U + \beta_D)\Delta dr_{ap}$, where $\Delta dr_{ap} = 0.1 \times 0.07$, and $\overline{FDI}_{apc} = \overline{FDI}^{+}_{apc} \times \Pr(FDI_{apc} > 0) = 7.1 \times 0.006 = 0.05$ (i.e., the average number of affiliates across the industry-pair-country triplets observed in the data times the probability of observing an affiliate in such triplet).

[21] This effect is calculated as in the previous footnote, using the β_U and β_D reported in column 5 of table 4, and where $\overline{FDI}_{apc} = \overline{FDI}^{+}_{apc} \times \Pr(FDI_{apc} > 0) = 554 \times 0.006 = 3.4$ (i.e., the average employment of affiliates across all possible industry-pair-country triplets with a positive number of employees, times the probability of observing an affiliate in such triplet).

any source of ambiguity, we report estimates of (1) when the sample is restricted to include only observations in which the affiliate and parent operate in different (primary) industries (columns 3 and 6 in table 4). In the restricted sample, the industry-pair-country triplets with a positive number of affiliates drops to 1,383, approximately 60 percent of the observations in the complete sample. The probability of observing affiliates in a given triplet is now 0.004. Although our results are qualitatively unchanged, the magnitude of the effects are substantially reduced, consistent with the fact that most affiliates and parents operate in the same primary industry.

4.2 Do I-O Links Predict Intra-Firm Flows?

The previous set of results establishes that an I-O link between the industries of operation of the parent and the affiliate is a good predictor of multinational activity across countries and industries. This result is consistent with Alfaro and Charlton (2009). Not having data on trade flows between parents and affiliates, however, they interpret the presence of an I-O link between parent and affiliate as the presence of vertical FDI, conjecturing that these input-output links are accompanied by substantial flows of physical goods between the parent and the affiliate. We turn to this point next: Are input-output linkages able to predict trade flows between the parent and the affiliate? Using data on the observed flows of physical goods between parents and affiliates, our answer is negative: While an I-O link is a good predictor of the existence and size of a multinational firm, it is not associated with substantial intra-firm trade.

The descriptive statistics in table 3 (panel 2) present a first overview of the intra-firm trade patterns between I-O linked parents and affiliates. Not only is the share of intra-firm trade small for the average affiliate, it is also remarkably invariant with respect to the position of the affiliate in the production chain (downstream from the parent, upstream from the parent, neither, or both). On average, less than 30 percent of affiliate sales are shipped within the firm, and less than eight percent are shipped to the parent, irrespective of whether the affiliate operates in an upstream industry. Parents provide less than seven percent of an affiliate's inputs, irrespective of whether the affiliate operates in a downstream industry (panel 3).

The same conclusion emerges from the histograms in figure 5. Figure 5a contains histograms of shipments from the parent to the affiliate as a share of the affiliate's total input costs. For most affiliates, parents are responsible for a very small fraction of their inputs, and this is unchanged if we consider parents and affiliates in the same industry or different industries. Figure 5b contains

histograms of shipments from the affiliate to the parent as a share of total affiliate sales. Again, intra-firm trade is small for most affiliates.

To measure the importance of I-O links while controlling for other factors, we turn to the firm-level data. Given that only 46 percent of affiliates report positive shipments to the parent, we estimate the following Tobit specification, which captures the determinants of both the probability of reporting positive flows and their magnitude,

$$Y_{apc} = \beta_U dr_{ap} + \beta_c X_c + \beta_s X_p + \beta_{cs} X_c \times X_p + \beta_p P_p + \epsilon_{apc}. \tag{2}$$

The dependent variable Y_{apc} is shipments from affiliate a in host country c, to the parent, p, as share of the affiliate's total sales.[22] We measure the I-O link between an upstream affiliate and the downstream parent with the direct requirements coefficient of the primary industry of affiliate a in the production of the primary industry of the parent p, dr_{ap}. In the robustness section, we also use a different measure that aggregates the requirements of all the affiliate's industries into the production of all the industries of the parent.

The vectors X_c and X_p contain affiliate-country controls and parent-industry controls, as used in (1). In addition, we include the number of affiliates owned by the parent and the total U.S.-located employment of the parent in the vector P_p.

Table 5 reports the results from estimating equation (2). In column 1 we report the estimates controlling only for country and parent characteristics. In column 2, we include our measure of I-O linkages, dr_{ap}. Column 3 restricts the sample to include only affiliates and parents operating in different primary industries. The coefficient on our variable of interest, dr_{ap}, is non-significant and small: The I-O link between a parent and an affiliate is not associated with intra-firm trade. Otherwise, our estimates are consistent with the ones in previous studies of intra-firm trade flows. We find that intra-firm shipments into the United States are significantly smaller for affiliates located in distant countries, and larger for affiliates in countries abundant in physical and human capital. Affiliates located in countries with poor rule of law tend to ship a larger share of their sales to the parent. Additionally, consistent with the descriptive statistics, larger multinational parents in terms of employment (one of the parent controls) are associated with more intra-firm flows (not reported).

[22] Although the BEA data report affiliate sales to all related parties, they only provide information on the identity of the related firm in the case of the parent. Therefore, we can only match flows and I-O links for trade between parent and affiliates.

Columns 4–6 of table 5 report the corresponding results for the intra-firm trade flow from the parent to the affiliate. The baseline regression is a Tobit specification,

$$Y_{pac} = \beta_D dr_{pa} + \beta_c X_c + \beta_s X_p + \beta_{cs} X_c \times X_p + \beta_p P_p + \epsilon_{pac}. \quad (3)$$

The dependent variable, Y_{pac}, is shipments from the parent, p, to the affiliate, a, in country c, as a share of total affiliate sales. The set of country, industry, and parent controls is the same as in (2).

Again, we find that the the I-O link between the upstream industry of the parent and the downstream industry of the affiliate is not a significant predictor of flows of goods from the parent to the affiliate. The distance between the location of the affiliate and the United States is, again, a significant predictor of intra-firm flows, while affiliates located in countries with poor rule of law receive a significantly larger fraction of their inputs from the parent.

In Section 6, we show that the results found in this section are robust to different definitions of an I-O link and to different empirical specifications.

5 Discussion

We have established above that most multinational firms own foreign affiliates operating in I-O linked industries. For the most part, however, these affiliates ship a surprisingly small share of their production to the parent operating in a downstream industry, and they receive a very small share of their physical inputs from the upstream parents. Moreover, most of the affiliates in these I-O linked chains appear to sell almost exclusively to unrelated parties. These results raise a question about the motives for not only owning foreign affiliates, but also the firm's multi-product patterns. Why do multinational firms own internationally segmented production chains if not for transferring physical goods along it? Our proposed answer to this question is in line with the answer given by Hortacsu and Syverson (2009) for U.S. domestic firms: The multinational firm exists for the purpose of transferring intangible goods such as know-how, brands, and organizational capabilities within it. These intangibles can be transmitted internationally to the affiliates within the firm, and they can be a source of comparative advantages in the production of goods that are related in an I-O sense, even in the absence of physical shipments between affiliates.

The results in this paper can be rationalized within the multi-product framework in Bernard, Redding and Schott (2011), by incorporating this additional source of comparative advantage in

the production of goods. In the model there is a continuum of firms, $\omega \in [0,1]$, and K goods that can be potentially produced by each firm, $k = 1, ..., K$. If produced, each firm produces a differentiated variety of a given good k. Each firm is characterized by a vector of productivities across goods, $\mathbf{z}(\omega) = [z_1(\omega), z_2(\omega), ..., z_K(\omega)]$, drawn from a multivariate distribution function $F(\mathbf{z})$. A good k can be produced by an affiliate of firm ω according to

$$y_k(\omega) = z_k(\omega) L_k(\omega), \tag{4}$$

where $y_k(\omega)$ is the quantity of good k and $L_k(\omega)$ the input bundle used in the production of good k—hired in the country of production—by an affiliate of firm ω.[23]

The firm-specific vector of productivity draws across goods, $\mathbf{z}(\omega)$, and the distribution function, $F(\mathbf{z})$, are reduced-form representations of the sources of comparative advantage for the multinational firm: Why are some firms more productive than others? How does a firm's comparative advantage in the production of one product translate to other products? To be consistent with our empirical findings, the properties of the distribution function should be related to the I-O matrix: Firms tend to have a comparative advantage in producing goods that are related by I-O linkages. Formally,

$$\frac{\partial \Pr(Z_n > \overline{z}^m | z_k > \overline{z}^m)}{\partial dr_{nk}} > 0 \qquad \frac{\partial \Pr(Z_n > \overline{z}^m | z_k > \overline{z}^m)}{\partial dr_{kn}} > 0, \tag{5}$$

where $\Pr(Z_n > \overline{z}^m | z_k > \overline{z}^m)$ is the probability that the (random-variable) productivity draw for good n, across the continuum of firms, is larger than the productivity threshold of opening an affiliate abroad ($\overline{z}^m$)—determined by reasons similar to the ones in Helpman et al. (2004) and the same across goods, for simplicity—given that the productivity draw for good k is large enough. dr_{nk} corresponds to the direct requirements coefficients for good n into the production of good k. Firms with draws above $\overline{z}^m$ open affiliates abroad who produce a variety of good n.

The source of the correlation among goods within the firm can be interpreted in different ways. As shown in figure 4, most industries require inputs from similar industries: The entries in the direct requirements matrix tend to be the largest on or near the diagonal. Consider, for example, the case of *Converted Paper Products (NAICS 3222)*—stationary and envelopes—which uses *Paper (NAICS 3221)* as its main input. Presumably, the production of paper and paper products involves similar knowledge about the quality of materials, demand, suppliers, and competitors. This com-

[23] For simplicity, we ignore heterogeneity across different host countries, but it can be easily incorporated.

monly required knowledge can be understood as the capacity to solve related problems, as in Garicano and Rossi-Hansberg (2006), the stock technology capital—specific to goods of similar characteristics—as in McGrattan and Prescott (2010), or the stock of knowledge capital that is a public good within the corporation, as in the seminal work by 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 intra-firm physical flows.

The BEA collects data on a few variables which are related to intangibles goods. Affiliates report the payments made to the parent for royalties and fees for the use of intangible property as well as royalties and fees paid by the parent to the affiliate. Data are also collected about services provided within the firm, such as managerial consulting, computer and technical support, and research and development. These data report the allocated expenses and sales of services between the parent and the affiliate.

The flows of payments for intangibles in the data are small: The median affiliate neither receives nor pays anything to the parent for the use of intangible property or for services. For the average affiliate, services bought from the parent and the royalties and fees paid to the parent make up only one percent of the value of its inputs. Of the 4,911 affiliates in the sample, 75 percent do not report any intra-firm service flows. The small magnitudes we observe when measuring the flow of intangible goods within the corporation should not be surprising. The same public-good nature of intangible goods that makes them so valuable to the firm also makes them difficult to measure in the data.[24]

While the reported flows are small, there is some interesting variation across affiliates. The average affiliate in the same industry as its parent pays almost 30 percent more royalties than the average affiliate operating in a different industry than its parent. The difference is larger for allocated expenses and sales of services: The average affiliate pays 80 more to the parent for services if it operates in the same industry as the parent. Of the affiliates who report purchases of services from the parent, more than 40 percent list management consulting or information technology services as the primary service provided.

[24]The difficulty in measuring intangibles in multinational firms has led McGrattan and Prescott (2010) to use an indirect measure of intangible capital. Others, like Bloom and Van Reenen (2007), try to directly measure a particular intangible input—namely, managerial ability.

6 Robustness

In this section we explore the robustness of our results to different empirical specifications and alternative measures of the I-O links between the affiliate and the parent. Regardless of our measure of I-O links and functional form, we do not find a positive and significant relationship between the input-output relationship of a parent and affiliate and intra-firm trade.

6.1 Alternative Empirical Specifications

Any measure of intra-firm trade flows may be contaminated by the reporting of artificially low values of goods traded, a phenomenon known as *transfer pricing*. While transfer pricing may bias downward the value of trade reported, it is unlikely a firm with significant intra-firm trade could report zero trade. Given that one of the most striking features of the data is the small number of parent-affiliate pairs reporting *any* intra-firm flows, we estimate a linear probability model,

$$d(Y_{apc}) = \beta_U dr_{ap} + \beta_c X_c + \beta_s X_p + \beta_{cs} X_c \times X_p + \beta_p P_p + \epsilon_{apc}. \tag{6}$$

The binary variable $d(Y_{apc})$ is equal to 1 if shipments from the affiliate to the parent are positive and 0 otherwise. Arguably, transfer pricing cannot contaminate this variable as long as transfer pricing does not completely eliminate the trade flow. The results from estimating (6) are reported in table 6. In columns 1 and 2, we report the estimates for shipments from the affiliate to the parent. In columns 3 and 4, we report estimates of (6) in which the intra-firm trade flow is shipments from the parent to the affiliate. Columns 1 and 3 correspond to all reporting parents and affiliates; in columns 2 and 4 the sample is restricted to parents and affiliates operating in different primary industries.

The estimates from this specification do not support the idea that parents own affiliates in related industries in order to move goods along the value chain. In fact, we find the opposite: The coefficients of interest are negative. A larger I-O link is associated with a lower probability of observing trade in goods between the parent and the affiliate, but with one exception, the coefficients are not significant. We also observe this pattern when we exclude the parent-affiliate pairs that operate in the same primary industry.

Our second set of alternative functional forms is meant to capture the importance of input-output relationships in explaining the intensive margin of intra-firm flows, that is, the magnitude

of the trade flow conditional on observing trade. We estimate, using ordinary least squares,

$$\log(Y_{apc}) = \beta_U dr_{ap} + \beta_c X_c + \beta_s X_p + \beta_{cs} X_c \times X_p + \beta_p P_p + \epsilon_{apc}. \tag{7}$$

The sample of affiliate-parent pairs is restricted to only those that report positive shipments. We do not transform the I-O link variable, because there are zeros in the direct requirements table and we do not want to discard those observations.

We report our estimates of (7) in table 6. The dependent variable in columns 5 and 6 is the logarithm of shipments from the affiliate to the parent as a share of total affiliate sales, $\log(Y_{apc})$. Columns 7 and 8 report the results from an analogous specification in which the dependent variable is the logarithm of shipments from the parent to the affiliate, $\log(Y_{pac})$, and the direct requirements coefficient, dr_{pa}, is the measure of the I-O link. In columns 6 and 8, the samples are further restricted to affiliates and parents operating in different primary industries.

The coefficients relating I-O links to intra-firm trade flows follow the same pattern as in our baseline specification. For shipments from the affiliate to the parent, the coefficients are positive, small, and insignificant. For shipments from the parent to the affiliate, the coefficients are negative and become positive when parent-affiliate pairs on the diagonal are discarded. Again, in this specification, I-O linkages are not found to be statistically significant predictors of intra-firm trade flows.

6.2 Alternative Measures of I-O Links

Our baseline I-O link measure is the direct requirements coefficient between the primary industry of the parent and the affiliate. Although this measure only uses a single industry per firm, it is hardly a restrictive definition: The share of sales in the primary industry is 1.00 for the median affiliate and 0.99 for the median parent in our sample (see table 2). Even so, in this section, we construct a measure of the input-output link between the parent and the affiliate that takes into account all of the industries of operation of both parties. We reestimate our baseline specification using this measure.

Our more general measure of an I-O link is a sales-weighted average of the direct requirements coefficients of all of the possible combinations of parent and affiliate industries. Let v_{ap} be the I-O link when the affiliate is upstream and v_{pa} be the I-O link when the parent is upstream. The set P contains all of the industries in which the parent operates and the set A is the set of industries in

which the affiliate operates. The new I-O link measures are defined by

$$v_{ap} \equiv \frac{\sum_{i\in A, j\in P} dr_{ij} \times sales_j^p}{total\ sales^a}, \tag{8}$$

$$v_{pa} \equiv \frac{\sum_{i\in A, j\in P} dr_{ji} \times sales_i^a}{total\ sales^a}, \tag{9}$$

where $sales_i^a$ and $sales_i^p$ correspond to affiliate and parent sales in industry i, respectively. These data are available for the parent's and affiliate's seven largest industries of operation.

In table 7, we report the results of estimating the baseline regressions in (2) and (3) using v_{ap} and v_{pa} as our measures of I-O links. These estimates are reported in columns 1 and 3. The estimates using the more general measure of I-O linkages are very similar to those using the baseline measure, which are in table 5, columns 2 and 5. Correcting for the multi-industry nature of multinational firms does not affect our results.

As we did in the baseline estimations, we estimate specifications in which the parent-affiliate pairs that operate in the same industry are excluded. We construct our more general I-O linkage measure in the same way, but we do not include parent-affiliate industry combinations in which the two industries are identical,

$$v_{ap}^{ex} \equiv \frac{\sum_{i\in A, j\in P, i\neq j} dr_{ij} \times sales_j^p}{total\ sales^a}, \tag{10}$$

$$v_{pa}^{ex} \equiv \frac{\sum_{i\in A, j\in P, i\neq j} dr_{ji} \times sales_i^a}{total\ sales^a}. \tag{11}$$

We report the results from estimating (2) and (3) using v_{ap}^{ex} and v_{pa}^{ex} in columns 2 and 4 of table 7. Here, when we look at shipments from the parent to the affiliate, and exclude the diagonal elements of the direct requirements matrix from our I-O link measure, we get a positive and significant coefficient.

6.3 Sample of Large Affiliates

Finally, we explore the extent to which I-O links predict trade flows between parents and affiliates when we restrict the sample to the largest affiliates, who account for most of the intra-firm trade. In columns 5 and 7 of table 7 we report the baseline regressions (2) and (3) for the sample of majority-owned affiliates with more than \$150 millions in sales, assets, or net income (MOFA$_{150}$ in table 1). In columns 6 and 8 we further restrict the sample to only include parents and affiliates that operate

in different primary industries. The estimated coefficients are positive and slightly significant for flows from the affiliate to the parent, but become insignificant if we remove the diagonal from the direct requirements matrix. The coefficients estimated from the parent to affiliate trade flow are negative and significant.

Our baseline conclusions are hardly changed by the previous robustness analysis: I-O linkages do not consistently predict the size, the existence, or even the direction of intra-firm trade flows.

7 Conclusion

Using confidential firm-level data from the Bureau of Economic Analysis, this paper documents new facts regarding the behavior of U.S. multinational firms. We find that intra-firm trade is concentrated among a small number of large affiliates. For the vast majority of affiliates, shipments to the parent account for a very small fraction of total sales, and shipments from the parent account for a small share of total input costs. For most U.S. foreign affiliates, local unrelated parties are the main destination of their sales. In this sense, "horizontal" FDI, as opposed to "vertical" FDI, seems to better capture the role of the majority of U.S. affiliates abroad.

Despite the lack of intra-firm trade, relative to the overall activity of affiliates, we find that multinational corporations often own production units that are linked in input-output space: Most affiliates operate in industries upstream or downstream from those of the parent. Nonetheless, these I-O links are not accompanied by an intra-firm flow of physical goods between upstream and downstream units of production. More precisely, the presence of an I-O link between the parent and the affiliate, as defined by the input-output matrix, does not predict the existence, or volume, of intra-firm flows. This fact suggests that the primary motive of the multinational firm is not the ability to transfer physical goods within the corporation. We conjecture that multinational firms may have a comparative advantage in producing goods related by I-O links which share the same intangible inputs, such as managerial ability or organizational capital.

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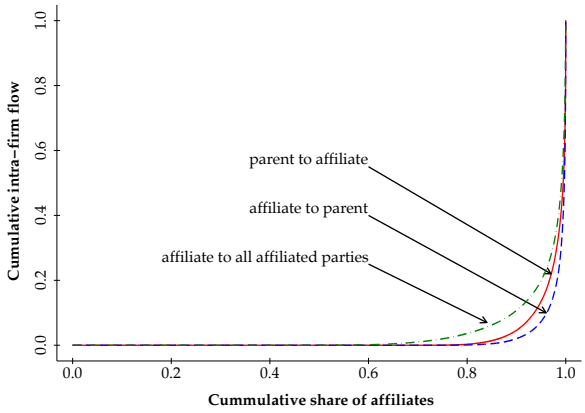
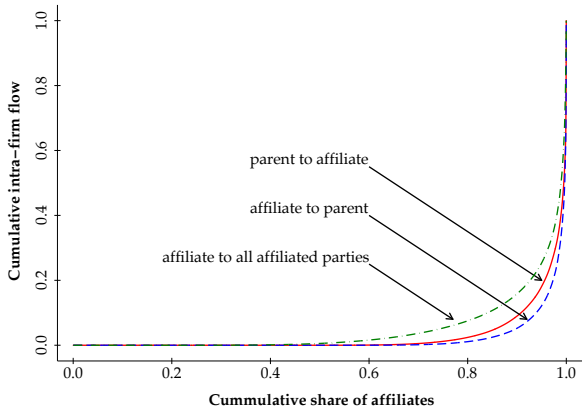
A Figures and Tables

Figure 1: Lorenz Curve: cumulative share of intra-firm trade by cumulative share of affiliates

(a) All

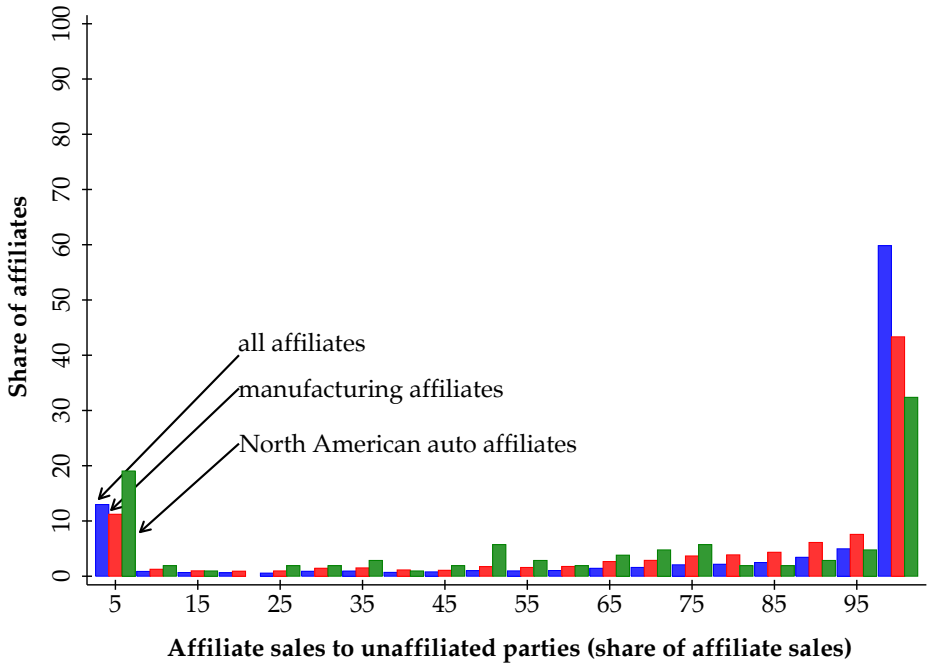


(b) Manufacturing



Notes: *All* includes all majority-owned, nonbank affiliates of nonbank parents, whose sales, assets, or net income (loss) is greater than $25 million. "Manufacturing" includes includes all majority-owned manufacturing affiliates whose parents' primary industry is in manufacturing, and whose sales, assets, or net income (loss) is greater than $25 million.

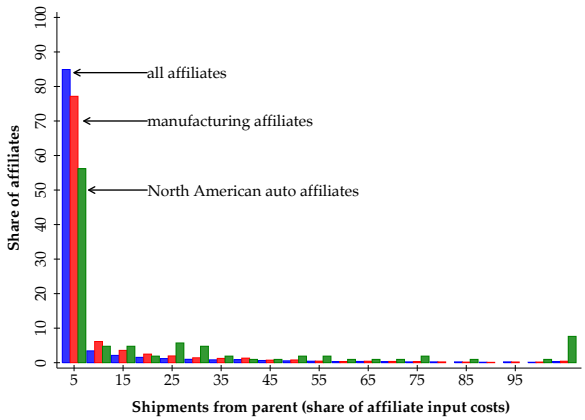
Figure 2: Distribution of affiliates by share of sales to all unaffiliated parties



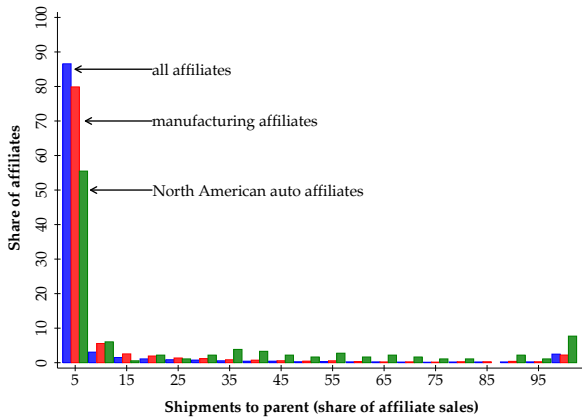
Notes: Sample includes majority-owned nonbank affiliates of nonbank parents whose sales, assets, or net income (loss) is greater than $25 million.

Figure 3: Distribution of affiliates by share of intra-firm trade

(a) By shipments from parent to affiliate



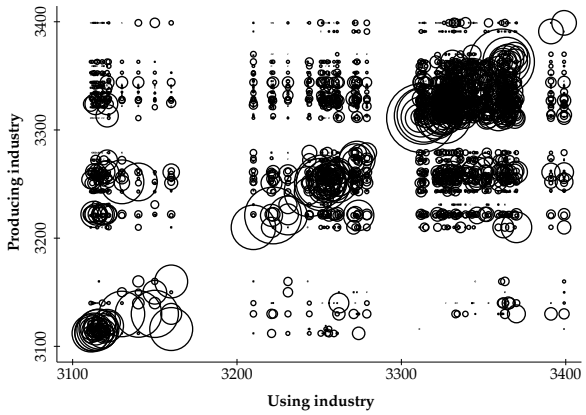
(b) By shipments from affiliate to parent



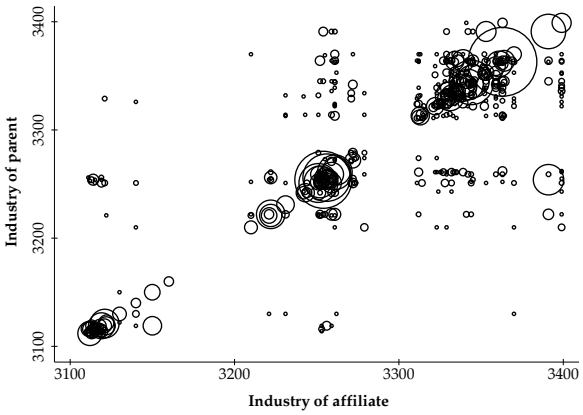
Notes: *All* includes all majority-owned, nonbank affiliates of nonbank parents. *Manufacturing* includes all majority-owned manufacturing affiliates whose parents' primary industry is in manufacturing. *North American autos* includes all majority-owned affiliates whose primary industry is automotive, and whose parents' primary industry is automotive, operating in Canada and Mexico. All of the samples are made up of affiliates whose sales, assets, or net income (loss) is greater than $25 million.

Figure 4: Direct requirements coefficients and I-O links

(a) Industry-pair direct requirements



(b) Distribution of parent-affiliate industry pairs

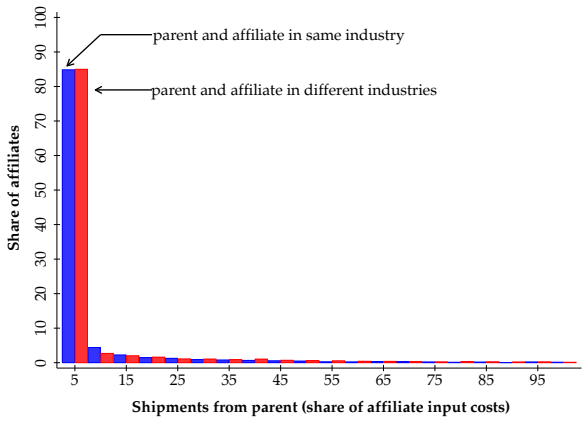


Left Panel: Direct requirements coefficients for industry pairs in 2002; bubbles are proportional to the size of the direct requirements coefficient. The direct requirements coefficient is the value of goods needed from the producing (upstream) industry in order to produce one dollar of output in the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

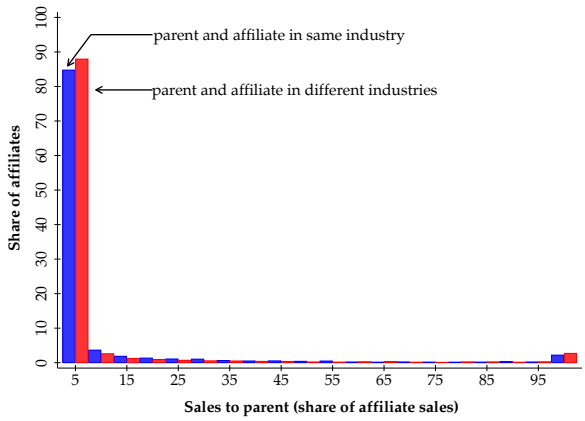
Right Panel: Frequency of the (primary) industries of parent-affiliate pairs; bubbles are proportional to the number of parent-affiliate pairs in a given industry pair. The sample includes majority-owned manufacturing affiliates of manufacturing parents whose sales, assets, or net income (loss) is greater than $25 million.

Figure 5: Distribution of affiliates by share of intra-firm trade and vertical links

(a) By shipments from parent to affiliate



(b) By shipments from affiliate to parent



Notes: *Industry* refers to the primary industry of the parent and affiliate. Sample includes majority-owned manufacturing affiliates of manufacturing parents whose sales, assets, or net income (loss) is greater than $25 million.

Table 1: Sample construction

	Parent-Affiliate in all non-bank sectors				Parent-Affiliate in manufacturing			
	All (1)	Reporting (2)	$MOFA_{25}$ (3)	$MOFA_{150}$ (4)	All (5)	Reporting (6)	$MOFA_{25}$ (7)	$MOFA_{150}$ (8)
# Affiliates	42,547	25,464	15,451	5,888	13,163	8,174	4,949	1,632
# Parents	3,444	2,412	1,673	802	1,458	1,049	734	351
Total parent sales	7,517,056	7,207,894	6,520,263	5,320,874	3,089,664	3,032,799	2,788,527	2,443,003
Total affiliate employment	10,445	10,149	7,335	5,179	4,646	4,530	3,323	2,286
Affiliate sales	3,976,341	3,939,894	3,045,381	2,584,693	1,705,473	1,691,360	1,304,586	1,112,004
to parent			270,225	246,319			137,626	124,027
to unaffiliate in US			55,989	46,260			25,943	21,425
to local unaffiliate			1,718,548	1,401,975			657,165	544,027
to local affiliate			169,560	149,973			91,756	80,717
to affiliate in 3rd countries			462,698	420,991			253,115	230,435
to unaffiliate in 3rd countries			368,361	319,175			138,980	111,374
Sales of goods from parent to affiliate			136,744	109,815			14,199	69,408
for further processing				63,826				59,484
for resale				40,948				6,944
of capital equipment				703				497
of other goods				4,337				2,483
# Parent industries	197	192	182	160	76	76	74	66
# Affiliate industries	202	200	195	182	77	77	77	74
# Countries	200	173	159	119	150	124	104	76

Notes: Columns 1–4 include all nonbank parent-affiliate pairs, while columns 5–8 include only the parent-affiliate pairs in which the primary industry of both the parent and affiliate are in manufacturing. Columns 1 and 5 describe all affiliates of all parents. Columns 2 and 6 describe affiliates whose sales, assets, or net income (loss) is greater than $10 million. Columns 3–4 and 7–8 describe Majority-Owned Foreign Affiliates (MOFAs) whose sales, assets, or net income (loss) is greater than $25 or $150 million. Sales are expressed in millions of dollars. Employment is expressed in thousands of employees.

Table 2: Summary statistics

	All			Parent-Affiliate in manufacturing		
	Mean (1)	Median (2)	Weighted Ave (3)	Mean (4)	Median (5)	Weighted Ave (6)
Panel 1: Number of industries						
# A industries	1.28	1.00	1.45	1.43	1.00	1.58
# P industries	2.38	2.00	3.29	2.30	1.00	2.72
Panel 2: Share of sales in primary industry						
Affiliate	0.96	1.00	0.94	0.94	1.00	0.92
Affiliate-country aggregate†	0.91	1.00	0.85	0.90	1.00	0.84
Parent	0.84	0.99	0.78	0.85	1.00	0.84
Panel 3: Share of affiliate sales						
to unaffiliated parties	0.78	0.99	0.78	0.73	0.91	0.67
to affiliated parties	0.22	0.01	0.22	0.27	0.09	0.33
to local unaffiliate	0.65	0.92	0.69	0.57	0.66	0.53
to local affiliate	0.07	0.00	0.04	0.06	0.00	0.06
to parent	0.06	0.00	0.08	0.07	0.00	0.11
to U.S. unaffiliate	0.02	0.00	0.02	0.02	0.00	0.03
to third country affiliate	0.10	0.00	0.10	0.14	0.01	0.17
to third country unaffiliate	0.10	0.00	0.07	0.14	0.00	0.11
Panel 4: Share of affiliate input costs from parent						
total	0.04	0.00	0.04	0.06	0.00	0.06
for further processing	0.02	0.00	0.02	0.05	0.00	0.05
for distribution	0.02	0.00	0.01	0.00	0.00	0.00
of capital equipment	0.00	0.00	0.00	0.00	0.00	0.00

Notes: Panels 1–3 include all majority-owned affiliates with sales, assets, or net income (loss), greater than $25 million. Panel 4 includes all majority-owned affiliates with sales, assets, or net income (loss), greater than $150 million. Columns 2 and 5 report the average of the 9 firms surrounding the median. In columns 3 and 6 observations are weighted by affiliate employment. †An observation is the aggregate over all affiliates of a parent, by country.

Table 3: Descriptive statistics. I-O linkages and intra-firm shipments

	$I_P = I_A$	$I_P \neq I_A$			
	$dr_{ap} = dr_{pa} > 0$	all	$dr_{ap} > 0$	$dr_{pa} > 0$	other
	(1)	(2)	(3)	(4)	(5)
Panel 1: Number of affiliates					
total	3103	1808	1393	1332	139
share with shipments to parent > 0	0.46	0.44	0.47	0.45	0.31
share with shipments to any affiliated party > 0	0.76	0.77	0.80	0.79	0.66
share with shipments to any unaffiliated party > 0	0.92	0.92	0.93	0.91	0.94
share with shipments from parent > 0	0.50	0.48	0.50	0.50	0.36
Panel 2: Avg. affiliate shipment size (share of total sales)					
to all affiliated	0.27	0.26	0.26	0.26	0.23
to all unaffiliated	0.73	0.74	0.74	0.74	0.77
to local unaffiliated	0.57	0.56	0.56	0.55	0.62
to local unaffiliated	0.06	0.07	0.07	0.07	0.07
to parent	0.08	0.06	0.05	0.05	0.06
to unaffiliated in U.S.	0.03	0.02	0.02	0.02	0.02
to third-country affiliated	0.13	0.14	0.13	0.14	0.10
to third-country unaffiliated	0.13	0.16	0.16	0.16	0.14
Panel 3: Avg. shipment size from parent (share of total input costs)					
total	0.05	0.06	0.05	0.06	0.08
for further processing	0.05	0.05	0.05	0.05	0.07
for resale	0.00	0.00	0.00	0.00	0.01
of capital equipment	0.00	0.00	0.00	0.00	0.00

Notes: The sample includes manufacturing affiliates whose parent's primary industry is in manufacturing. Panels 1 and 2 include affiliates whose sales, assets, or net income (loss) is greater than $25 million. Panel 3 includes affiliates whose sales, assets, or net income (loss) is greater than $150 million. $dr_{ap} > 0$ refers to affiliates whose primary industry of operation supplies inputs into the primary industry of the parent. $dr_{pa} > 0$ refers to affiliates whose primary industry of operation uses as inputs the primary industry of the parent.

Table 4: I-O linkages and FDI activity

Dep. Variable	# affiliates$_{apc}$			employment$_{apc}$		
	(1)	(2)	(3)	(4)	(5)	(6)
dr_{pa}		28.746^{***}	16.568^{***}		$29,290.5^{***}$	$10,433.2^{***}$
		(1.221)	(0.657)		(3,998.6)	(719.2)
dr_{ap}		28.173^{***}	14.933^{***}		$28,590.5^{***}$	$9,477.5^{***}$
		(1.378)	(0.629)		(3,996.9)	(646.6)
$\log(gdp_c)$	1.310^{***}	1.247^{***}	0.777^{***}	$1,289.1^{***}$	$1,303.2^{***}$	502.8^{***}
	(0.062)	(0.063)	(0.036)	(174.1)	(186.7)	(37.4)
$\log(gdpl_c)$	0.797^{***}	0.783^{***}	0.601^{***}	668.6^{***}	683.6^{***}	332.2^{***}
	(0.157)	(0.155)	(0.121)	(177.0)	(187.8)	(80.1)
$\log(distance_c)$	-0.689^{***}	-0.620^{***}	-0.374^{***}	-713.6^{***}	-697.8^{***}	-256.5^{***}
	(0.081)	(0.076)	(0.059)	(124.1)	(128.1)	(42.1)
$\log(law_c)$	1.402^{***}	1.452^{***}	0.974^{***}	1345.0^{***}	$1,470.9^{***}$	617.9^{***}
	(0.287)	(0.292)	(0.236)	(310.8)	(336.3)	(153.2)
$\log(k/gdp_c)$	-0.465^{*}	-0.542^{**}	-0.424^{**}	-327.3	-414.4	-212.7
	(0.267)	(0.259)	(0.199)	(265.2)	(273.3)	(132.2)
$\log(schooling_c)$	0.810	0.601	0.111	451.5	261.2	19.7
	(0.676)	(0.633)	(0.493)	(672.9)	(674.6)	(321.7)
Ind. controls	yes	yes	yes	yes	yes	yes
Parent controls	yes	yes	yes	yes	yes	yes
Observations	379,456	379,456	374,528	379,456	379,456	374,528
Positive obs.	2,378	2,378	1,383	2,327	2,327	1,341
Pseudo R^2	0.11	0.21	0.17	0.05	0.10	0.09
Sample	$MOFA_{25}$	$MOFA_{25}$	$MOFA_{25}$ No diag.	$MOFA_{25}$	$MOFA_{25}$	$MOFA_{25}$ No diag.

Notes: Results from the Tobit regression in (1). In columns 1–3 the dependent variable is the number of affiliates in industry a in country c owned by parents in industry p. In columns 4–6, the dependent variable is aggregate employment in affiliates in industry a in country c owned by parents in industry p. In columns 3 and 6, the sample does not include parent affiliate pairs that share the same primary industry. Industry controls include physical and human capital intensities, as well as their interaction with the respective country factor abundance. Parent controls include total employment and total number of foreign affiliates in the firm. Robust standard errors, clustered at the country-main industry of the parent level, are in parentheses. Levels of significance are denoted *** $p < 0.01$, ** $p < 0.05$, and * $p < 0.1$.

Table 5: I-O linkages and intra-firm shipments

Dep. Variable	Y_{ap}			Y_{pa}		
	(1)	(2)	(3)	(4)	(5)	(6)
dr_{ap}		0.142	0.004			
		(0.101)	(0.147)			
dr_{pa}					−0.210	0.462
					(0.134)	(0.348)
$\log(gdp_c)$	0.003	0.003	0.002	0.012	0.012	0.002
	(0.007)	(0.007)	(0.008)	(0.010)	(0.010)	(0.011)
$\log(gdpl_c)$	−0.018	−0.018	−0.028	0.054*	0.054*	0.018
	(0.027)	(0.027)	(0.034)	(0.028)	(0.028)	(0.033)
$\log(distance_c)$	−0.075***	−0.075***	−0.081***	−0.039**	−0.039**	−0.042**
	(0.011)	(0.011)	(0.012)	(0.016)	(0.016)	(0.019)
$\log(law_c)$	−0.147**	−0.146**	−0.119	−0.312**	−0.314**	−0.257*
	(0.068)	(0.067)	(0.074)	(0.127)	(0.127)	(0.147)
$\log(k/gdp_c)$	0.036**	0.036	0.047	0.029	0.031	0.023
	(0.046)	(0.046)	(0.056)	(0.049)	(0.049)	(0.063)
$\log(schooling_c)$	0.220*	0.220*	0.078	0.126	0.126	0.091
	(0.114)	(0.114)	(0.131)	(0.143)	(0.143)	(0.184)
Ind. controls	yes	yes	yes	yes	yes	yes
Parent controls	yes	yes	yes	yes	yes	yes
Observations	4,717	4,717	1,728	4,714	4,714	1,728
Pseudo R^2	0.07	0.07	0.10	0.03	0.03	0.03
Sample	$MOFA_{25}$	$MOFA_{25}$	$MOFA_{25}$ No diag.	$MOFA_{25}$	$MOFA_{25}$	$MOFA_{25}$ No diag.

Notes: The sample includes majority-owned manufacturing affiliates with sales, assets, or net income (loss) greater than $25 million. In columns 1–3, the dependent variable, Y_{ap}, is shipments from the affiliate to the parent as a share of the affiliate's total sales. dr_{ap} is the direct requirements coefficient of the primary industry of the affiliate in the production of the parent's primary industry. In columns 4–6, the dependent variable, Y_{pa}, is shipments of goods from the parent to the affiliate as a share of the affiliate's total input costs. dr_{pa} is the direct requirements coefficient of the primary industry of the parent in the production of the affiliate's primary industry. The samples in columns 3 and 6 include only parent-affiliate pairs in which the parent's main industry differs from that of the affiliate. Industry controls include physical and human capital intensities, as well as their interaction with the respective country factor abundance. Parent controls include total employment and total number of foreign affiliates in the firm. Robust standard errors, clustered at the country-main industry of the parent level, are in parentheses. Levels of significance are denoted *** $p < 0.01$, ** $p < 0.05$, and * $p < 0.1$.

Table 6: Robustness. Alternative empirical specifications

Dep. Variable	$\mathrm{d}(Y_{ap})$		$\mathrm{d}(Y_{pa})$		$\log(Y_{ap})$		$\log(Y_{pa})$	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
dr_{ap}	-0.089	-0.002						
	(0.112)	(0.182)						
dr_{pa}			-0.420^{***}	0.005				
			(0.110)	(0.163)				
$\log(dr_{ap})$					0.021	-0.020		
					(0.028)	(0.037)		
$\log(dr_{pa})$							-0.027	0.008
							(0.025)	(0.034)
$\log(gdp_c)$	0.031^{***}	0.025^{**}	0.016^{**}	0.007	-0.248^{***}	-0.174^{*}	-0.010	0.074
	(0.009)	(0.013)	(0.008)	(0.012)	(0.064)	(0.091)	(0.059)	(0.096)
$\log(gdpl_c)$	0.038	0.012	0.080^{***}	0.046	-0.540^{**}	-0.500	-0.125	-0.309
	(0.031)	(0.045)	(0.026)	(0.042)	(0.248)	(0.346)	(0.204)	(0.298)
$\log(distance_c)$	-0.076^{***}	-0.085^{***}	-0.009	-0.011	-0.582^{***}	-0.678^{***}	-0.395^{***}	-0.431^{***}
	(0.012)	(0.018)	(0.012)	(0.018)	(0.086)	(0.117)	(0.069)	(0.096)
$\log(law_c)$	-0.070	-0.036	-0.248^{***}	-0.226^{**}	-0.779	-0.433	-0.991^{**}	-0.930
	(0.063)	(0.091)	(0.053)	(0.091)	(0.520)	(0.750)	(0.385)	(0.580)
$\log(k/gdp_c)$	0.006	0.042	-0.059	-0.016	0.160	0.001	0.297	-0.483
	(0.056)	(0.085)	(0.053)	(0.079)	(0.425)	(0.658)	(0.365)	(0.566)
$\log(schooling_c)$	0.249^{*}	-0.047	0.043	-0.062	2.439^{**}	1.000	0.007	1.201
	(0.132)	(0.216)	(0.119)	(0.206)	(1.131)	(1.747)	(0.882)	(1.530)
Ind. controls	yes	yes	yes	yes	yes	yes	yes	yes
Parent controls	yes	yes	yes	yes	yes	yes	yes	yes
Observations	4,717	1,728	4,714	1,728	2,046	646	2,169	641
$\mathrm{R}^2 adj$	0.05	0.06	0.04	0.04	0.10	0.09	0.06	0.07
Sample	MOFA_{25}	MOFA_{25} No diag.	MOFA_{25}	MOFA_{25} No diag.	MOFA_{25}	MOFA_{25} No diag.	MOFA_{25}	MOFA_{25} No diag.

Notes: The sample includes majority-owned manufacturing affiliates with sales, assets, or net income (loss) greater than \$25 million. Sample *No diag.* excludes parent-affiliate pairs in which the parent and affiliate operate in the same industry. Columns 1–2 and 3–4 correspond to the linear probability model in equation (6), for flows from affiliate to parent (Y_{ap}) and parent to affiliate (Y_{pa}). Columns 5–6 and 7–8 report the results for the OLS estimation of equation (7), for intra-firm flows to and from the parent. Industry controls include physical and human capital intensities of the parent's primary industry, as well as their interaction with the respective country factor abundance. Parent controls include total employment and total number of foreign affiliates in the firm. Robust standard errors, clustered at the country-main industry of the parent level, are in parentheses. Levels of significance are denoted *** $p < 0.01$, ** $p < 0.05$, and * $p < 0.1$.

Table 7: Robustness. Alternative measure of I-O links and sample

Dep. Variable	Y_{ap}		Y_{pa}		Y_{ap}		Y_{pa}	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
v_{ap}	0.127	0.009						
	(0.097)	(0.120)						
v_{pa}			-0.106	0.449^{**}				
			(0.125)	(0.220)				
dr_{ap}					0.237^{*}	0.085		
					(0.142)	(0.141)		
dr_{pa}							-0.381^{***}	-0.278^{*}
							(0.099)	(0.156)
$\log(gdp_c)$	0.004	0.004	0.013	0.013	-0.028^{***}	-0.018	-0.002	-0.010
	(0.007)	(0.007)	(0.010)	(0.010)	(0.010)	(0.013)	(0.008)	(0.014)
$\log(gdpl_c)$	-0.016	-0.016	0.055^{*}	0.054^{*}	-0.020	-0.006	0.001	-0.002
	(0.027)	(0.027)	(0.028)	(0.028)	(0.033)	(0.043)	(0.024)	(0.043)
$\log(distance_c)$	-0.075^{***}	-0.075^{***}	-0.041^{***}	-0.041^{**}	-0.066^{***}	-0.059^{***}	-0.041^{***}	-0.050^{***}
	(0.011)	(0.015)	(0.016)	(0.016)	(0.015)	(0.016)	(0.010)	(0.014)
$\log(law_c)$	-0.141^{**}	-0.143^{**}	-0.310^{**}	-0.310^{**}	-0.083	-0.090	-0.106^{*}	-0.161^{*}
	(0.067)	(0.068)	(0.126)	(0.128)	(0.089)	(0.111)	(0.061)	(0.084)
$\log(k/gdp_c)$	0.034	0.034	0.027	0.025	-0.013	-0.027	0.029	0.037
	(0.046)	(0.046)	(0.050)	(0.050)	(0.056)	(0.067)	(0.051)	(0.083)
$\log(schooling_c)$	0.238^{**}	0.237^{**}	0.135	0.137	0.091	-0.079	0.020	-0.222
	(0.114)	(0.114)	(0.144)	(0.143)	(0.150)	(0.194)	(0.092)	(0.151)
Ind. controls	yes	yes	yes	yes	yes	yes	yes	yes
Parent controls	yes	yes	yes	yes	yes	yes	yes	yes
Observations	4,717	4,717	4,714	4,717	1,567	524	1,567	524
Pseudo R^2	0.08	0.08	0.03	0.03	0.12	0.31	0.10	0.15
Sample	$MOFA_{25}$	$MOFA_{25}$ No diag.	$MOFA_{25}$	$MOFA_{25}$ No diag.	$MOFA_{150}$	$MOFA_{150}$ No diag.	$MOFA_{150}$	$MOFA_{150}$ No diag.

Notes: The $MOFA_{25}$ sample includes majority-owned manufacturing affiliates with sales, assets, or net income (loss) greater than \$25 million. The $MOFA_{150}$ sample includes majority-owned manufacturing affiliates with sales, assets, or net income (loss) greater than \$150 million. The dependent variable Y_{ap} is sales from the affiliate to the parent as a share of the affiliate's total sales; Y_{pa} is shipments of goods from the parent to the affiliate as a share of the affiliate's total input costs. The sub-sample *No diag.* is restricted to parent-affiliate pairs in which the parent and affiliate operate in different industries (for the measure v, the diagonal elements of the direct requirements coefficient matrix are omitted). Industry controls include physical and human capital intensities of the parent's primary industry, as well as their interaction with the respective country factor abundance. Parent controls include total employment and total number of foreign affiliates in the firm. Robust standard errors, clustered at the country-main industry of the parent level, are in parentheses. Levels of significance are denoted *** $p < 0.01$, ** $p < 0.05$, and * $p < 0.1$.

B For Online Publication

Table B1: BEA 2004 benchmark survey reporting thresholds

	All Affiliates	Majority-Owned Affiliates	
	$> \$10$ million	$> \$25$ million	$> \$150$ million
Total affiliate sales	✓	✓	✓
to parent		✓	✓
to U.S. unaffiliate		✓	✓
to local unaffiliate		✓	✓
to local affiliate		✓	✓
to third-country affiliate		✓	✓
to third-country unaffiliate		✓	✓
Total parent sales of goods to affiliate		✓	✓
in goods for further processing			✓
in goods for resale			✓
in capital goods			✓
Affiliate employment	✓	✓	✓
Affiliate cost of goods sold		✓	✓
Allocated expenses and sales of services			
from the parent to the affiliate		✓	✓
from the affiliate to the parent		✓	✓

Notes: Reporting thresholds refer to affiliate sales, assets, or net income (loss).

Table B2: Summary by region

	Obs	Mean	Std	25pc	50pc	75pc
Sales to unaffiliated parties, as a share of total sales						
All	4911	0.73	0.34	0.58	0.91	1.00
OECD	3093	0.74	0.34	0.59	0.90	1.00
Non-OECD	1818	0.73	0.36	0.57	0.92	1.00
North America	643	0.70	0.36	0.50	0.88	1.00
Latin America, not Mexico	400	0.81	0.29	0.75	0.96	1.00
Europe	2668	0.72	0.34	0.56	0.88	1.00
Africa	93	0.78	0.37	0.71	0.99	1.00
Middle East	45	0.67	0.40	0.27	0.88	1.00
Asia	1062	0.75	0.35	0.61	0.95	1.00
Shipments from parent, as a share of total input costs						
All	4908	0.07	0.29	0.00	0.00	0.04
OECD	3093	0.08	0.34	0.00	0.00	0.04
Non-OECD	1815	0.06	0.16	0.00	0.00	0.04
North America	643	0.21	0.69	0.00	0.04	0.22
Latin America, not Mexico	400	0.06	0.14	0.00	0.01	0.04
Europe	2667	0.04	0.12	0.00	0.00	0.01
Africa	92	0.03	0.09	0.00	0.00	0.01
Middle East	45	(D)	(D)	(D)	(D)	(D)
Asia	1061	0.09	0.18	0.00	0.00	0.07

Notes: The sample includes all majority-owned affiliates with sales, assets, or net income (loss), greater than $25 million. 25, 50, and 75 percentiles report the average of the 9 firms surrounding the percentile affiliate. (D) Suppressed to avoid disclosure of firm-level data.

Table B3: Summary by industry

	Obs	Mean	Std	25pc	50pc	75pc
Sales to unaffiliated parties, as a share of total sales						
All	4911	0.73	0.34	0.58	0.91	1.00
Food, beverage, tobacco	481	0.80	0.32	0.75	0.98	1.00
Textile and apparel	89	0.76	0.34	0.58	0.96	1.00
Chemicals	1203	0.76	0.34	0.66	0.94	1.00
Glass and stone	84	0.83	0.25	0.76	0.94	1.00
Metal	104	0.77	0.33	0.67	0.95	1.00
Metal products	201	0.75	0.30	0.60	0.88	0.99
Machinery	485	0.64	0.36	0.33	0.79	0.97
Electronics	573	0.68	0.38	0.41	0.90	1.00
Electrical equipment	208	0.63	0.38	0.22	0.78	0.97
Transportation	635	0.75	0.32	0.61	0.88	1.00
Others	848	0.74	0.34	0.58	0.91	1.00
Shipments from parent, as a share of total input costs						
All	4908	0.07	0.29	0.00	0.00	0.04
Food, beverage, tobacco	481	0.01	0.05	0.00	0.00	0.00
Textile and apparel	89	0.05	0.16	0.00	0.00	0.01
Chemicals	1203	0.06	0.14	0.00	0.00	0.04
Glass and stone	84	0.06	0.14	0.00	0.01	0.04
Metal	103	0.06	0.15	0.00	0.00	0.03
Metal products	201	0.07	0.15	0.00	0.01	0.07
Machinery	485	0.07	0.16	0.00	0.00	0.07
Electronics	572	0.12	0.37	0.00	0.00	0.08
Electrical equipment	207	0.10	0.21	0.00	0.00	0.07
Transportation	635	0.09	0.52	0.00	0.00	0.02
Others	848	0.08	0.34	0.00	0.00	0.06

Notes: The sample includes all majority-owned affiliates with sales, assets, or net income (loss), greater than $25 million. 25, 50, and 75 percentiles report the average of the 9 firms surrounding the percentile affiliate.

Table B4: 1999 summary statistics

	All			Parent-Affiliate in manufacturing		
	Mean (1)	Median (2)	Weighted Ave (3)	Mean (4)	Median (5)	Weighted Ave (6)
Panel 1: Number of industries						
# A industries	1.41	1.00	1.65	1.59	1.00	1.79
# P industries	2.33	2.00	2.94	2.48	2.00	2.68
Panel 2: Share of sales in primary industry						
Affiliate	0.95	1.00	0.91	0.92	1.00	0.90
Affiliate-country aggregate†	0.90	1.00	0.85	0.89	1.00	0.87
Parent	0.85	0.98	0.80	0.82	0.90	0.81
Panel 3: Share of affiliate sales						
to unaffiliated parties	0.79	0.99	0.77	0.75	0.90	0.66
to affiliated parties	0.21	0.01	0.23	0.25	0.10	0.34
to local unaffiliate	0.67	0.92	0.68	0.59	0.68	0.52
to local affiliate	0.05	0.00	0.03	0.04	0.00	0.04
to parent	0.06	0.00	0.09	0.08	0.00	0.14
to U.S. unaffiliate	0.02	0.00	0.02	0.03	0.00	0.03
to third country affiliate	0.09	0.00	0.11	0.13	0.01	0.16
to third country unaffiliate	0.11	0.00	0.07	0.14	0.00	0.11
Panel 4: Allocated expenses and sales of services						
to the parent (share of input costs)	0.01	0.00	0.01	0.01	0.00	0.01
from the parent (share of aff. sales)	0.01	0.00	0.01	0.00	0.00	0.00
Panel 5: Share of affiliate input costs from parent						
total	0.06	0.00	0.09	0.09	0.01	0.15
for further processing	0.03	0.00	0.08	0.09	0.00	0.14
for distribution	0.02	0.00	0.01	0.00	0.00	0.01
of capital equipment	0.00	0.00	0.00	0.00	0.00	0.00

Notes: Panels 1–4 include all majority-owned affiliates with sales, assets, or net income (loss), greater than $50 million. Panel 5 includes all majority-owned affiliates with sales, assets, or net income (loss), greater than $100 million. Columns 2 and 5 report the average of the 9 firms surrounding the median. In columns 3 and 6 the average is weighted by affiliate employment. †An observation is the aggregate over all affiliates of a parent, by country.