Multinational Firms in Context*

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Abstract

Using a novel firm-level dataset linking directories of international ownership to the universe of manufacturing establishments in the Census Bureau, this paper studies multinational firms in the context of their exporting (non-multinational) and domestic-only counterparts. Multinational firms are shown to be larger, more productive, more capital-intensive, and pay higher wages than either domestic-only or exporting firms. The magnitude of this "multinational premia" is consistently 3-4 times that of the so-called "exporter premia" documented in previous research. Although 70 percent of multinational firms record positive levels of exports, the share of sales destined for outside the U.S. is small - only 10 percent. There is substantial evidence for the role of international ownership patterns on trade flows. Roughly 40 percent of the imports to a foreign multinational affiliate in the U.S. originate from the country of the parent company. The empirical evidence offers valuable guidance on the appropriate framework for thinking about multinational production more broadly.

JEL Codes: F10, F14, F23,

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Multinational firms are a dominant feature of the world economy, and these firms have attracted an enormous amount of research in recent years. According to aggregate numbers published by the Bureau of Economic Analysis (BEA), U.S. majority-owned manufacturing affiliates abroad recorded sales of over 2 trillion USD in 2009. By comparison, U.S. manufacturing exports in 2009 amounted to just 916 billion USD. Moreover, a significant fraction of exports are conducted within multinational firms. Bernard et al. (2010) report that 46 percent of imports are intra-firm.

Understanding the nature and determinants of multinational production has been complicated, however, by a general scarcity of firm-level data. Prior work on these firms have relied on data that has either neglected the heterogeneity that firm-level analysis can afford, or have failed to place these firms in the context of their exporting (non-multinational) and domestic-only counterparts. Specifically, an accurate assessment of how and why firms decide to locate production abroad should naturally consider an alternate method, namely trade, of accessing foreign markets and country-specific factors of production. Put differently, it is potentially misleading to look at exports without considering multinational production, and vice-versa.

This paper documents a number of stylized facts about multinational firms, using novel data linking directories of international firm structure to the universe of manufacturing establishments in the United States. In addition to providing critical benchmark groups for the analysis, this new data allows for multinational firms to be separated into those originating in the United States (U.S. multinationals) and those operating in the U.S., but originating abroad (Foreign multinationals). Indeed, standard models of FDI and multinational production would expect these firms to behave differently.

Such a novel dataset allows this research to explore questions that have been previously unanswered in the literature. Specifically, this paper explores how multinational firms differ from exporting and domestic-only firms, how ownership patterns affect trade flows, and the degree of heterogeneity across these types of firms at the industry-level. Underlying all of these questions are two competing frameworks with which to view multinational production. The "horizontal" framework of FDI is defined as the replication of production across countries in order to save on transport and tariff costs to more cheaply access foreign consumers. This

framework is exemplified in the "proximity-concentration tradeoff" popularized by Brainard (1997) and Krugman (1983). A second framework – termed vertical FDI – is defined as the fragmentation of the production process in order to take advantage of differing cross-country factors of production.[1] Hence, these frameworks differ not only in the motivation for multinational production, but critically in the destination of sales: horizontal FDI seeks to principally sell to the local market, whereas vertical FDI does not.

Section 1 provides information on the traditional sources of data on multinational firms and documents the datasets used in the present analysis. Section 2 presents some key findings of how multinational firms compare. The section shows that multinational firms are larger, more productive, more capital-intensive, pay higher wages, and employ more non-production workers than either domestic-only or exporting firms. This "multinational premia" is consistently 3-4 times the magnitude of the so-called "exporter premia" that has been previously examined in the literature.

Section 3 discusses the influence of international ownership patterns on trade flows. Although 70 percent of multinational firms in the manufacturing sector record positive levels of exports, the median share of a multinational firm's U.S. production is destined for sale outside the U.S. market is small - only 10-12 percent. Foreign multinational affiliates in the U.S. send roughly 15 percent of total exports to the country of their parent firm. A considerably larger share of exports - 37 percent - is directed at the economies of Canada and Mexico. The composition of the source countries of foreign affiliate imports is even more striking: roughly 40 percent originate from the country of the parent company.

Section 4 summarizes how the empirical evidence from the preceding sections speaks to the nature and determinants of multinational production. There is suggestive evidence for the presence of both horizontal and vertical notions of FDI, making any binary characterization of all multinational production in an economy necessarily incorrect. However, it appears to be the case that the large majority of the sales of Foreign multinationals in the United States is intended for local sale, consistent with horizontal FDI. At the same time, large shares of import flows for these firms from the country of their parent company suggests

[1] This framework is also referred to as the "factor proportions hypothesis", and dates back to at least Helpman (1984).

some fragmentation of production where intermediate inputs from the parent are assembled in the host country for local sale. This view is consistent with a "capabilities" definition of the firm as argued by Hortacsu, Hortacsu, and Syverson (2013), among others.

Finally, section 5 examines industry heterogeneity in the composition of exporting and multinational production. Separating the data into 18 manufacturing categories (roughly corresponding to the 3-digit NAICS subsectors) allows for an examination of the sectoral distribution of plants, sales, employment, and exports by firm type. The results show significant heterogeneity of multinational behavior across sectors. For example, Foreign multinational firms account for 27 percent of total sales in the Chemical Products sector, 28 percent in Nonmetallic Minerals, but only 8.3 percent in Fabricated Metals. In addition, the bulk of exporting activities by U.S. and Foreign multinationals are concentrated in the Chemical Products, Computer and Electronics, and Transport Equipment sectors. Although these three sectors comprise roughly 40-45 percent of total sales for these two groups of firms, the account for over 60 percent of total exports.

1 Data Description and Matching Procedure

This section outlines the traditional data sources used to study multinational firms, documents their relative strengths and weaknesses, and presents the details of the dataset used in the remainder of the paper.

1.1 Traditional Data Sources on Multinational Firms

Prior research has primarily relied on two principal data sources to infer information about multinational firms in the United States. Each source has some advantages while also suffering from important drawbacks.

The primary source for firm-level analysis of multinationals in the U.S. has been the annual surveys conducted by the Bureau of Economic Analysis. The Foreign Direct Investment in the United States (FDIUS) is run annually, with benchmark years being conducted in the years ending in a 2 or 7 (concurrently with the Economic Censuses of the Census Bureau). The U.S. Direct Investment Abroad (USDIA) survey conducts benchmark surveys

in those years ending in a 4 or 9. Numerous studies have used the aggregate totals from these surveys, or conducted firm-level analysis using the restricted datasets.[2] There are two primary disadvantages with the BEA data. First, the surveys sample *only* multinational firms, and thus there are no relevant comparison groups for the researcher interested in issues such as multinational entry/exit, export vs FDI decisions, and other questions where relevant benchmark groups are necessary. Second, the lack of standardized firm identifiers in the BEA data makes it difficult to link firms across time. Moreover, the sampling criteria in the non-benchmark years have changed frequently, making longitudinal analysis even more difficult.

A second source for identifying multinational firms has been the Longitudinal Foreign Trade Transactions Database (LFTTD). The LFTTD links individual trade transactions to firms operating in the U.S., and is assembled via a collaboration between the U.S. Census Bureau and the U.S. Customs Bureau. The LFTTD contains information on destination (or source) country, quantity and value shipped, the transport mode, and other details from point-of-trade administrative documents. Existing studies (e.g. Bernard et al. (2007), Bernard, Jensen, and Schott (2006), and Bernard, Jensen, and Schott (2009)) have identified multinational firms from a variable on the LFTTD that identifies whether a trade transaction took place at "arms-length" or by "related party". Using this variable, researchers have been able to infer multinational status depending on whether a firm has *any* related party trade.[3]

There are three primary difficulties of this approach. First, the ownership threshold that classifies a foreign trade transaction as between related parties differs between exports and imports, and is generally low relative to common definitions of international subsidiaries.[4] Second, the LFTTD data is unable to differentiate between a U.S.-based multinational with affiliates abroad, and a Foreign-based multinational with affiliates located within the United States. Finally, by its nature the LFTTD-based definition of a multinational will miss the

[2] A select sample of papers using the BEA data are: Zeile (1998), Borga and Zeile (2004), Ramondo, Rappoport, and Ruhl (2007), Yeaple (2009), and Helpman, Melitz, and Yeaple (2004).

[3] For an excellent summary of the sources of intra-firm trade statistics in the U.S., see Ruhl (2013).

[4] Firms are designated as "related" on the import side if either owns, controls, or holds voting power equivalent to 6 percent of the outstanding voting stock or shares of the other organization. (see Section 402(e) of the Tariff Act of 1930). On the export side, firms are designated as "related" if either party owns, directly or indirectly, 10 percent or more of the other party (see Section 30.7(v) of The Foreign Trade Statistics Regulations).

firm-level international ownership patterns that do not rely on frequent intra-firm trade.

This is not the first paper to seek alternative sources for identifying multinational firm behavior. Perhaps the study closest to the present paper is work by Doms and Jensen (1998), which utilized a short-lived link between the Census and BEA data for a select year in 1987.[5] This paper found foreign-owned plants to be more capital-intensive, more productive, pay higher wages, and use a higher proportion of nonproduction workers than typical U.S. plants. The study also found U.S. multinationals (defined by the paper as those U.S.-owned plants with > 10 percent of total assets held abroad) to outperform foreign-owned plants on the same set of criteria, though the differences were small.

Rowland and Tesar (2004) classify multinationals based on a listing of multinational corporations in the "Worldwide Branch Locations of Multinational Companies" (Hoopes, 1994). They examine whether investors can obtain international diversification via multinational firms, and find conflicting evidence depending on the country of portfolio. A recent paper by Fort (2013) uses a special inquiries section on the 2007 Census of Manufacturers which asks whether an establishment purchased contract manufacturing services either domestically or abroad . Using this information, the author shows that domestic fragmentation is considerably more common than foreign fragmentation. Finally, Alfaro and Charlton (2009) use a large proprietary directory from Dunn and Bradstreet to characterize FDI according to the industry classification of foreign affiliates. The authors argue that greater industry-level detail reveals considerably more vertical FDI than previously measured, thus labeling these affiliates "intra-industry" FDI.

1.2 Data Description

The strategy adopted by this paper is to utilize when possible the huge wealth of trade and operating data the firm level in Census Bureau data architecture. To identify multinational firms in the Census Bureau, this paper employs proprietary directories of international firm structure which are matched at the establishment level to data from the Census Bureau. The result is a unique dataset containing indicators of multinational status and ownership

[5]The BEA-Census link for establishment-level detail in manufacturing existed between 1987 and 1991. For more information on this link, see Commerce (1992).

information, together with a host of other firm-level characteristics.

The primary directory used is the LexisNexis Directory of Corporate Affiliations (DCA), which provides information on the ownership, organization, and locations of firms headquartered in the U.S. and abroad. The DCA consists of three separate databases: U.S. Public Companies, U.S. Private Companies, and International – those parent companies with headquarters located outside the United States. The U.S. Public database contains all firms traded on the major U.S. exchanges, as well as major firms traded on smaller U.S. exchanges. To be included in the U.S. Private database, a firm must demonstrate revenues in excess of $1 million, 300 or more employees, or substantial assets.[6] Those firms included in the International database, which include both public and private companies, generally have revenues greater than $10 million. Each database contains information on all parent company subsidiaries/affiliates, regardless of the location in relation to the parent company.

The second source used to identify multinational firms comes from Uniworld Business Publications (UBP). This company has produced periodic volumes documenting the locations and international scope of i) American firms operating in foreign countries; and ii) foreign firms with operations in the United States. Although only published biennially, these directories benefit from a focus on multinational firms, and from no sales threshold for inclusion.

These directories include establishment-level information on affiliate name, location, and industry classification; however, operating information on sales and employment is not always reported. To correct for this shortcoming, the paper links these directories to the Business Register (BR) of the U.S. Census Bureau. Originally known as the Standard Statistical Establishment List (SSEL), this register of information forms the backbone of many firm and establishment-level reporting to statistical and other federal agencies. In 2002 the SSEL was renamed the Business Register after a through redesign in order to improve coverage and quality control. There are two primary sources of information: First the IRS compiles information on single establishments and the administrative units of multi-establishment firms from payroll tax records. The Census Bureau's annual Company Organization Survey (COS) provides information on multi-unit establishments. The content of the Business

[6]This inclusion threshold changed in 2003, before which the criteria were mildly more restrictive.

Register includes business name and address, industry classification, and selected operating data (such as sales and employment). The frequency for updating individual data items varies from every quarter to every five years. The establishment and firm identifiers in the BR allow the researcher to match information to a wide array of other Census Bureau Data products. Specifically, this paper will use the 2007 Census of Manufacturers, along with the 2007 annual LFTTD files detailed above.

The Census of Manufacturers (CMF) is undertaken every five years (in years ending in a 2 and 7), and contains information on the universe of manufacturing establishments in the United States. Basic information collected from all establishments include kind of business, geographic location, type of ownership, annual and first quarter payroll, total revenue, and employees in the pay period including March 12. Larger and multi-unit establishments are required to report much more information, such as inventories, capital expenditures, value of shipments, cost of materials, and the identification of some 1,000 materials consumed.

1.3 Matching procedure

As there are no common firm or establishment identifiers linking the LexisNexis and Uniworld directories to the BR, the matching procedure relies on name and address information to link the datasets at the establishment level. The presence of misspellings, alternate name and address conventions, abbreviations, and other issues is a central challenge of this form of data linking, and as a result the researcher is forced to move beyond exact matches and consider linking records that have a high degree of similarity. Such probabilistic record linking algorithms are an active field of research across a wide array of different disciplines.

Appendix A provides detailed information on the matching process and reports various statistics on the match rate. In brief, the matching procedure utilizes a multi-variable weighted bigram matching algorithm as detailed by Blasnik (2010), and iterates several times with decreasingly stringent sets of match standards. As is frequently the case with such exercises, a degree of "ocular review" is used to supplement the automated steps in order to maintain a high degree of both accuracy and coverage. Although the matching is done at the establishment level, the foreign ownership and affiliate location information are

firm-level objects. The advantage of this feature is that these variables can be pulled through to all establishments within a firm even though only a subset of possible establishments may be matched.[7]

2 Multinational Firms in the U.S. Manufacturing Sector

This section documents a series of stylized facts regarding the characteristics of multinational firms relative other firms. The baseline dataset consists of manufacturing firms with operations in the United States in the year 2007. All information has been aggregated to the level of the firm.

2.1 Non-Parametric Estimates of Firm Distributions

Standard models of multinational production with fixed costs would predict multinational firms to be the largest in the economy, with exporting firms being larger than domestic-only firms.[8] To evaluate whether this prediction finds evidence in the data, Figure 1 plots non-parametric kernel density estimates of the distributions of each firm type according to log employment, a standard measure of firm size.[9] The figure confirms the predicted size ordering by firm type from theory. On the other hand, standard models abstracting from sunk or idiosyncratic fixed costs would predict a strict ordering – that is, the largest exporting firm should be smaller than the smallest multinational firm. This, of course, does not find evidence in the data as the densities exhibit substantial overlap by size. It is worth emphasizing the log scale in Figure 1 – the difference in central tendency in the multinational vs exporter densities is roughly $log(2.5)$, which corresponds to a factor of 12 difference in size. The typical multinational firm is larger than the typical domestic-only firm by a factor of almost 30.

[7] There are two complications that make the establishment-firm linkage more cumbersome. The first is joint ventures, which makes choosing the relevant parent firm less clear. The second complication comes from when there are disagreements between the proprietary directories and Census identifiers as to the boundaries of the firm. A discussion of the treatment of these special cases can be found in Appendix A.

[8] Helpman, Melitz, and Yeaple (2004) being the classic example.

[9] Note that this consists of employment in a firm's *manufacturing* establishments. A firm's employment in establishments identified in other industries is not counted.

While Figure 1 considers the distribution of firm size within each group of firms, it does not reflect the relative number of firms across these groups. The CMF identifies roughly $150,000$ manufacturing firms in the U.S. in 2007. This analysis identifies 80 percent of these firms as "domestic-only", 18 percent as recording positive exports without foreign operations, and only 1.7 percent as "multinational". To convey these relative disparities in the number of firms, figure 2 re-weights the distributions from figure 1 according to their relative shares. In other words, adding together these three distributions will accurately convey the firm-size distribution of all manufacturing firms in the U.S. This figure visually conveys the significant skewness in the right tail of the firm size distribution, which is significantly occupied by multinational firms.

Next, figure 3 examines whether the ordering follows through to productivity, measured by log value added per worker.[10] This indeed appears to be the case: relative to domestic firms, the density estimate for exporting firms is shifted to the right and the kernel density for multinational firms even more so.[11] Of course, there is substantial heterogeneity of productivity levels across industries, and thus it is possible that the productivity advantages of exporting and multinational firms may reflect a larger concentration in relatively high-productivity industries, rather than firm-level advantages. To account for this possibility, one can remove the common industry component from each productivity estimate. Following Lileeva (2008), I further scale by the inter-quartile range, to account for varying degrees of industry dispersion in productivity. Specifically, let $z_{i,j}$ be the productivity of firm i in industry j. Then the adjusted productivity measure $\tilde{z}_{i,j}$ is defined as follows:

$$\tilde{z}_{i,j} = \frac{z_{i,j} - \bar{z}_j^{50}}{\bar{z}_j^{75} - \bar{z}_j^{25}} \qquad , \tag{1}$$

where $\bar{z}_j^x$ is the xth percentile of industry j. Figure 4 displays the results. By construction, the overall density estimate is now centered around zero. As expected, the productivity distribution of domestic-only firms is largely symmetric about zero, with perhaps slightly

[10] Value added is measured as gross output minus material inputs.

[11] While this is possibly the first such picture corresponding to manufacturing firms in the U.S. economy, a number of other papers have documented similar results using data from other countries. For instance, see Mayer and Ottaviano (2007) for Belgium, Girma, Gorg, and Strobl (2004) for Ireland, and Antrás and Yeaple (2013) for Spain. The results from these studies largely align with the U.S. findings.

more mass in the negative region of the plot. The distribution of exporting firms is shifted (albeit slightly) to the right, and once again the distribution of multinational firms shifted further.

2.2 Multinational Premia vs Exporter Premia

This subsection turns to a basic regression framework to further analyze how multinational firms compare to their exporting and domestic counterparts. In an important contribution, Bernard et al. (2007) use the 2002 Census of Manufacturers to document a number of "premia" associated with exporting activity. The additional information in the present analysis allows for an extension of this prior work to include the premia associated with multinational activity. Moreover, separating out multinationals from firms engaging foreign markets exclusively through exporting allows for a more precise identification of premia corresponding to the act of export activity itself. To be concrete, some firms may primarily engage in multinational production to access foreign consumers, but nonetheless export to a small degree. Including these firms in the "exporter" category is not entirely accurate, and to the extent these firms exhibit higher premia will in a sense bias upward the estimates for the exporter category. On the other hand, there is also the potential for a multinational firm to exhibit no exports – either because it is a foreign affiliate solely accessing the U.S. market, or a U.S. multinational firm that *only* utilizes FDI to serve foreign markets. Grouping such a firm in the "non-exporter" category is also inaccurate, and may potentially affect the estimate for an "export-specific" premia in the opposite direction.

Specifically, rather than regress features of firm behavior on a dummy variable indicating the firm's export status, the analysis below separates out separate effects for three types of firms. Thus, to consider a specific dependent variable $X_{i,j}$ of firm i in industry j the specification,

$$log(X_i j) = \alpha_j + \beta^D E_{ij}^D + \beta^{MF} M_{ij}^F + \beta^{MU} M_{ij}^{US} + u_{ij} \tag{2}$$

allows for greater heterogeneity in separating out the mean effect by firm type. Here, the variable $E^D = 1$ when a firm reports positive exports (but is not identified as a multina-

tional), $M^F = 1$ identifies a Foreign multinational firm, and $M^{US} = 1$ for U.S. multinational firms. The term α_j removes an industry fixed effect. The control group are those firms without international exposure – the domestic-only group.

Tables 1 and 2 contain the results of these regressions, using a number of different firm characteristics as dependent variables. In each case the first and third columns correspond to using the exporter dummy by itself – that is, these columns are a 2007 update to the calculations made in Table 3 of Bernard et al. (2007). These numbers largely confirm the results of the earlier study. Columns two and four report the results for the more flexible specification outlined in equation 2.

Table 1 compares the size and productivity-related regression coefficients corresponding to each type of firm identified above. The estimate of the premia associated with exporting when multinationals are treated separately are quite similar to the baseline. This is likely due to the small share of multinational firms relative to both the non-multinational exporters and the control group of domestic-only firms. The estimated premia associated with multinational status, however, are generally three to four times the magnitude for exporting. The estimated productivity premia between the Foreign multinationals and U.S. multinationals are broadly similar, though Foreign multinationals appear to be slightly more productive.

Table 2 considers other firm characteristics, such as the capital intensity, average wage, and share of non-production workers in total employment. Once again the exporter premia are largely consistent with the estimates corresponding to the specification from Bernard et al. (2007) when multinationals are not included. The exception is the premia associated with capital intensity, which was measured to be in the 4 to 12 percent range in the 2002 data, are actually reported to be negative in some specifications in 2007. The Foreign and U.S. multinationals, on the other hand, are roughly 60-80 percent more capital intensive than the control group of domestic-only firms. Exporting firms pay on average 5 percent more in average wage than a domestic-only firm, but the wage premia for multinationals is once again considerably higher: multinationals pay roughly 20 percent higher wages than the baseline firm.

Finally, it is interesting to note that the premia associated with the share of non-production workers in total employment is lower for Foreign multinationals than U.S. multi-

national firms. This likely reflects some share of the "headquarter services" for foreign multinationals to be taking place in the country of origin, and thus not being picked up in the U.S. statistics. On the other hand, the premia is still significantly higher than the baseline, domestic-only firm.

We consider how these results speak to the horizontal vs vertical FDI frameworks in section 4.

3 The Impact of Ownership on Trade Flows

Information on the participation and size of trade at the firm level provide valuable insight into the determinants of aggregate trade flows. Moreover, combining this with the multinational status of the firm allows one to draw further conclusions regarding the nature and purpose of locating production outside of a firm's home country. This section explores these questions using export data from the CMF, as well as transaction level import/export data from the LFTTD.

3.1 Multinational Exporters

Table 3 reports summary statistics on export activity among the three specific types of exporters: non-multinationals, U.S. multinational firms, and foreign affiliates in the United States. First, the table confirms the stylized fact from Bernard et al. (2007) that just under 20% of firms export. However, among U.S. multinational firms, the number is significantly higher: 68% report non-zero exports. Remarkably, the number is nearly the same for foreign affiliates operating in the United States. At first glance, this number seems to provide substantial support for the vertical notion of FDI, as the country of sale for multinational affiliates is often distinct from the country of production.

Exploring further, table 3 takes the number of firms recording positive exports, and then calculates the share of export sales in the total sales reported by the firm. This exercise makes clear that exports represent a small portion of total sales regardless of firm type. For the median domestic-exporter, only 6.7% of firm sales are destined for outside the United States. The corresponding numbers for Foreign and U.S. multinationals are slightly higher,

at 10% and 12% respectively. Although this is a relatively small number, it does not rule out the presence of a subset of largely export-oriented multinationals. The distribution of firms is known to be highly skewed in a number of different dimensions, and thus the median could mask significant detail in the right tail. To explore this possibility, the table then reports other moments of the distribution: the mean, 25th, and 75th percentiles. Even when considering the 75th percentile of this statistic, the share of exports in total sales is still only between 19 and 26%.

For a final check on the potential for a small subset of predominantly exporting multinationals in the U.S., we rank each firm type by total export sales, and then consider the top 5% according to exports by each firm type. Remarkably, the exports in total sales for this select group remains surprisingly low: the median Foreign multinational in this group records 16% of exports in sales, and for the median U.S. multinational, only 20%. As might be expected when considering the results in table 1, the figure for non-multinationals is slightly higher.

3.2 Export Destinations and Import Sources

The analysis now turns to the destinations of exports and source of imports by firm type. Put differently, the paper will now examine the extent to which firm ownership patterns affect trade flows. As such, this section switches the source of trade from the CMF to the LFTTD. The drawback is that the connection to other firm attributes, such as sales, material inputs, etc, is less strong. The advantage is the ability to consider country-specific exports, and the ability to separately consider import flows.

For ease of exposition, we first compare the trade flows of Foreign multinationals from a single source country – Japan – to U.S. multinationals and exporting/importing non-multinationals. Panel A of Table 4 divides the destination of exports into five broad groups: Japan, North America, EU-15, "Low- Wage", and a residual "Other" category.[12] A country is defined as "low-wage" if its GDP-per capita was less than 20% of the U.S. value in 2007.[13]

[12]The EU-15 consists of the European Union member countries prior to the 2004 enlargement. The 15 countries are Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden, United Kingdom.

[13]The list of countries in this category is provided in Table A4. Using a threshold of 10% of U.S. GDP per capita

For Japanese multinationals operating in the U.S., the exports to Japan represent exports back to the "source" country.

Over 21 percent of the exports of Japanese multinationals in manufacturing are destined to the "source" country of Japan. This is substantially larger than the average U.S. multinational or non-multinational firm, which report less than 5 percent of exports destined for Japan. In contrast, all three firm types report the predominant share of exports to be destined for North America.

Panel B of Table 4 replicates Panel A but instead considers the source countries of firm imports. Most striking is that Japanese multinationals on average receive over 60 percent of imports from their source country. This is in contrast to the average non-Japanese multinational importing firm, which records only about 4-5 percent of imports sourced from Japan. U.S. multinationals and importing non-multinationals, on the other hand, rely most heavily on imports from "low-wage" source countries, as well as countries comprising the EU-15. Japanese multinational affiliates import comparatively less from North America and the EU-15, though still import about 16 percent of the total from "low-wage" countries.

Table 5 expands the analysis from Table 4 to include Foreign multinationals from all source countries. In this table, the destination/source of Japan has been replaced with the corresponding "Source Country" label, which is calculated as the statistic representing the average Foreign multinational firm. To be precise, the shares for the Foreign multinational category are a weighted average using the number of Foreign multinational firms in each country as weights. These country weights are then applied to the U.S. multinational and non-multinational groups as well, to keep the comparisons meaningful.[14][15]

The results are broadly similar to the case using Japanese multinationals as the benchmark. Country ownership continues to be a strong driver of trade flows, particularly for imports to the United States. For the average Foreign multinational firm, roughly 17 percent of exports are destined back to the source country, and almost 44 percent of imports

generated qualitatively similar results.

[14] It is important to note that the destination/source groups are not mutually exclusive for all countries. For example, the exports to the EU-15 for a Foreign multinational from France would correspond to all non-French EU-15 countries, as exports to France would already be counted in the "source country" category.

[15] Using other weights to aggregate the Foreign multinational country groups up to an aggregate (such as employment of affiliate, or size of trade) yield qualitatively similar results.

originate from the source country. In contrast U.S. multinationals and non-multinational firms export roughly 5 percent to – and import roughly 5 percent from – the average country representing this group. The North American countries of Canada and Mexico are the most significant export markets for all three types of firms.

The large disparity in export/import shares to/from the source country raise questions as to the relative values of trade for these firm types. Exploring further, Table 6 documents the average magnitudes of exports and imports for the three types of firms. On average, Foreign multinational firms import substantially more (roughly 3 times as much) than they export. Multinational firms headquartered in the United States, on the other hand, actually report a higher share of exports than imports. Interestingly, the non-multinational firms also display a large deficit between the average export and import values, though not as large as the Foreign multinationals. Not surprisingly, the average trade values of non-multinationals are two orders of magnitude smaller than either multinational group.

The second set of rows in Table 6 aggregates the trade flows by firm type. In the year 2007, Foreign multinationals in the United States recorded a trade deficit of 222.5 billion USD. The published trade deficit in goods for that year recorded by the BEA was 822.7 billion, implying that Foreign multinationals accounted for over 27 percent of the total U.S. goods trade deficit. Of course, if we restrict the trade flows to only those manufacturing firms (for which we have firm identifiers in the LFTTD) in the U.S. economy, the share rises to over 56 percent.[16] It is also worth noting that the U.S. multinationals record a small trade surplus, but not nearly as large as the deficit incurred by Foreign multinationals.

There are a number of potential explanations for the high ratio of imports to exports corresponding to Foreign multinational firms. First, the U.S. affiliates of these firms may concentrate on the final goods assembly for sale in the U.S., which may require substantial import of intermediate inputs and limited export to other markets. A second explanation may be that these firms also consist to some degree as the wholesale/retail operations for final goods imported directly from the source country. Finally, it is possible that the import and export numbers for multinational firms (both Foreign and U.S.) are influenced by transfer

[16] This number is calculated as $\frac{222,496}{/}(222496 + 206604 - 33956)$.

pricing considerations for motives such as profit shifting.[17] An obvious method of differentiating the first and second explanations would be to differentiate the import values into categories based on intended use: final consumption goods, intermediate inputs for further manufacture, and capital goods. Unfortunately, the LFTTD provides no direct information on the intended use of product being traded.[18]

The FDIUS survey from the BEA offers some partial answers to the composition of imports for Foreign multinationals. Specifically, the survey asks firms to separate out trade transactions by the intended use: 1) capital goods; 2) goods for resale without further manufacture; and 3) goods for further manufacture. The published totals using the benchmark 2007 survey indicate that the share of imports "for further manufacture" from all countries among U.S. foreign affiliates is 0.66 in the manufacturing sector.[19] Unfortunately, the published tables do not break down this industry-level detail based on the origin of the import, or whether the import came from the foreign parent group. Looking at the share of "for further manufacture" in total imports for all industries from the foreign parent group, the share is somewhat higher at 0.75 (see table II.G23).[20] Thus, one could infer that somewhere between 65 and 75 percent of a foreign affiliate's U.S. imports from the parent group are for further manufacture.[21]

[17] For an analysis of the transfer pricing behavior of "U.S. based multinationals" (which include the U.S. multinationals and foreign multinational affiliate operations in the U.S.) see Bernard, Jensen, and Schott (2006).

[18] There are two potential sources of data that may provide more firm-level information on the type of product being traded. The first would be the input-output tables produced periodically by the BEA. The disadvantage of this approach is the difficulty in concording the HS codes (which are defined as "products") to the direct requirements tables produced by the BEA, which exist at an industry-level. The second source of data is the product trailer files of the CMF, which could be used alongside the HS product information to infer what is actually produced at U.S. locations. Concordances to match HS codes to the NAICS product classes have been made available as documented in Pierce and Schott (2012). These avenues will be explored in future work.

[19] This share is calculated by dividing the manufacturing totals using tables II.G24 and II.G6.

[20] BEA data estimate that the share of imports from the foreign parent group represent 67 percent of total imports in the manufacturing sector.

[21] See Zeile (1998) for a more complete analysis of the trade and input sourcing of Foreign multinationals, using the 1992 benchmark FDIUS data. For this activity based on USDIA data, see Borga and Zeile (2004). Interestingly, Zeile (1998) also presents estimates from the BEA on the share of imports of foreign multinationals arriving from the investing (source) country. The average for manufacturing affiliates of 60 (confirm!) percent is even higher than the estimates reported above in table 5 for 2007.

4 Vertical vs Horizontal FDI

The empirical picture formed from the results of the preceding sections offers valuable guidance on how to properly motivate and model multinational production.

Recall that a critical distinction between the competing horizontal-vs-vertical theories of multinational production is the location of final sale. Vertical FDI seeks to take advantage of differing factors of production, whereas horizontal FDI locates production abroad to save on transport costs in accessing the host country market. Taken as a whole, the results from this paper show that a binary classification of foreign investment in the United States is misleading. As is clear in Table 3, firms with production abroad engage in trade to a large extent. Roughly 70 percent of the foreign affiliates operating in the United States export goods abroad, and the fraction is remarkably similar for U.S. multinationals. This would seemingly give support to the vertical notion for Foreign multinationals, in which the ultimate sale is outside of the location of production. Moreover, a surprising finding of this paper is the extent to which foreign affiliate operations rely on imported goods (and what could arguably be called imported intermediate goods) from their source country. This finding goes against the strict tradeoff between exporting and multinational production that is implied in the horizontal view of FDI, and more to one involving the fragmentation of production as implied in the vertical view. The presence of exporting behavior among U.S. multinationals has similar implications.

Yet, other features of the data lend support to the horizontal framework. While a strong majority of multinational firms also export, the share of exports in total shipments is quite small. Table 3 shows that the share of exports for the average firm is small – the median Foreign multinational firm exports only 10 percent of its shipments in 2007. Even when considering the right tail of the exporting distribution of multinational firms, the share of exports does not surpass 25 percent. Moreover, Table 5 indicates that a substantial share of these exports are destined for either Canada and Mexico – which could arguably be classified as a common market with the U.S. Finally, the evidence of large import shares from the country of origin – combined with suggestive evidence from BEA data– lends support to a framework in which the multinational firm relies on intermediate inputs from the source

country for further production and sale principally in the host market.[22]

Such a hybrid horizontal/vertical framework requires a careful re-thinking of the role of the firm across national boundaries. Why might it be the case that a multinational affiliate sources intermediate inputs from the source country for sale in the host market? Considering the "capabilities" notion of the firm as emphasized by Hortacsu, Hortacsu, and Syverson (2013) offers one potential explanation. Suppose there is a firm born in the Home country that is endowed with a particular capability. If some degree of that capability is location dependent, then the firm's international sales will be subject to other considerations beyond those present in the proximity/concentration or factor-proportions frameworks. The firm may optimally maintain some production phases in the country of origin while expanding others (less location-dependent capabilities) abroad. Such a framework would be consistent with the fact that Toyota continues to send 2 million transmissions a year to North America, despite having numerous production facilities in the United States and Mexico.[23] Further evaluation of such a capabilities-driven framework is an area for future research.

How might one reconcile the evidence supporting this nuanced view of multinational firm behavior with the findings from previous research in support of either horizontal or vertical FDI? Specifically, there are two recent papers that emphasize the vertical dimension of multinational behavior: the export platform FDI emphasized in Tintelnot (2013), and the intra-industry FDI pointed out in Alfaro and Charlton (2009). While this paper supports the presence of export platform FDI, it finds the quantitative magnitude of this behavior to be small. In the United States, foreign firms locate production principally for local sale. The statistic cited in Tintelnot (2013) of exports accounting for roughly 40 percent of U.S. multinational affiliate output in Europe is likely due to the unique market environment of the European Union. At the same time, however, the low export share in the United States is also surely influenced by the fact that the U.S. is a large and relatively isolated market. These distinctions point to the importance of geographic factors, market size, and development status as other determinants of the form of multinational production and should be areas

[22]The model of input sourcing and multinational firms in Garetto (2013) is an important contribution of how to endogenize production decisions across locations. The model, however, rules out horizontal FDI. Irarrazabal, Moxnes, and Opromolla (2013) is another example of the integration of intra-firm trade and multinational production.

[23]See Chappell (2011)

for further research.

Alfaro and Charlton (2009) emphasize that previous studies relying on coarse industry classifications across firm locations may tend to mischaracterize the form of FDI. Using a more highly disaggregated 4-digit industry classification of affiliate locations, the authors argue that the share of vertical FDI is considerably higher than previously thought. The authors rely on a definition of horizontal FDI as any affiliate operation in the same 4 digit SIC industry as its parent firm. An important drawback of this definition is that it ignores the "replication of production" feature inherent in the proximity-concentration tradeoff, particularly for firms whose establishments span many industries even within their home country.[24] To explore the extent of this disconnect, I use the industry and affiliate information in the DCA data for 2007 and calculate the implied shares of vertical FDI based on several definitions of such a intra-firm industry classification.

Table 7 presents the results. Looking at the foreign affiliates of manufacturing parent firms (the middle column), the Alfaro and Charlton (2009) definition of horizontal FDI does indeed represent a low share of foreign affiliate operations – only 38.7. However, if you expand the definition to include those cases when a foreign affiliate replicates the industry of a domestic affiliate within the same parent firm, the share increases substantially. Finally, if a foreign affiliate shares any industry with a domestic establishment within the same firm (parent or domestic affiliate), the share climbs to over 62 percent. An alternate exposition of this point is to consider the scatterplots comprising Figure 5. Here we take each parent firm in the manufacturing sectors (based by 4 digit SIC), and plot the industries of each domestic affiliate. The top panel demonstrates the substantial degree of vertical integration even within a firm's home country. The bottom panel overlays the parent firm's foreign affiliates in red. It is remarkable the extent to which the within-firm industry clustering abroad mirrors that at home.

Ramondo, Rappoport, and Ruhl (2007) eschews industry as a reliable indicator of the horizontal-vertical nature of foreign affiliates. Among other useful empirical evidence from the confidential firm-level BEA data, the authors document that almost 55 percent of af-

[24] It should be noted, however, that Alfaro and Charlton (2009) emphasize that the horizontal-vertical distinction is not always clear-cut.

filiates report no shipments to their parent. The paper does not, however, devote much attention to the flow of trade in the other direction – from parent firm to foreign affiliate.

5 Industry Composition

This section separates the data into 18 manufacturing sectors, (roughly corresponding to the 3-digit NAICS subsectors) to examine industry heterogeneity in the composition of exporting and multinational production. It is important to note here that the nature of the data linking prevents any claim for the samples of U.S. and Foreign multinationals to be complete; however, it is likely that the considerable majority of these firms are included.

Table 8 documents the distribution of manufacturing plants across industries and firm type. Although most manufacturing establishments are domestic-only in nature, the totals hide substantial variation across industry subsectors. U.S. multinationals represent 24 percent of plants in the Paper Products subsector, while non-multinational exporters represent over 31 percent of the plants in the machinery and computer/electronics subsectors. The share of domestic-only plants ranges from a low of 46.3 percent in the Chemical products subsector to a high of over 90 percent in the furniture and related subsector.

Multinational firms represent a considerably larger share of firm sales, as is evident in Table 9. The sales of Foreign multinational firms tend to be largely in the Petroleum and Coal, Chemical Products, and Transport Equipment, which together make up 56 percent of the total sales by this group. At the same time, there is substantial heterogeneity in the representation of this group of firms within a particular subsector. For example, Foreign multinational firms account for 27 percent of total sales in the Chemical Products sector, 28 percent in Nonmetallic Minerals, but only 8.3 percent in Fabricated Metals. As Table 10 demonstrates, the employment is spread more evenly across the subsectors.

The largest degree of concentration within industries and type of firm appears when considering export activity. This is shown in Table 11. The bulk of exporting activities by U.S. and Foreign multinationals are concentrated in the Chemical Products, Computer and Electronics, and Transport Equipment subsectors. Although these three subsectors comprise roughly 40-45 percent of total sales for these two groups of firms, the account for over 60

percent of total exports. This fact is also present when comparing the share of exports in total shipments for these subsectors, shown in Table 12.

6 Conclusion

This paper utilizes a novel dataset to examine the behavior and operations of multinational firms in the context of other manufacturing firms in the U.S. economy. The benchmark groups allow for a more complete picture of the firm size distribution as it relates to international exposure, as well as accurate estimates of the "premia" associated with firms engaged in exporting and multinational production. The country of ownership of Foreign multinationals in the United States is a strong predictor of trade flows, particularly on the import side.

Although this study contains several new insights into multinational firm behavior, there are a number of unanswered questions for future work. In particular, further information on the type of trade taking place between foreign affiliates and their country of origin will clarify the position of the affiliate in a firm's global production chain. Relating the products being imported by foreign affiliates to the products produced appears to be a promising approach in this regard. Moreover, using the arms-length and related-party indicators in the LFTTD data should help characterize the extent of intra-firm trade between affiliates and their country of origin. This information may also help to clarify the extent to which transfer-pricing influences a firms reported trade values.

Hopefully the empirical picture of the multinational firm in this and future research will help inform further study on the role of these firms in subjects such as international business cycles, domestic employment dynamics, and other aggregate phenomena.

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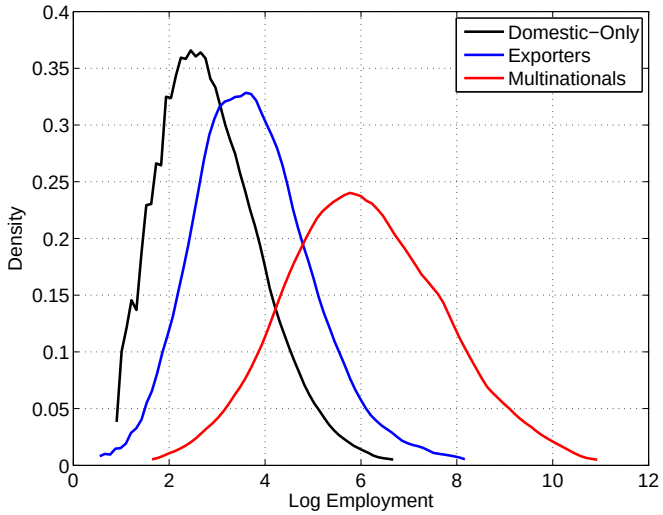
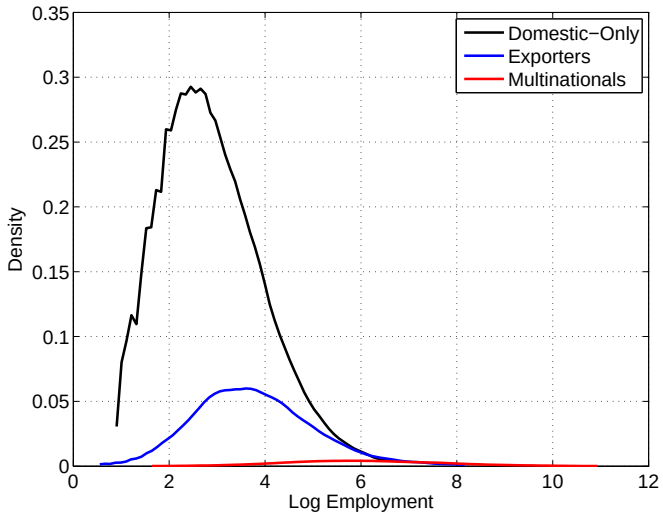
Figure 1. Kernel Density Estimates of Firm Size Distribution



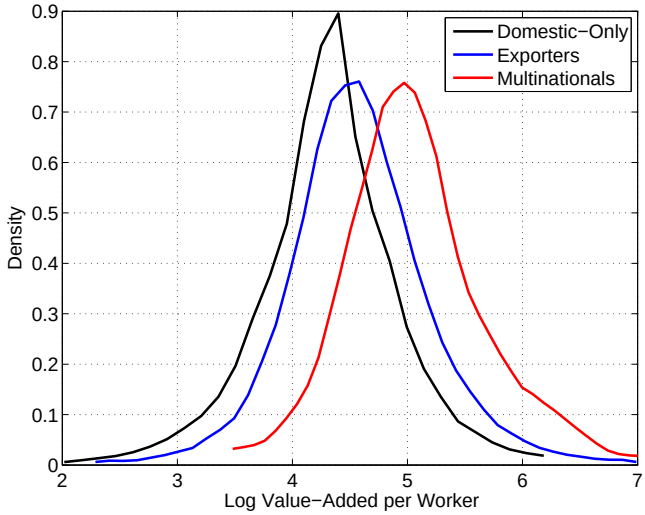
Source: CMF, DCA, and UBP as explained in the text. The data is for year 2007.
This figure plots the kernel density estimate of firm size (measured by log employment) based on three firm types: domestic-only, exporting (non-multinational) and multinational firms.

Figure 2. Kernel Density Estimates of Firm Size Distribution



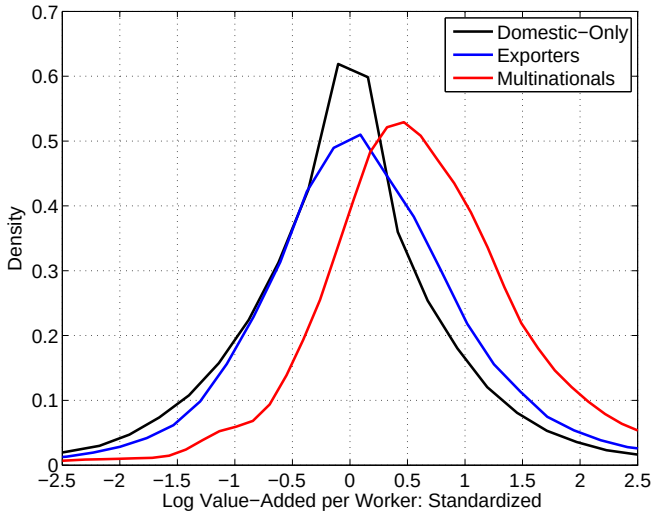
Source: CMF, DCA, and UBP as explained in the text. The data is for year 2007.
This figure plots the kernel densities from figure 1 but re-weights each density based on its share of the total manufacturing firms in the U.S. economy. The domestic-only group represents roughly 80 percent of all manufacturing firms, the exporting group 18 percent, and the multinationals only 2 percent.

Figure 3. Kernel Density Estimates of Firm Productivity Distribution



Source: CMF, DCA, and UBP as explained in the text. The data is for year 2007. This figure plots the the kernel density estimate of firm productivity (measured by log value-added) based on three firm types: domestic-only, exporting (non-multinational) and multinational firms.

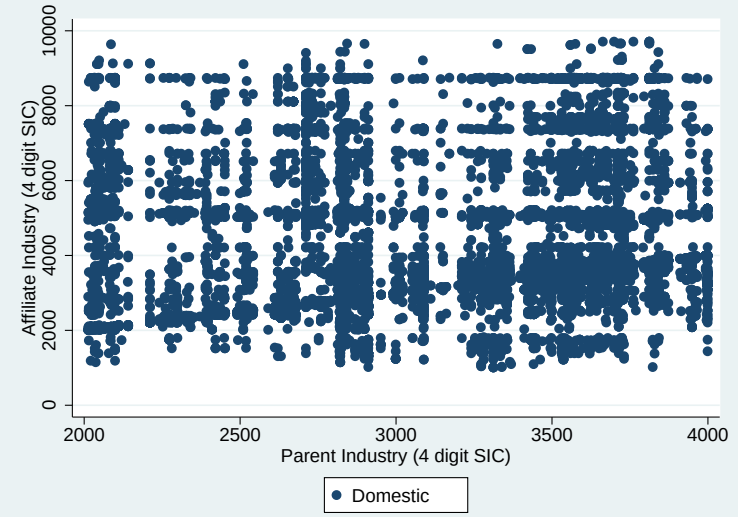
Figure 4. Kernel Density Estimates of Firm Productivity Distribution



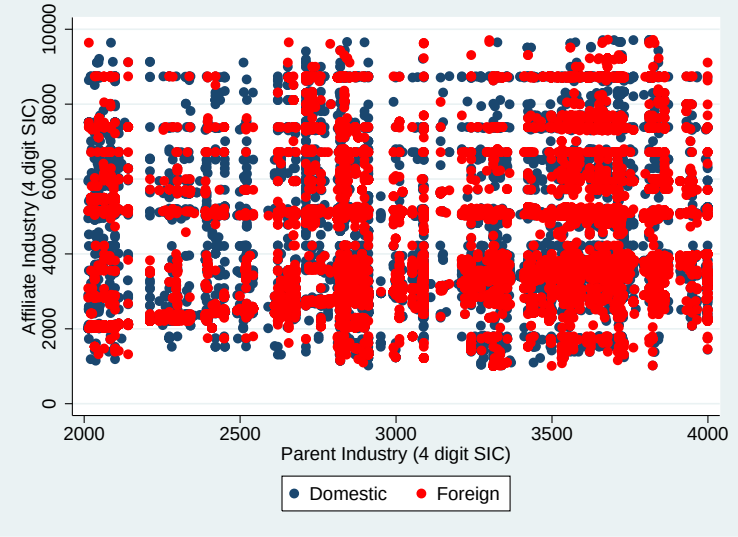
Source: CMF, DCA, and UBP as explained in the text. The data is for year 2007. This figure plots the kernel density estimate of firm productivity (measured by employment) that has been standardized to account for differences across industry. See equation 1 in the text. The kernel density estimates are shown separately for three firm types: domestic-only, exporting (non-multinational) and multinational firms.

Figure 5. Industry of Affiliate by Industry of Parent: Parent Manufacturing Firms

A. Domestic Affiliate Locations



B. Domestic and Foreign Affiliate Locations



Source: DCA, 2007.
This figure plots the scatters pertaining to the industry of domestic and foreign affiliate establishments for parent firms in the manufacturing sector. Each dot represents a particular industry of a parent firm's affiliate.

Table 1. Size and Productivity Premia for Exporting and Multinational Activity

Var	Log Shipments				Log Output per Worker				Log Value-Added per Worker			
Exporter	1.07		0.14		0.20		0.18		0.13		0.14	
Domestic Exporter		0.94		0.13		0.18		0.17		0.12		0.13
Foreign Multinational		3.26		0.64		0.70		0.67		0.50		0.53
U.S. Multinational		3.65		0.49		0.56		0.52		0.45		0.49
Industry Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Log Employment	No	No	Yes	Yes	No	No	Yes	Yes	No	No	No	No
Observations	151,635				151,635				151,170			

Source: CMF, DCA, and UBP as explained in the text. The data is for year 2007.
*All Coefficients are significant at the 1% level. This table reports the regression coefficients corresponding to dummy variables assigned by firm type. See equation 2 in the text.

Table 2. Other Premia for Exporting and Multinational Activity

Var	Log Capital per Worker				Log Wages				Log Skill per Worker			
Exporter	-0.02		0.00[1]		0.05		0.06		0.06		0.15	
Domestic Exporter		-0.05		-0.01		0.05		0.05		0.06		0.14
Foreign Multinational		0.76		0.88		0.19		0.20		0.05		0.33
U.S. Multinational		0.61		0.75		0.19		0.21		0.07		0.41
Industry Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Log Employment	No	No	Yes	Yes	No	No	Yes	Yes	No	No	No	No
Observations	151,257				151,669				139,763			

Source: CMF, DCA, and UBP as explained in the text. The data is for year 2007.
*All Coefficients are significant at the 1% level. This table reports the regression coefficients corresponding to dummy variables assigned by firm type. See equation 2 in the text.
[1] indicates coefficient is not significant

Table 3. Exports by Firm Type

	Foreign Multinationals	U.S. Multinationals	Non Multinationals
Percent Exporters	70.7	68.3	19.1
Exports as % of Total Shipments			
Mean	16.0	19.1	16.3
25th Percentile	4.1	4.9	1.9
50th Percentile	10.6	12.4	6.7
75th Percentile	20.3	26.8	19.2
Top 5% by Volume of Exports			
Mean	24.2	25.5	34.8
50th Percentile	16.1	20.0	25.9

Source: CMF, DCA, and UBP as explained in the text. The data is for year 2007.

Table 4. Trade by Destination/Source and Firm Type: Japanese Multinationals

Destination / Source	Japanese Multinationals	U.S. Multinationals	Non Multinationals
		Panel A: Exports	
Japan	21.3	4.7	3.0
North America	39.1	33.6	45.3
EU-15	14.9	23.8	18.2
Low-Wage[1]	11.9	17.8	13.9
Other	12.8	20.1	19.6
		Panel B: Imports	
Japan	61.2	5.4	4.5
North America	9.0	20.0	11.8
EU-15	7.0	29.2	27.9
Low-Wage[1]	16.2	30.4	37.8
Other	6.6	15.0	18.0

Source: CMF, LFTTD, DCA, and UBP as explained in the text. The data is for year 2007. This table reports the share of trade based on the destination/source for the three firm types. For the sake of clarity, the Foreign multinationals are restricted to only those from Japan.

[1] Defined as GDP per capita less than 20% of U.S. level in 2007.

Table 5. Trade by Destination/Source and Firm Type: All Multinationals

Destination / Source	Foreign Multinationals	U.S. Multinationals	Non Multinationals
		Panel A: Exports	
Source Country	17.5	5.4	5.7
North America	35.7	31.4	41.9
EU-15	15.0	21.9	16.7
Low-Wage[1]	13.9	17.8	13.9
Other	17.7	23.4	21.6
		Panel B: Imports	
Source Country	44.0	4.9	4.2
North America	11.3	19.1	11.2
EU-15	18.8	26.7	25.5
Low-Wage[1]	16.2	30.3	37.8
Other	9.5	18.7	20.9

Source: CMF, LFTTD, DCA, and UBP as explained in the text. The data is for year 2007.
This table reports the share of trade based on the destination/source for the three firm types. The shares for Foreign multinatioanls are calculated from averaging the shares from each source country and using the number of firms from each source country as weights. These averages are then applied to the U.S. and non-multinational samples, to keep the comparisons meaningful.
[1] Defined as GDP per capita less than 20% of U.S. level in 2007.

Table 6. Exports vs Imports by Firm Type (Millions USD)

	Foreign Multinationals	U.S. Multinationals	Non Multinationals
Average Value of Trade			
Exports	108.7	255.8	1.3
Imports	298.6	233.7	2.6
Ratio	**2.7**	**0.91**	**2.0**
Total Value of Trade			
Exports	126,776	382,238	195,481
Imports	349,272	348,281	402,086
Deficit	**-222,496**	**33,956**	**-206,604**

Source: CMF, LFTTD, DCA, and UBP as explained in the text. The data is for year 2007.

Table 7. Industry Composition of Affiliates: DCA 2007

		All Foreign Affiliates	Foreign Affiliates of Manuf. Parents	Foreign Manuf. Affiliates of Manuf. Parents
Number of Affiliates		56,942	30,665	21,393
Same Industry as Parent?	Yes	21,270	11,864	11,245
	No	35,672	18,801	10,148
	% Same	37.4	38.7	52.6
Same Industry as Domestic Affiliate?	Yes	29,554	15,545	12,686
	No	27,388	15,120	8,707
	% Same	51.9	50.7	59.3
Same Industry as Parent or Domestic Affiliate?	Yes	36,185	19,062	15,959
	No	20,757	11,603	5,434
	% Same	63.5	62.2	74.6

Source: Directory of Corporate Affiliations (DCA), 2007

Table 8. Percent of Plants by Industry: 3 Digit NAICS Industries

NAICS	Description	Total	US. Mult	Foreign Mult	Exporter	Domestic Only	US. Mult	Foreign Mult	Exporter	Domestic Only
		Within Types					Across Types			
311	Food	7.5	8.7	5.7	5.0	8.0	7.9	3.0	11.0	78.1
312	Beverage & Tobacco	1.0	1.7	1.1	0.9	1.0	11.2	4.1	15.1	69.7
31X	Textile, Apparel, Leather	6.2	2.1	1.0	4.2	7.3	2.3	0.6	11.2	85.9
321	Wood Products	4.9	3.7	1.0	3.0	5.6	5.2	0.8	9.9	84.1
322	Paper Products	2.1	7.3	2.3	2.2	1.6	24.0	4.3	17.0	54.7
323	Printing & Related	9.5	3.5	1.5	3.8	11.7	2.6	0.6	6.7	90.2
324	Petroleum and Coal	1.0	0.8	5.8	0.5	0.9	5.5	22.3	8.4	63.8
325	Chemical Products	4.6	11.9	13.3	7.1	2.9	17.6	11.2	24.9	46.3
326	Plastic & Rubber	4.8	7.2	6.1	7.7	3.9	10.2	5.0	26.2	58.7
327	Nonmetallic Mineral	6.5	2.4	25.9	2.4	6.8	2.5	15.5	6.0	76.0
331	Primary Metals	1.8	3.5	3.2	2.6	1.3	13.6	7.2	24.4	54.8
332	Fabricated Metals	18.5	10.1	7.9	17.4	20.1	3.7	1.7	15.5	79.2
333	Machinery	8.3	10.3	8.2	16.0	6.3	8.6	3.9	31.8	55.8
334	Computer & Electronics	4.0	9.8	5.1	7.6	2.6	16.9	5.0	31.1	47.0
335	Electrical Equipment	1.9	4.2	2.7	3.4	1.3	15.4	5.7	29.2	49.8
336	Transport Equipment	3.8	7.2	5.6	5.6	3.0	12.9	5.8	24.1	57.2
337	Furniture & Related	5.5	1.8	0.5	2.3	6.8	2.3	0.4	7.0	90.4
339	Miscellaneous	8.2	3.8	3.1	8.2	8.9	3.2	1.5	16.4	79.0
	TOTAL	100	100	100	100	100	6.9	3.9	16.4	72.9

Source: Census of Manufacturers, Directory of Corporate Affiliations, and Uniworld Business Publications as explained in the text. Data is for the year 2007.

Table 9. Percent of Sales by Firm Type: 3 Digit NAICS Industries

NAICS	Description	Total	US. Mult	Foreign Mult	Exporter	Domestic Only	US. Mult	Foreign Mult	Exporter	Domestic Only
		Within Types					Across Types			
311	Food	11.1	11.3	6.8	9.0	15.1	35.9	9.7	18.6	35.9
312	Beverage & Tobacco	2.4	4.0	1.1	1.7	1.7	57.8	6.9	16.2	19.0
31X	Textile, Apparel, Leather	1.7	1.2	0.4	2.0	3.0	24.9	3.8	26.2	45.1
321	Wood Products	1.9	0.9	0.2	1.5	4.4	17.7	1.5	18.4	62.4
322	Paper Products	3.4	4.8	2.0	2.9	2.6	50.9	9.5	19.4	20.2
323	Printing & Related	1.9	1.1	0.8	1.1	4.4	20.5	6.4	12.5	60.5
324	Petroleum and Coal	11.7	8.0	15.7	13.9	12.2	24.1	21.1	27.1	27.6
325	Chemical Products	13.5	14.7	23.6	12.3	7.0	38.4	27.4	20.6	13.6
326	Plastic & Rubber	3.9	2.7	3.2	4.8	5.2	24.1	12.9	27.9	35.1
327	Nonmetallic Mineral	2.4	0.7	4.3	1.3	4.5	10.2	28.1	12.2	49.5
331	Primary Metals	4.9	5.2	5.5	5.3	3.7	37.7	17.8	24.7	19.9
332	Fabricated Metals	6.4	3.7	3.4	6.9	11.4	20.2	8.3	24.4	47.1
333	Machinery	6.6	7.7	6.3	7.4	4.4	41.5	15.0	25.8	17.7
334	Computer & Electronics	7.4	11.4	5.4	4.9	5.5	54.0	11.4	15.0	19.6
335	Electrical Equipment	2.4	2.7	2.3	2.6	2.0	39.0	14.7	24.5	21.8
336	Transport Equipment	14.1	15.9	17.2	18.1	6.5	39.6	19.1	29.2	12.2
337	Furniture & Related	1.6	1.2	0.3	1.3	3.1	26.8	2.7	19.1	51.3
339	Miscellaneous	2.8	2.8	1.6	3.0	3.2	35.1	9.2	25.1	30.7
	TOTAL	100	100	100	100	100	35.2	15.7	22.8	26.3

Source: Census of Manufacturers, Directory of Corporate Affiliations, and Uniworld Business Publications as explained in the text. Data is for the year 2007.

Table 10. Percent of Employment by Firm Type: 3 Digit NAICS Industries

NAICS	Description	Total	US. Mult	Foreign Mult	Exporter	Domestic Only	US. Mult	Foreign Mult	Exporter	Domestic Only
		Within Types					Across Types			
311	Food	11.0	10.2	8.2	9.8	13.0	25.0	7.1	20.4	47.5
312	Beverage & Tobacco	1.2	1.5	1.2	0.9	1.1	36.1	9.9	17.0	37.0
31X	Textile, Apparel, Leather	3.8	2.1	1.1	3.8	5.5	15.1	2.9	23.5	58.5
321	Wood Products	3.8	2.1	0.4	2.7	6.4	14.8	1.0	16.3	67.8
322	Paper Products	3.2	4.7	2.7	2.9	2.5	39.7	8.0	20.6	31.6
323	Printing & Related	4.7	2.5	2.4	2.4	8.1	14.1	4.9	11.5	69.5
324	Petroleum and Coal	0.8	0.5	1.8	0.8	0.8	16.7	21.6	22.7	39.0
325	Chemical Products	6.1	7.9	11.8	6.1	3.5	35.3	18.6	23.1	23.0
326	Plastic & Rubber	6.3	4.8	6.4	8.1	6.3	20.7	9.7	29.3	40.3
327	Nonmetallic Mineral	3.6	1.1	7.2	2.1	5.2	8.6	19.1	13.6	58.7
331	Primary Metals	3.4	3.6	5.3	4.2	2.2	29.4	15.2	28.4	27.0
332	Fabricated Metals	11.9	5.9	6.7	12.5	16.7	13.5	5.4	24.2	57.0
333	Machinery	8.6	9.8	10.6	11.6	5.6	31.0	11.7	31.0	26.4
334	Computer & Electronics	8.0	14.6	8.7	6.9	4.0	49.7	10.4	19.8	20.0
335	Electrical Equipment	3.2	3.8	4.0	3.8	2.2	32.4	11.8	27.5	28.3
336	Transport Equipment	12.0	18.2	17.2	13.0	6.1	41.1	13.6	24.9	20.4
337	Furniture & Related	3.7	2.6	0.7	3.0	5.7	18.7	1.9	18.1	61.3
339	Miscellaneous	4.8	4.1	3.7	5.6	5.1	22.9	7.4	26.7	43.0
	TOTAL	100	100	100	100	100	27.1	9.6	23.0	40.3

Source: Census of Manufacturers, Directory of Corporate Affiliations, and Uniworld Business Publications as explained in the text. Data is for the year 2007.

Table 11. Percent of Exports by Firm Type: 3 Digit NAICS Industries

NAICS	Description	Total	US. Mult	Foreign Mult	Exporter	US. Mult	Foreign Mult	Exporter
		Within Types				Across Types		
311	Food	5.5	4.2	5.0	7.5	37.7	14.0	48.3
312	Beverage & Tobacco	1.0	1.6	0.2	0.5	78.9	2.7	18.4
31X	Textile, Apparel, Leather	1.3	0.7	0.7	2.4	28.0	8.2	63.8
321	Wood Products	0.5	0.1	0.1	1.3	11.4	2.5	86.1
322	Paper Products	2.3	2.8	1.5	2.1	58.6	9.9	31.4
323	Printing & Related	0.4	0.2	0.1	0.8	24.7	4.0	71.4
324	Petroleum and Coal	2.5	1.2	(D)	3.8	23.7	(D)	55.0
325	Chemical Products	17.5	15.6	27.4	15.9	43.8	24.1	32.1
326	Plastic & Rubber	2.5	1.7	2.7	3.4	34.6	16.8	48.6
327	Nonmetallic Mineral	1.1	1.0	1.4	1.1	44.4	19.9	35.7
331	Primary Metals	4.2	4.0	2.7	5.2	46.6	9.7	43.7
332	Fabricated Metals	4.1	3.0	3.2	6.1	35.5	11.8	52.6
333	Machinery	11.5	12.5	9.8	10.9	53.4	13.2	33.4
334	Computer & Electronics	16.8	23.1	11.0	10.5	67.7	10.1	22.2
335	Electrical Equipment	2.7	2.5	3.0	2.9	45.3	17.1	37.6
336	Transport Equipment	22.7	22.6	25.9	21.4	49.0	17.6	33.4
337	Furniture & Related	0.4	0.3	(D)	0.7	32.7	(D)	63.4
339	Miscellaneous	3.1	3.2	2.1	3.6	49.4	10.1	40.6
	TOTAL	100	100	100	100	49.2	15.4	35.3

Source: Census of Manufacturers, Directory of Corporate Affiliations, and Uniworld Business Publications as explained in the text. Data is for the year 2007.
A "(D)" indicates that the data have been suppressed to avoid the disclosure of data of individual companies.

Table 12. Exports as Percent of Shipments by Firm Type

NAICS	Description	Total	US. Mult	Foreign Mult	Exporter	Domestic Only
311	Food	2.2	8.8	15.0	16.2	
312	Beverage & Tobacco	1.6	13.4	17.9	7.2	
31X	Textile, Apparel, Leather	1.9	19.3	18.9	15.0	
321	Wood Products	1.8	12.5	16.2	17.3	
322	Paper Products	3.4	9.3	12.1	12.9	
323	Printing	1.0	6.6	9.4	13.7	
324	Petroleum and Coal	1.8	10.2	(D)	16.0	
325	Chemical Products	6.5	18.3	20.4	16.0	
326	Plastic & Rubber	3.8	13.7	13.8	10.8	
327	Nonmetallic Mineral	1.2	17.0	15.7	14.9	
331	Primary Metals	4.7	14.2	15.7	13.3	
332	Fabricated Metals	2.4	13.6	13.8	13.0	
333	Machinery	7.0	21.5	21.1	17.4	
334	Computer & Electronics	11.0	30.9	26.7	23.9	
335	Electrical Equipment	6.4	17.8	18.6	15.3	
336	Transport Equipment	5.6	18.2	18.4	15.4	
337	Furniture & Related	1.0	5.2	(D)	13.2	
339	Miscellaneous	3.2	18.2	18.3	16.6	
	TOTAL	3.3	17.3	18.1	15.5	

Source: Census of Manufacturers, Directory of Corporate Affiliations, and Uniworld Business Publications as explained in the text. Data is for the year 2007.
A "(D)" indicates that the data have been suppressed to avoid the disclosure of data of individual companies.

A Appendix: Data Matching

The discussion below is an abbreviated form of the full technical note (see Flaaen (2013)) documenting the Bridge between the DCA and the Business Register. The process is virtually identical for matching the Uniworld directories.

A.1 Background on Name and Address Matching

Matching two data records based on name and address information is necessarily an imperfect exercise. Issues such as abbreviations, misspellings, alternate spellings, and alternate name conventions rule out an exact merging procedure, leaving the researcher with probabilistic string matching algorithms that evaluate the "closeness" of match – given by a score or rank – between the two character strings in question. Due to the large computing requirements of these algorithms, it is common to use so-called "blocker" variables to restrict the search samples within each dataset. A "blocker" variable must match exactly, and as a result this implies the need for a high degree of conformity between these variables in the two datasets. In the context of name and address matching, the most common "blocker" variables are the state and city of the establishment.

The matching procedure uses the program *reclink* created by Michael Blasnik. This program uses a bigram string comparator algorithm on multiple variables with differing user-specified weights.[25] This way the researcher can apply, for example, a larger weight on a near *name* match than on a perfect *zip code* match. Hence, the "match score" for this program can be interpreted as a weighted average of each variable's percentage of bigram character matches. Further information on this program is available in Flaaen (2013) or Blasnik (2010).

A.2 The Unit of Matching

The primary unit of observation in both the DCA and BR datasets is the business establishment. Hence, the primary unit of matching for this bridge will be the establishment, and not the firm. However, there are a number of important challenges with an establishment-to-establishment link. First, the DCA and BR may occasionally have differing definitions of the establishment. One dataset may separate out several operating groups within the same firm address (i.e. JP Morgan – Derivatives, and JP Morgan - Emerging Markets), while another may group these activities together by their common address. Second, the name associated with a particular establishment can at times reflect the subsidiary name, location, or activity (i.e. Alabama plant, processing division, etc), and at times reflect the parent company name. Recognizing these challenges, the primary goal of the bridge will be to assign each DCA establishment to the most appropriate business location of the parent firm identified in the BR. As such, the primary matching variables will be the establishment name, along with geographic indicators of street, city, zip code, and state.

[25] the term bigram refers to two consecutive characters within a string (the word *bigram* contains 5 possible bigrams: "bi", "ig", "gr", "ra", and "am"). The program assigns a score for each variable between the two datasets based on the percentage of matching bigrams.

A.3 The Matching Process: An Overview

The danger associated with probabilistic name and address procedures is the potential for false-positive matches. Thus, there is an inherent tension for the researcher between a broad search criteria that seeks to maximize the number of true matches and a narrow and exacting criteria that eliminates false-positive matches. The matching approach used is conservative in the sense that the methodology will favor criteria that limit the potential for false positives at the potential expense of slightly higher match rates. As such, the procedure generally requires a match score exceeding 95 percent, except in those cases where ancillary evidence provides increased confidence in the match.[26]

The outline below summarizes the steps taken to merge the DCA dataset to the BR for a given year. This is an iterative process, in which a series of matching procedures are applied with decreasingly restrictive sets of matching requirements. In other words, the initial matching attempt uses the most stringent standards possible, after which the non-matching records proceed to a further matching iteration, often with less stringent standards. In each iteration, the matching records are assigned a flag that indicates the standard associated with the match.

1. Match DCA to Compustat (and then to Compustat-Bridge) for those DCA observations with a Compustat Identifier (see Zhou (2011) for more details.)
2. Implement Tier 1 changes to name and address variables of DCA (see table A1). Separate out DCA observations that have matched via Compustat.
3. Tier 1 Matching
   (a) Restrict BR to LBD observations (save non-matching observations for Tier 2)
   (b) Implement Tier 1 changes to Name/Address variables of BR.
   (c) Apply *reclink* of Compustat-linked DCA observations to BR (using name, street address, zip code, with city, state, and firmid as blockers)
   (d) Apply *reclink* of non Compustat-linked DCA observations to BR (using name, street address, and zip code, with city and state as blockers)
   (e) Apply *reclink* of non-matching DCA to BR (using name, street address, zip code, and city, but now only state as a blocker)
   (f) Evaluate matches
      - if "match score" is above 0.95, classify as a match[27].
      - if "match score" is between 0.80 and 0.95, evaluate manually [28]

[26] The primary sources of such ancillary evidence are manual (ocular) review of the matches, and additional parent identifier matching evidence.

[27] Several thousand checks of these potential matches have produced VERY few incidents of false-positive matches (i.e. less than 0.5 percent)

[28] The manual evaluation of matches is the one step in which longitudinal information is used. (Without this, the set of potential matches to evaluate was too large – in the range of 5-6 thousand per year.) Rather than continue to manually review common matches (and non-matches) from year to year, the pool of manually evaluated matches from previous years is used to automatically accept as a match any potential match that exactly aligns with a match evaluated in a previous year. The same is true for previously-evaluated non-matches.

- if "match score" is below 0.80, classify as a non-match

(g) Append evaluated-as-match DCA observations to the other matched observations, and send non-matching DCA observations to Tier 2 matching

4. Tier 2 Matching

(a) For the non-matching DCA observations, try to find an existing match with the same (DCA) parent identifier. Take the corresponding BR firm identifier (alpha or ein) for this match, and search for match over BR observations with identical alpha/ein

- apply *reclink* of DCA to BR (using name, street address, and city, with state and alpha/ein as blockers)
- if "match score" is above 0.70 classify as a match – spot checks have shown no false positives when requiring the alpha/ein to match

(b) Implement Tier 2 changes to name variable of DCA (see table A2)

(c) Take non-LBD matched BR observations and implement Tier 1 and Tier 2 changes to name and address variables.

(d) Apply *reclink* of DCA to non-LBD-matched BR observations (using name, street address, and city, with state as a blocker)

- if "match score" is above 0.95, classify as a match

A.4 Cleaning Matches

The following rules are followed when the matching process yields two or more within-firm establishment matches that disagree on parent-firm characteristics from the DCA. These rules will apply to cases involving joint ventures, those in which the DCA and Census definitions of the firm disagree, or incorrect matches. There are three potential cases:

Potential 1: A Census-identified firm in which two or more establishments match to different foreign-country parent firms

1. Collapse the Census-identified firm employment based on the establishment-parent firm link by country of foreign ownership
2. Calculate the firm employment share of each establishment match
3. If one particular link of country of foreign ownership yields an employment share above 0.75, apply that link to all establishments within the firm.
4. If one particular link of country of foreign ownership yields an employment share above 0.5 and total firm employment is below 10,000, then apply that link to all establishments within the firm.
5. All other cases require manual review.

Potential 2: A Census-identified firm in which one establishment is matched to a foreign-country parent firm, and another establishment is matched to a U.S. multinational firm.

1. Collapse the Census-identified firm employment based on the establishment-parent firm link by type of DCA link (Foreign vs U.S. Multinational)
2. Calculate the firm employment share of each establishment match
3. If one particular type of link yields an employment share above 0.75, apply that link to all establishments within the firm.
4. If one particular type of link yields an employment share above 0.5 and total firm employment is below 10,000, then apply that link to all establishments within the firm.
5. All other cases require manual review.

Potential 3: A Census-identified firm in which one establishment is matched to a non-multinational firm, and another establishment is matched to a foreign-country parent firm (or U.S. multinational firm).

Apply same steps as in Potential 2.

Table A1. Tier 1 String Variable Modifications

Changes to *Name* Variable

All characters changed to lowercase
Remove all commas and single quotes from string
Remove leading, trailing, and doubles spaces
If first word of string is "the ", remove
Each of the following treated as identical[1]

" incorporated" — " inc." — "inc"	" corporation" — " corp." — " corp"
" company" — " co." — " co"	" limited" — " ltd." — " ltd"
" association" — " assn." — " assn"	" manufacturing" — " mfg." — " mfg"
" international" — " intl." — " intl"	" division" — " div." — " div"
" &" — " +" — " and"	

Changes to *Street* Variable

All characters changed to lowercase
Remove all commas and single quotes from string
Remove leading, trailing, and doubles spaces
Each of the following treated as identical[1]

" street" — " st." — " st"	" drive" — " dr." — " dr"
" road" — " rd." — " rd"	" boulevard" — " blvd." — " blvd"
" avenue" — " ave." — " ave"	" court" — " ct." — " ct"
" circle" — " cir." — " cir"	" lane" — " ln." — " ln"
" place" — " pl." — " pl"	" parkway" — " pkwy." — " pkwy"
" expressway" — " expwy." — " expwy"	" highway" — " hwy." — " hwy"
" freeway" — " fwy." — " fwy"	" center" — " ctr." — " ctr"
" building" — " bldg." — " bldg"	" suite" — " ste." — " ste"
" floor" — " fl." — " fl"	
" n." — " n"	" w." — " w"
" s." — " s"	" e." — " e"
" n.w." — " nw." — " nw"'	" s.w." — " sw." — " sw"'
" n.e." — " ne." — " ne"'	" s.e." — " se." — " se"'
" first" — " 1st"	" second" — " 2nd"
" third" — " 3rd"	" fourth" — " 4th"
" fifth" — " 5th"	" sixth" — " 6th"
" seventh" — " 7th"	" eighth" — " 8th"
" ninth" — " 9th"	" tenth" — " 10th"
"p.o." — "po"	

Changes to *City* Variable

All characters changed to lowercase
Each of the following treated as identical

"saint " — "st. " — "st "	"fort " — "ft. " — "ft "
"north " — "n. " — "n "	"south " — "s. " — "s "
"east " — "e. " — "e "	"west " — "w. " — "w "

[1] Note that the use of spaces before each character string reduces the chance that altering an abbreviation may result in changing a non-abbreviated (but identically denoted) string. Any unintended changes that may still result are not necessarily a problem, however, as they are implemented on both datasets. Thus in principle the match should be unaffected.

Table A2. Tier 2 String Variable Modifications

Changes to *Name* Variable	
Remove the characters "-" and "/"	
Remove each of the following from the string[1]	
"national"	"systems"
"industries"	"securities"
"management"	"insurance"
"association"	"america"
"american"	"north america"
"north american"	"intl"
"ltd"	"corp"
"inc"	

[1] Note here the general lack of spaces before each character string. One must be careful that the string to be removed is not embedded as part of a larger string that should be maintained in the variable. The chances of this appear to be very low, and once again any unintended changes would be implemented on both datasets.

Table A3. Match Statistics: 2007

	# of Establishments	Matched to B.R.	Percent Matched
Total	112,346	81,656	0.73
U.S. Multinationals	22,500	16,396	0.73
Foreign Multinationals	10,331	7,555	0.73

Table A4. Selected Country List: Less than 20% of US GDP per Capita

* All Africa *	El Salvador	Paraguay
Afghanistan	Guatemala	Peru
Argentina	Haiti	Philippines
Albania	Honduras	Romania
Bangladesh	India	Russian Federation
Bolivia	Indonesia	South Africa
Brazil	Iran, Islamic Rep.	Thailand
Bulgaria	Iraq	Tunisia
Cambodia	Jamaica	Turkey
China	Jordan	Ukraine
Colombia	Kazakhstan	Uruguay
Costa Rica	Malaysia	Uzbekistan
Cuba	Mozambique	Venezuela, RB
Dominican Republic	Nepal	Vietnam
Ecuador	Nicaragua	Yemen, Rep.
Egypt, Arab Rep.	Pakistan	

[1] Source: