Review of International Economics

WILEY

ORIGINAL ARTICLE

The Multinational Revenue, Employment, and Investment Database (MREID)

Saad Ahmad[1] | Jeffrey Bergstrand[2] | Jordi Paniagua[3] | Heather Wickramarachi[1]

[1]U.S. International Trade Commission, Washington, DC, USA | [2]University of Notre Dame, South Bend, Indiana, USA | [3]University of Valencia, Valencia, Spain

Correspondence: Saad Ahmad (saad.ahmad@usitc.gov)

Received: 25 April 2025 | **Revised:** 25 April 2025 | **Accepted:** 28 April 2025

Funding: Jeffrey Bergstrand and Jordi Paniagua acknowledge financial support from the U.S. International Trade Commission and the Kellogg Institute for International Studies. Jordi Paniagua also acknowledges funding from MICIN (Grant Number: PID2021-122133NB-100).

ABSTRACT

We introduce the Multinational Revenue, Employment, and Investment Database (MREID). Utilizing firm-level data from Orbis, MREID offers comprehensive and consistent information on international and domestic revenue, employment, and investment of multinational enterprises (MNEs) for 185 countries, 25 industries, and (initially) a 12-year annual time series. The database covers a range of industries, including agriculture, mining, energy, manufacturing, and services, enabling a full account of MNE activities across sectors and countries.

JEL Classification: F15, F21, F23

1 | Introduction

This paper outlines the development of the Multinational Revenue, Employment, and Investment Database (MREID), a comprehensive source of information on the financial activities of affiliates of multinational enterprises (MNE) for 187 countries and 25 sectors over a period of 12 years (2010 through 2021). By offering information on key economic variables at the bilateral level for a large set of countries, MREID provides researchers a comprehensive overview of the MNE activities taking place in the global economy—where countries often act as both a source and a destination of foreign direct investment (FDI).[1]

A key feature of MREID is its focus on MNE activities at the sector level. International datasets on bilateral FDI or foreign affiliate sales (FAS) often lack information at the sector level, preventing an analysis of whether some sectors of the economy are more conducive to FDI—and thus have a greater concentration of MNEs—than other sectors. We overcome such data gaps by relying on firm-level financial data, supplemented with detailed ownership records, from Orbis and aggregating it to the 2-digit NAICS sector level. These financial data allow us to report the revenues, employment, and assets of all foreign affiliates located in a host country (inward FDI). Since Orbis includes detailed ownership data, the foreign affiliates in our sample can also be linked to their parent company in the source country (outward FDI). Thus, MREID is able to capture MNE activity in a particular year at the source-destination-sector level.

At the country level, MREID provides information on MNE activities for 187 countries over the years 2010 through 2021. However, MREID is not a balanced panel. Eleven countries in our sample only have data on outward FDI, while 14 countries in our sample only have data on inward FDI. We also see sparse coverage for certain developing countries, especially those located in Africa.[2] Since MREID was developed to serve as a resource for estimation purposes, we also do not rely on any econometric

model (such as the gravity framework) to fill in any of the missing observations.[3]

Two other aspects of MREID are also worth noting. First, MREID can distinguish affiliates based on the mode of entry that the MNE chooses to serve the host market. If the MNE establishes a new affiliate from the ground up in the host country, we characterize it as a Greenfield investment in MREID. Alternatively, if the MNE acquires or merges with an existing domestic firm, we characterize it as a Mergers and Acquisitions (M&A) investment in MREID. By tracking the FDI decisions of MNEs as Greenfield or as M&A, MREID provides researchers the ability to evaluate if the determinants of bilateral FDI differ by the mode of entry.

Second, MREID includes information on the financial activities of domestic affiliates (affiliates where the parent is also a domestic firm). Beyond theoretical considerations (e.g., market-clearing conditions requiring the allocation of capital not transferred internationally), there are other significant benefits from having information on domestic investment activity. Domestic flows have been a relevant element of structural gravity estimations with Yotov (2022) outlining 15 reasons why gravity models should be estimated with domestic (in addition to international) trade. Many of these reasons similarly apply to a gravity-based analysis of FDI. For instance, incorporating domestic investment in the empirical analysis can help researchers identify the impact of country-specific variables on bilateral FDI flows. Carril-Caccia et al. (2023) apply such a strategy to identify the effect of local terrorist attacks on Greenfield FDI using a dataset that includes both domestic and foreign investment.[4] MREID should thus complement trade datasets that also include information on domestic trade.

Because of MREID's unique characteristics, the dataset opens numerous avenues for new research in international economics. Bergstrand and Paniagua (2024) is the first study to combine MREID data with trade data from the International Trade and Production Database for Estimation (ITPD-E).[5] The authors propose a novel method to assess the depth of Deep Trade Agreements (DTAs) and conclude that, with respect to DTAs, trade and FDI appear to function as substitutes. In parallel, Ahmad et al. (2024) have utilized MREID data to investigate the prevalence of phantom FDI—foreign direct investment that lacks substantial economic activity or real economic grounds. MREID could also prove beneficial for understanding the bilateral determinants of MNE activities at the sector level using a gravity framework, an area that, due to data limitations, has been relatively unexplored in the literature.

The rest of the paper is organized as follows. Section 2 reviews the relevant literature related to FDI measurement and multinational production. Section 3 describes the Orbis dataset and discusses the search strategy for constructing the MREID database. Section 4 provides a detailed description of the MREID database. Section 5 reports gravity estimates. Section 6 concludes and outlines future work on the database. In the Supporting Information available online, we compare MREID to existing multinational datasets for both coverage and validity and provide additional tables and figures.

2 | Background and Literature Review

There is a growing consensus around the advantages of using firm-level financial data instead of national (income) accounts data for measuring FDI. As discussed in Wildmer et al. (2019), due to profit-shifting motives, there is often a divergence between FDI reported in aggregate National Income Accounts and their representation of productive activities and investments.[6] For instance, Damgaard et al. (2019) find that nearly 40 percent of reported inward FDI is a result of financial and tax engineering, generating no real economic benefits to the host country. Similarly, Guvenen et al. (2022) shows that US affiliates commonly employ accounting practices that reduce their tax burden and affect the measurement of aggregate economic variables. As noted by Egger et al. (2023), heterogeneous reporting standards and the lack of differentiation between financial and real FDI transactions in existing bilateral FDI datasets from UNCTAD, IMF, and the OECD are a key challenge for any empirical analysis of FDI.

Moreover, relying on FDI stock data could be a bigger issue if it is used as a proxy for MNE activities at the sector level. In these instances, production activities of foreign affiliates—such as revenues and employment—are more likely to be overestimated in capital-intensive sectors, such as mining, while labor-intensive sectors that generate a large number of sales relative to capital, such as retail, are more likely to be underestimated. Indeed, Fukui and Lakatos (2012) find that while national FDI statistics might be considered to be an appropriate measure of the aggregate activity of foreign affiliates, there are significant mismatches between FAS and FDI at the sector level.

Given the inherent advantages of firm-level financial data for analyzing cross-border investment activities, we rely on Orbis to construct our bilateral FDI variables in MREID. Several recent studies have also used firm-level data from Orbis for their empirical analysis. Kalemli-Özcan et al. (2023) rely on Orbis to construct a representative firm-level dataset for European countries and show that small-and medium-sized firms (SMEs) account for a large share of aggregate economic activity. Gopinath et al. (2017) also used Orbis to examine the productivity of manufacturing firms in Spain from 1999 to 2012. In the context of FDI, Cravino and Levchenko (2017) use Orbis to investigate how MNEs contribute to transmitting economic shocks across countries, while Alfaro and Chen (2018) analyze the nature of productivity gains arising from multinational production in the host country using Orbis data. Osnago et al. (2019) use Orbis to construct an FDI dataset for several European countries and distinguish between vertical and horizontal FDI.

A notable feature of the Orbis data is the ownership linkages that connect affiliates to parent firms. Aminadav and Papaioannou (2020) use Orbis, among other sources, to investigate ownership concentration and the types of corporate control across countries. Alabrese and Casella (2020) rely on Orbis to map the complex linkages between parent firms and foreign affiliates and their broader implications for investment and tax policy. Applying a network framework on Orbis ownership data, Rungi et al. (2017) assessed direct and indirect control of corporations

within and across national borders. Fonseca et al. (2023) used 22,000 listed firms in Orbis to study the globalization of corporate control employing a gravity framework. Alviarez (2019) construct an industry-level dataset using production, employment, and foreign affiliate data from OECD, Eurostat, BEA, and Orbis, which provided sixty percent of all bilateral-sector values in the dataset. They show that multinational shares of total output are disproportionately higher in industries with less productive domestic firms.[7] Garcia- Bernardo et al. (2017) use Orbis data to unravel offshore financial centers.

Despite having detailed ownership information that allows researchers to distinguish between domestic and foreign affiliates, Orbis has been relatively underutilized when it comes to recording MNE activities at the bilateral level. An exception is the EU Foreign Ownership (FOWN) dataset, constructed using Orbis and described in detail in Wildmer et al. (2019). Focusing on foreign-controlled firms that operated in the European Union (EU) for the period 2007 to 2016, the FOWN dataset allows researchers to track how investment in the EU has changed over time and which EU sectors are the ones being targeted for foreign investment.[8] Financial variables track the revenues, total assets, and the number of employees of foreign firms in the EU and are aggregated to the NAICS (Revision 2) two-digit sector level. Compared with official data sources on foreign investment in the EU, Wildmer et al. (2019) find that the FOWN dataset provides similar trends for the number of firms and sales after 2008, but underreports slightly smaller firms before 2008. Beyond the evolution of foreign ownership in the EU, the FOWN database also provides information on M&A and greenfield activity in the EU by relying on some other financial data products released by Moody's. However, the FOWN dataset's exclusive focus on EU countries limits its usefulness for a global analysis of MNE activities and investment.

3 | MREID: An Overview

3.1 | Data Source: Orbis

Research on cross-border activities of MNEs is challenging due to different measures of FDI, types of FDI, and other data limitations. FDI statistics based on a country's balance of payments are designed to only measure the movements of capital between investors and affiliates. But such data may be inadequate and incomplete if the goal is to better understand how MNEs transfer production activities from one country to another. Further, existing FDI datasets do not account for domestic investment, which is important for empirical estimates that rely upon a structural gravity framework.[9] Given such constraints, researchers have moved away from national FDI statistics, which often capture the subsidiary's financing from abroad, and instead turned towards firm-level datasets that better reflect the production activities of subsidiaries in the host economy.[10]

MREID follows a similar path, focusing on the production activities of affiliates as reflected by their financial statements. Information on production activities at the firm level enables MREID to provide comparable information on revenues, employment, and assets by ownership (domestic vs. foreign) and by type of investment (greenfield vs. M&A) in the host economy. The firm-level data needed in the construction of MREID is obtained from Orbis. Orbis is Bureau van Dijk's (a Moody's Analytics company) flagship database with information on more than 500 million companies worldwide. It focuses on financial statements of both public and private companies and presents the companies' financial variables in comparable formats. The sources of information come from over 170 different providers, which are standardized into comparable cross-country information and follow international generally accepted accounting standards. Kalemli-Özcan et al. (2015) were the first to describe the standard benchmark-search strategy needed to construct nationally representative firm-level data from the Orbis global database[11]

Some studies have examined the representativeness of Orbis against micro data collected through surveys and administrative records by national statistical agencies, often of the entire firm population. Gopinath et al. (2017) studied capital stock (fixed assets), output (sales), and employees and found that Orbis data coverage is comparable to Spanish administrative data. Focusing on a subset of OECD countries that are well represented in Orbis, Bajgar et al. (2020) find that Orbis captures around sixty percent of output and aggregate employment, as well as 40 percent of aggregate value-added, when compared to official micro data. However, they also see that significant variation in coverage of financial variables exists across countries and sectors. In particular, larger, older, and more productive firms are more likely to be covered in Orbis than smaller firms found at the bottom of the productivity distribution. Thus, Bajgar et al. (2020) recommend that Orbis is better suited to examining the performance of large and high-performing firms such as MNEs and to investigate global trends, rather than using it to make determinations on the entire firm distribution. Since MREID's focus is on capturing MNE activities at the bilateral level over disaggregate sectors and years, we consider Orbis to be a reliable and suitable source of information in the absence of cross-country micro data.

3.2 | Methodology for Selecting Firms in Orbis

Our search strategy in Orbis to construct a representative dataset on the affiliates of MNEs follows the best practices in the literature. The key variable to identify foreign ownership in Orbis is the variable "global ultimate owner" (GUO).[12] We thus rely on the GUO to track parent firms that invest in foreign countries. A limitation of accessing Orbis through its web interface is that the GUO is only available for the latest year. This constraint may lead to incorrect ownership if the underlying firm had been part of an M&A in recent years. To overcome this limitation, Kalemli-Özcan et al. (2015) proposed using yearly historical data provided by Orbis (in disk format) to track these complex changes in ownership. In an updated version of their original working paper, Kalemli-Özcan et al. (2023) used the M&A module in Orbis instead to track these ownership changes. We follow the same procedure to obtain accurate ownership records of affiliates without the need to access the historical Orbis data (with the limitation of the ten-year rolling period for financial statements).

We limited our search to affiliates with more than USD 1 million in turnover (i.e., revenues) or in total assets in at least one year in the sample. Consequently, we reduce the number of affiliates with no "real" activity. Other FDI datasets have similar

thresholds (e.g., the BEA established its threshold at USD 25 million). A key feature of our search strategy is that we also include *domestic establishments* (i.e., domestic affiliates). We established an ownership threshold of 50.01%.[13] The constructed MREID database consists of publicly owned and privately owned corporate firms with assets or sales larger than USD 1 million; hence, most will be publicly owned. It excludes state-owned enterprises and banks.

Establishing a foreign affiliate can be recorded in many ways (e.g., capital investment, employment) and executed in various ways (e.g., greenfield investment or merger and acquisitions (i.e., M&As)). Using the M&A module in Orbis in our search strategy, as recommended by Kalemli-Özcan et al. (2023), allows constructing a comparable companion dataset recording if the foreign activity is a result of an M&A. Similarly, whenever an affiliate first enters the dataset within our sample period (2010–2021), we flag it as a greenfield investment.[14] This way, we obtain a comparable companion dataset with greenfield FDI.[15]

We are aware of certain limitations present in the Orbis data. We only selected economically active affiliates, as recorded by Orbis. We also implemented a criterion to detect firm exits from the market. Affiliates with more than four consecutive years without reports on any of the key financial variables are marked as having exited. The attrition rate with this strategy is around 8 percent of affiliates per year. Moreover, some data in Orbis contains errors and typos from the original source. For example, some key financial variables contain negative values coded incorrectly or reflect local accounting practices. Following Kalemli-Özcan et al. (2022), we drop all negative values.

3.3 | Financial Variables Covered in MREID

We focused on the revenues, assets, and employees as the main variables of interest for the affiliates identified by our search strategy. These financial variables were obtained from Orbis at the closing date of each year per 2-digit NAICS 2017 (core code). All the key financial variables were taken from the global format accounting balance sheet in Orbis, which consolidates US and non-US accounting practices.[16]

a. Investment: Investment is measured as either total assets or fixed assets.
   - Total assets: The sum of current assets and fixed assets, including intangibles.
   - Fixed assets: Tangible fixed assets, intangible fixed assets, and other fixed assets (exploration, long-term receivables, investments, long-term associated companies, investment properties, and other long-term assets).

b. Revenue (Turnover or Sales): Total operating revenues (= net sales + other operating revenues + stock variations[17]) excluding taxes. However, for some companies, no information is provided on value-added taxes (VAT); alternatively, the figure is stated as after indirect taxes or excluding sales-related taxes.[18]

c. Number of employees: Total number of employees included in the company's payroll.

d. Number of affiliates: Total number of affiliates of the parent firm.

Total assets, fixed assets, and revenue variables are measured in thousands of current US dollars. Number of employees and affiliates are measured in actual numbers.[19]

Orbis provides estimates for turnover and the number of employees when these data are not available. The estimation procedure uses country and industry averages to impute missing data and does *not* use gravity estimates. There are no estimates available for either Total Assets or Fixed Assets in Orbis.[20]

3.4 | Comparison With Other FDI Datasets

Overall, MREID offers several notable advantages over existing FDI data sources, particularly those who report balance of payment statistics (Table 1).[21] First, MREID offers comprehensive country and sector coverage at the bilateral level, includes domestic investment data, and is suitable for use within a structural gravity model for estimation purposes.[22] While other datasets offer similar country coverage, several of the most commonly used datasets for FDI coverage (UNCTAD) do not include bilateral country investment data. Additionally, the UNCTAD dataset, as well as the IMF's, does not include sector-specific data. This limits the type of analysis researchers can undertake to explain the determinants of FDI as well as the impact of investment and trade policy on FDI, especially since more capital-intensive industries may be impacted to a larger extent by investment policies, such as those that restrict expropriation.

The most comprehensive dataset in comparison to MREID is that from the OECD. It offers bilateral balance-of-payments data by sector, when available. It also takes the additional step of removing investment values to SPEs in an attempt to report investment for productive purposes. However, its country coverage is limited, as it focuses on the 38 OECD members and their reported partners. Although these members represent a significant portion of the global economy, they do not have bilateral coverage of a significant number of emerging and developing countries. Additionally, there is a break in the data between BMD3 and BMD4, which reduces the comparability over the years.

Like Orbis, the data from which MREID is comprised, fDiMarkets is a database of Greenfield projects that includes data on the source company and country, host country, sectors for both parent and affiliate, and data on capital investment for the project and employment. However, because it only captures announcements of Greenfield projects, it doesn't include M&A data, nor does it include financial information of the parent firm, thus, it is not able to provide robust affiliate information for a country as a whole. Thus, MREID provides a host of data on MNE activity at the bilateral country-sector level that is more holistic than other commonly used FDI databases.

In summary, MREID provides several analytical benefits for researchers wanting to go beyond the FDI stock and flow variables commonly available in other datasets. Some recent studies have begun to utilize the MREID dataset for empirical analysis. For instance, Bergstrand and Paniagua (2024) explores the rich

TABLE 1 | Comparison of MREID with various FDI databases.

	MREID	UNCTAD	IMF CDIS	OECD	fDiMarkets
Countries	187	195	110	38	182
Years	2010–2021	1990–2023	2009–2022	2005–2022	2003–2024
Sectors	25 (2-digit NAICS)	No	No	61 (2 and 4 digit NAICS) if available	50 (2–6 digit NAICS)
Variables	Affiliates; Total Assets; Fixed Assets; Revenue; Employees	Flow; Stock	Stock	Stock; Income	Company; Parent; Sector; Capital Expenditure; Jobs
Bilateral	Yes	No	Yes	Yes	Yes
Information on GUOs	Yes	No	No	Yes, when available	Yes, when available
Greenfield or M&A	Both	Neither	Neither	Neither	Greenfield
Notes	Includes activities of domestic affiliates	May include SPEs if reported by country	Some values may be suppressed for confidentiality purposes	Removes values from SPEs and reports it separately; break in data between BMD3 and BMD4	Project-level database; Source country represents the GUO of the investor

dimensions of the MREID dataset to uncover the mechanisms through which deep trade agreements influence MNE activities, finding that the effects are primarily driven by labor costs. Similarly, Ahmad et al. (2024) leverage MREID data to show that structural gravity equations effectively identify phantom or conduit FDI.

4 | Description of the Database

4.1 | Country, Sector, and Year Overview

The dimensions of our database are as follows: MREID (initially) spans 12 years from 2010 through 2021. The dataset contains the financial data of 1,132,707 affiliates. Of those, 351,600 are foreign affiliates of 70,661 parent companies (Global Ultimate Owners), and the rest are domestic affiliates of 292,184 parent companies. Raw data from the 25 sectors are combined, and after undergoing data cleaning, we have approximately 27,000 raw observations per year at the country-sector (two-digit) level.

MREID provides data on FDI for 187 countries, including 11 countries that only have outward FDI[23] and 14 countries that only have inward FDI.[24] Overall, MREID covers data from 176 countries that host affiliates from 173 countries. Table B.8 in the Supporting Information (Section B.1) displays the list of countries MREID covers. It also shows each country's average and maximum number of affiliates.

As noted earlier, domestic affiliates are included in MREID. These are defined as affiliates that are located in the same country as the parent firm.[25] There are 47 countries for which data is not available for domestic affiliates. Therefore, MREID's coverage of both domestic and foreign investment is limited to 139 countries. Information on domestic investment can be beneficial for studies examining FDI in a structural gravity framework, complementing existing trade datasets that also include domestic trade flows (e.g., ITPD-E).

4.2 | Aggregate MREID Variables Over Time

We start by examining how the variables capturing the activities of foreign affiliates in MREID, aggregated across countries and sectors, have behaved in recent years. Figure 1 shows the evolution over the sample period for the following MREID variables: Total revenues Figure 1a, total employees Figure 1b, total assets Figure 1c, total fixed assets Figure 1d, total number of affiliates Figure 1e, and the revenues per employee Figure 1f. While the overall trend is upward for most MREID variables, total revenues and total assets of foreign affiliates dipped around 2014, in the aftermath of the economic slowdown that was especially severe in Europe; these financial metrics did not start to recover until 2017. In nominal terms, both total revenues and total assets peaked in 2018. The number of employees has also increased steadily over time; however, revenues per employee have declined after peaking in 2012. The global COVID pandemic in 2020 has resulted in a dramatic decline in the financial activities of MNEs in the last couple of years.

It might also be interesting to look at the regions that are contributing to the observed aggregate FDI trends. Figure 1 displays the share of the aggregate financial variables in MREID for the following five regions: North America, European Union, UK, East Asia and Pacific, and the Rest of the World. Figure 1a shows that the affiliates in the EU and the East Asia and Pacific region are responsible for the bulk of the total revenues of foreign affiliates in MREID. Since the EU operates as a single market, many EU countries invest in other EU countries, and so it is not surprising that they are well-represented in MREID. Similarly, foreign affiliates in the EU and East Asia, and the Pacific have the largest share of aggregate employees Figure 1b and of the total

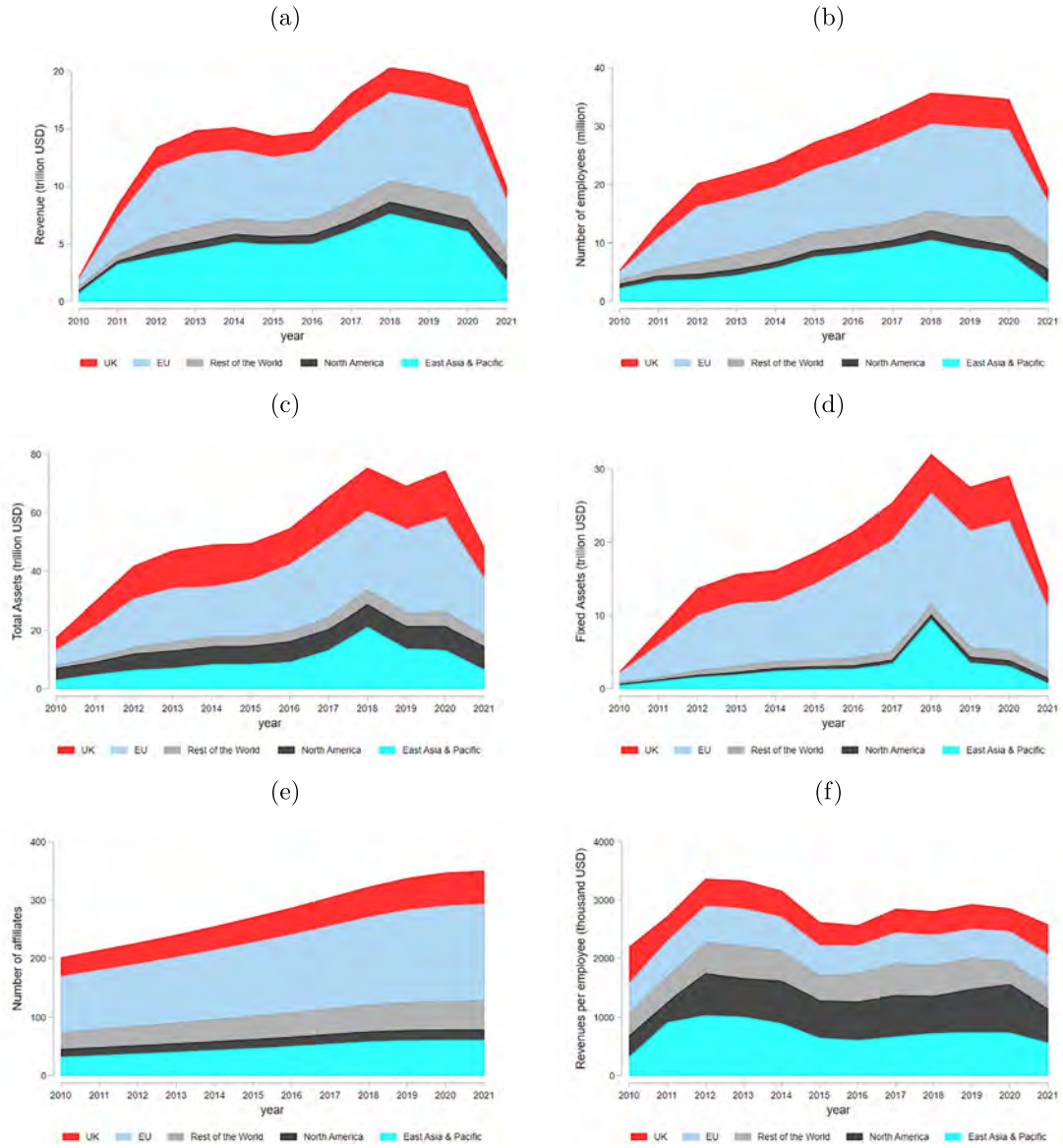

FIGURE 1 | Aggregate MREID variables over time (by regions). The composition of aggregate MREID variables over the sample period is shown for the following regions: United Kingdom, European Union, North America, East Asia & Pacific, and Rest of the World. (a) Revenues, (b) Employees, (c) Total assets, (d) Fixed assets, (e) Foreign affiliates, and (f) Revenues per employee. [Colour figure can be viewed at wileyonlinelibrary.com]

number of affiliates Figure 1b in MREID. However, we do find that the foreign affiliates in the UK have a sizeable share of total assets Figure 1c and fixed assets Figure 1d, a reflection of the strength of the UK's financial sector. Lastly, Figure 1f shows that the average revenue per worker for foreign affiliates in MREID, and we see that the affiliates in the East Asia and Pacific region have the highest labor productivity, while affiliates in the Rest of the World region are the least productive in MREID.

Apart from the regional shares, we can also look at the sectors that are most responsible for the observed aggregate FDI trends. Figure 2 displays the respective FDI shares of the following ten sectors in MREID: Agriculture & Mining, Finance, Information, Manufacturing, Professional Services, Retail, Transport, Utilities, Wholesale, and Other Services. In Figure 2a, we see that affiliates associated with Manufacturing, Professional Services, and Wholesale are responsible for nearly the majority of total revenues in MREID. Manufacturing and Professional Services similarly employ a large share of the total workers employed by foreign affiliates in MREID Figure 2b. The large share of manufacturing firms in revenues and employment increases our confidence that MREID is actually capturing the production activities of foreign affiliates in host countries. As we move from the production side towards the capital side, we see that affiliates in the Financial and Professional Services sectors have a significant share of both total assets Figure 2c and fixed assets Figure 2d in MREID. So, in some sectors, we may need to be careful when linking financial assets to production, as there may be other considerations in play for the observed values in MREID. Lastly, Figure 2f shows that the average revenue per worker is highest for affiliates in the Utilities sector while it is the lowest for affiliates in the Transport sector, within our sample period.

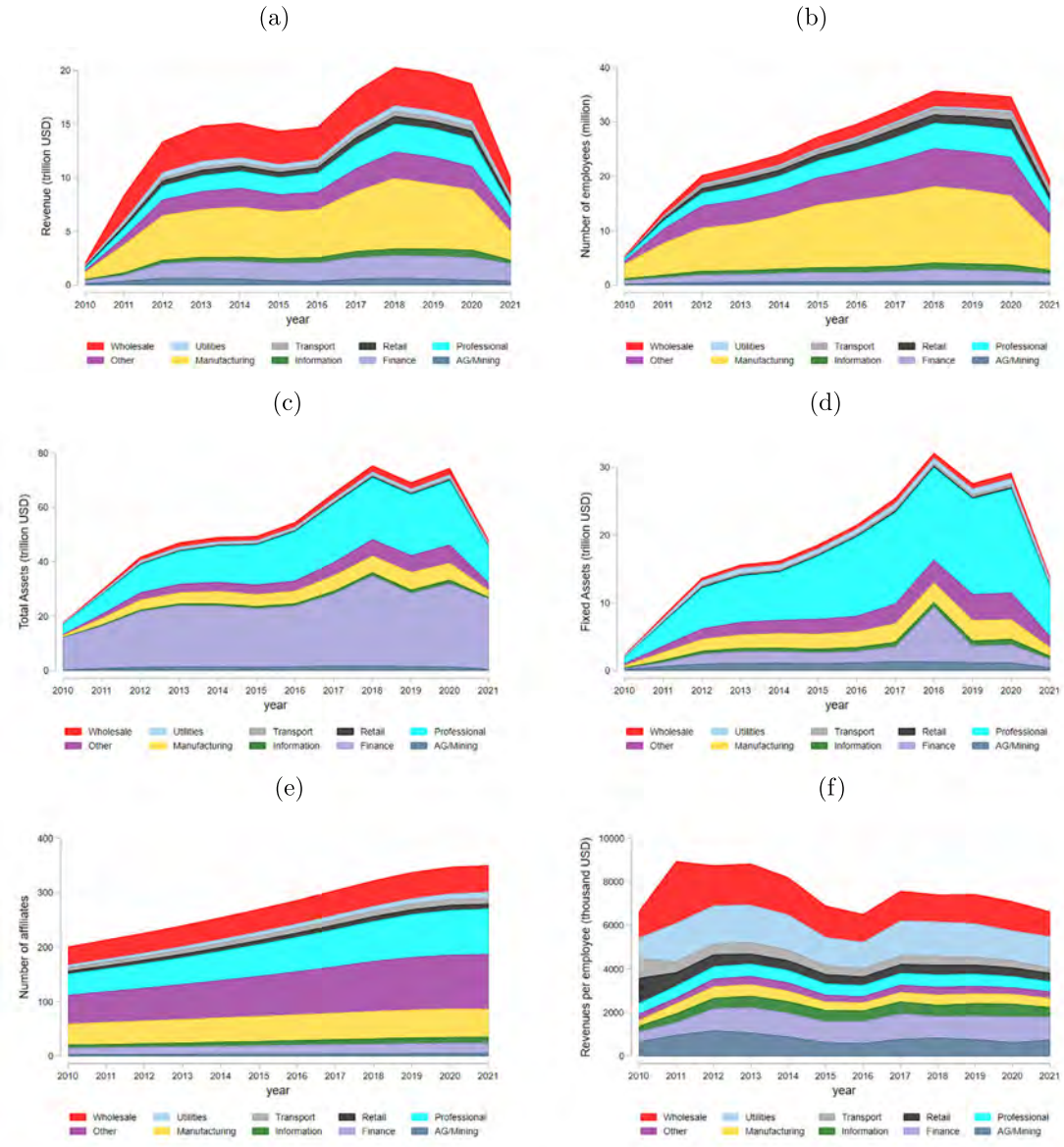

FIGURE 2 | Aggregate MREID variables over time (by sector). The composition of aggregate MREID variables over the sample period is shown for the following NAICS sectors: Agriculture/Mining, Manufacturing, Utilities, Wholesale Trade, Retail Trade, Transport, Financial Services, Professional Services, Information and Communication, and Other Services. (a) Revenues, (b) Employees, (c) Total assets, (d) Fixed assets, (e) Foreign affiliates, and (f) Revenues per employee. [Colour figure can be viewed at wileyonlinelibrary.com]

4.3 | Country Overview

4.3.1 | Descriptive Statistics for Host Countries

Table 2 reports summary statistics on the (time-averaged) revenues, employees, and total and fixed assets by ownership (i.e., domestic vs. foreign). Since foreign affiliate statistics include all affiliates of parent companies from different countries, the statistics in Table 2 are reported at the host country level. We see that each host country has, on average, around 1500 foreign affiliates. Yet, there is significant variation in the number of foreign affiliates across countries as reflected by a very high standard deviation of around 4,500 affiliates, indicating that the average might be skewed towards larger countries. The average revenues generated by foreign affiliates in a host country are around 80 billion dollars, while the average number of workers employed by MNEs is around 140,000. Still, certain countries dominate these statistics, with the UK seeing a maximum of around 1.6 trillion dollars in revenues from foreign affiliates and China seeing the maximum number of workers employed by MNEs of around 4 million. A similar story is observed on total assets and fixed assets.

Table 2 also includes information on domestic affiliates in the host country (affiliates of parent companies from the same country). As discussed earlier, only 139 countries in MREID have information on domestic affiliates. For these 139 countries, we find that each country has, on average, around 4500 active domestic affiliates. Again, there is significant variation in the number of domestic affiliates, with the United States having a maximum of around 128,000 affiliates. Table 2 further shows that

TABLE 2 | Summary statistics at the host country by ownership (total).

	Panel A: Foreign			Panel B: Domestic		
	Mean	**Max**	**SD**	**Mean**	**Max**	**SD**
Affiliates	1588	44,747	4584	4550	128,363	16,286
Revenues	80,568	1,666,594	230,842	120,905	3,570,717	445,011
Employees	141,943	3,968,938	467,030	218,448	4,783,207	722,912
Total assets	294,719	12,108,262	1,136,425	675,472	28,438,464	3,161,068
Fixed assets	106,175	4,000,906	458,076	116,923	5,199,483	510,060
Number of Countries		176			139	

Note: Revenues and assets in million USD. Statistics are at the host country (all affiliates).

TABLE 3 | Summary statistics at the host country by ownership (per affiliate).

	Panel A: Foreign			Panel B: Domestic		
	Mean	**Max**	**SD**	**Mean**	**Max**	**SD**
Revenues	86	1,260	183	75	1051	181
Employees	273	5,139	721	235	4,037	616
Total assets	400	5551	747	392	12,013	1192
Fixed assets	96	3915	436	57	1694	192
Number of countries		176			138	

Note: Revenues and assets in millions of USD. Foreign statistics are at the host country (per affiliate).

the aggregate revenues, employment, and assets of all domestic affiliates are higher than foreign affiliates, which is not surprising given that there are three times as many domestic affiliates as foreign affiliates in the representative host economy.

Table 3 reports summary statistics on the (time-averaged) revenue, number of employees, and total and fixed assets *per affiliate* and *by ownership* (i.e., domestic vs. foreign). Note that the average foreign affiliate in our sample tends to be larger in terms of revenues, number of employees, and assets than the average domestic affiliate. Moreover, the largest foreign affiliate (max) has greater revenues, a larger number of employees, and more fixed assets than the largest domestic affiliate.

However, means, maximum values, and standard deviations provide only a limited picture. Figure 3 shows the distributions of the variables of Table 3 (averages per affiliate and host country). On a per affiliate basis, the revenue and employee distributions reveal a different story for foreign and domestic affiliates relative to aggregate values seen in Table 2.[26] Figure 3a shows that foreign affiliates are likely to have higher revenues relative to domestic affiliates. The longer left tail of the distribution of revenues for domestic affiliates indicates that the mass of very small domestic affiliates is larger than the mass of very small foreign affiliates. Foreign affiliates are also more concentrated around the larger mean revenue per affiliate; the longer right tail for foreign revenues further suggests that the largest foreign affiliates generate higher revenues than the largest domestic affiliates.

Figure 3b similarly shows that the number of employees per affiliate is also relatively higher for foreign affiliates (with similar left and right tails) than for domestic affiliates. Although foreign and domestic total (and fixed) assets show similar distributions in Figures 3c,d, a larger share of foreign affiliates are clustered at the average level of assets than is the case for domestic affiliates.

Going to revenues per employee, a crude measure of a firm's labor productivity, Figure 3e shows that the distributions of revenue per employee are similar for foreign and domestic affiliates. However, the share of revenue per employee is also relatively larger for foreign affiliates (and with similar left and right tails), the evidence is suggestive that profits per foreign affiliate may exceed profits per domestic affiliate, which is consistent with theoretical models' hypotheses that foreign affiliates need to recover larger profits than domestic affiliates to cover the extra fixed costs of establishing a foreign affiliate as discussed in Ramondo and Rodriguez-Clare (2013) and Arkolakis et al. (2018).

4.3.2 | Country Maps

Figure 4 provides a heatmap of the spatial distribution of the multinational activity in MREID. Figure 4a shows the number of inward affiliates by host country. The heatmaps of the spatial distribution of the revenues and employees of foreign affiliates in host countries are represented in Figures 4b,c, respectively. Figure 4d provides a heatmap of the spatial distribution of the total and fixed assets owned by foreigners in a country.

Since the figures are readily interpretable, we do not provide extensive commentary. However, a few results are worth noting. First, China is close in numbers to the United States in the number of inward affiliates. Second, as host countries, China, Germany, and the United Kingdom see the largest revenues

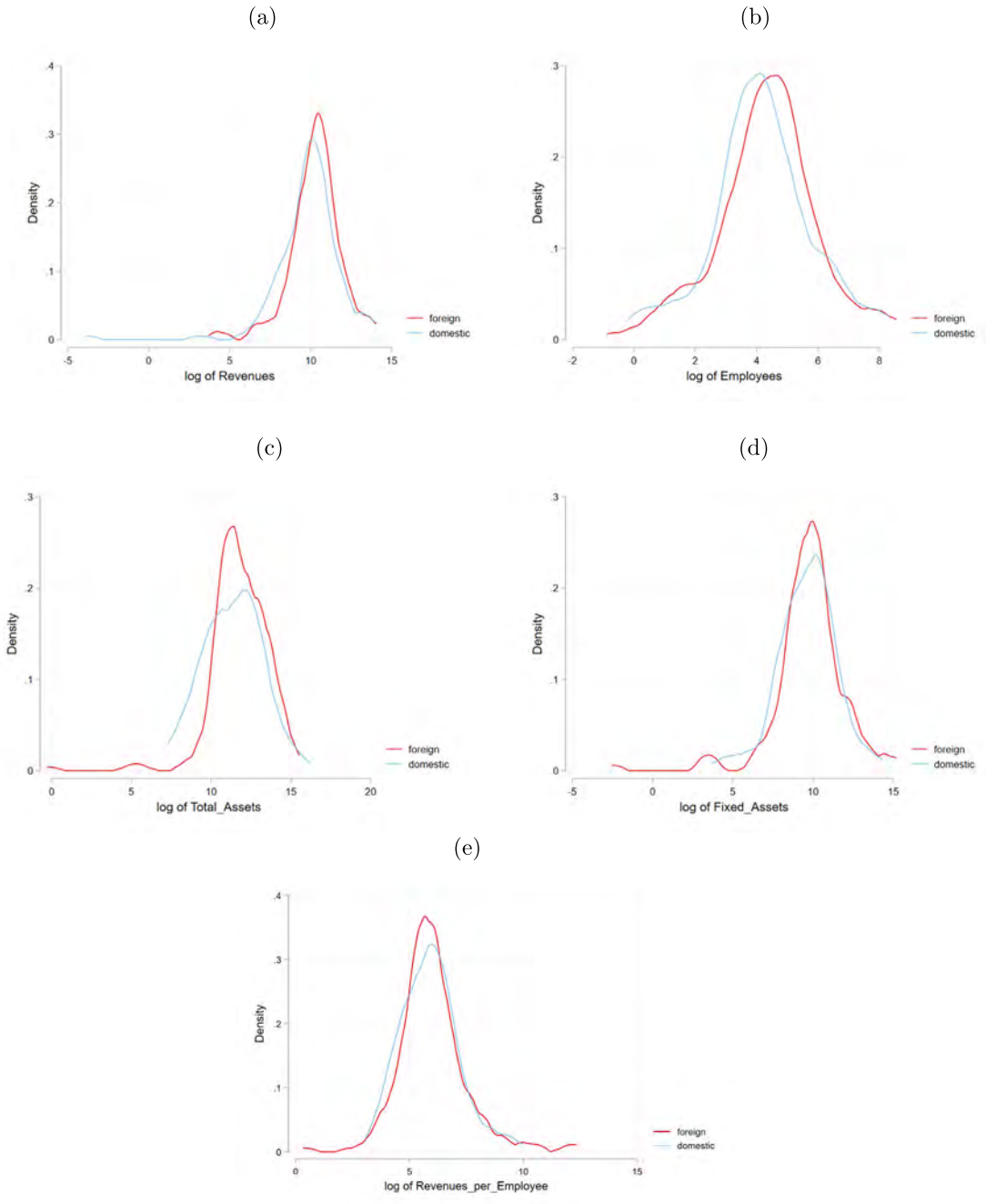

FIGURE 3 | Distribution of affiliates in host country by ownership. (a) Revenues per affiliate, (b) Employees per affiliate, (c) Total assets per affiliate, (d) Fixed assets per affiliate, and (e) Revenues/employee per affiliate. These figures represent the kernel density plots per affiliate of the MREID variables in the host county. The distribution of domestic and foreign affiliates is fairly similar. [Colour figure can be viewed at wileyonlinelibrary.com]

earned from foreign affiliates, with China also being among the countries with the highest number of employees in foreign countries. Third, the distribution of total assets is very similar to the distribution of the number of affiliates.

4.3.3 | Descriptive Statistics at the Country-Pair Level

A feature of MREID is the use of uni-directional bilateral data (e.g., American investment in Spain and Spanish investment in America) instead of net FDI, an average of the two-way FDI flows, or country-specific aggregating data from all origins, as is often the case with bilateral FDI data sourced from national accounts.

Table 4 reports summary statistics for foreign affiliates at the country-pair level (averages of years 2010–2021). Panel A reports (time-averaged) total statistics for all country pairs where there are positive observations. Panel B reports revenues, employees, and total and fixed assets *per affiliate*.

As noted previously, MREID has data on FDI for 187 countries; hence, there are potentially 34,410 (=186 × 185) FDI measures (for each year). However, investments by MNEs are characterized

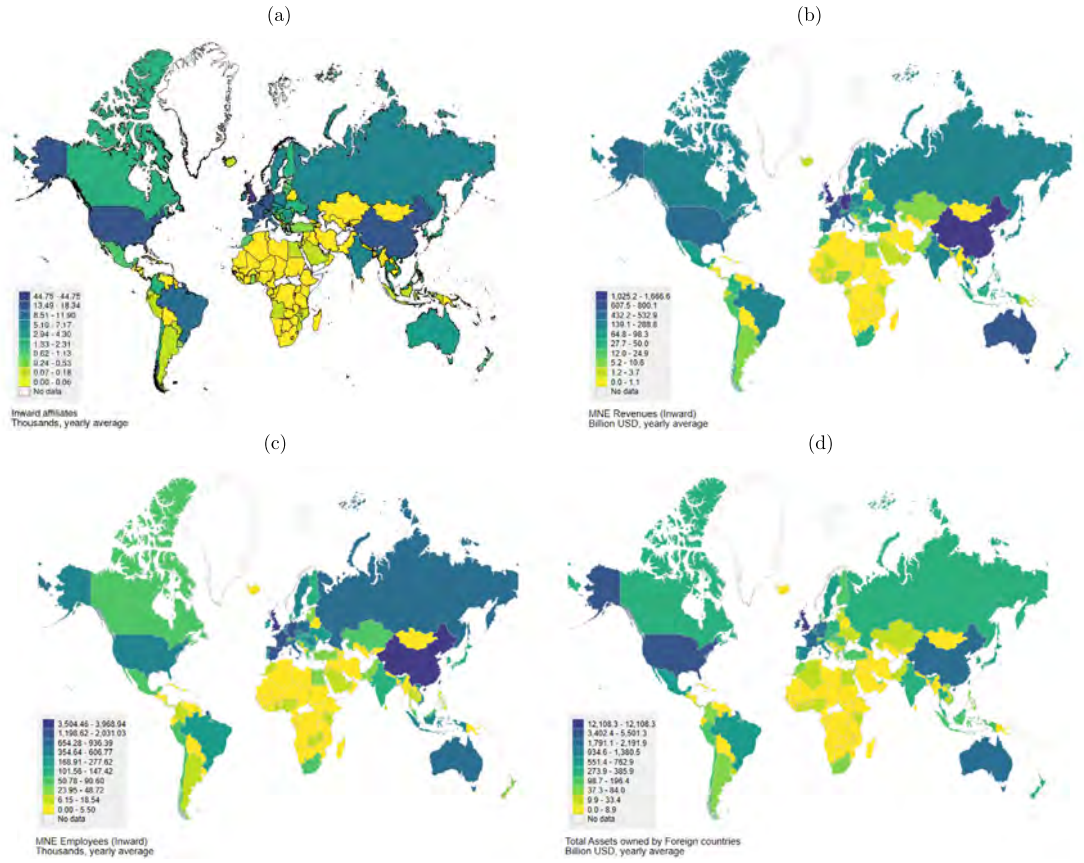

FIGURE 4 | Spatial distribution of selected variables in MREID. (a) Inward foreign affiliates, (b) Revenues of foreign affiliates in host countries, (c) Employees of foreign affiliates in host countries, and (d) Total assets in host countries (inward FDI). The figure is comprised of four heatmaps showing the spatial distribution of multinational activity (inward affiliates, revenues, employment, and assets in each country.). [Colour figure can be viewed at wileyonlinelibrary.com]

TABLE 4 | Summary statistics for foreign affiliates at the country-pair level.

	Panel A: Total			Panel B: Per affiliate		
	Mean	**Max**	**SD**	**Mean**	**Max**	**SD**
Foreign affiliates	65	19,873	392			
Revenues	3319	609,312	18,631	59	10,782	293
Employees	5846	1,735,375	40,181	200	156,239	2666
Total assets	12,139	6,309,828	120,773	218	56,616	1472
Fixed assets	4373	1,615,221	44,571	66	22,530	610
Bilateral pairs		4273		4273		

Note: Revenues, total assets, and fixed assets are in million USD.

by a large number of zeros. As noted in Table 4, there are only 4,273 country-pairs with at least one foreign affiliate. The mean number of active foreign affiliates across country-pairs in our sample is 65, while the average FAS in a country-pair is around 3 billion dollars. Still, there is significant variation across the country pairs, with the maximum number of foreign affiliates being around 20,000 and the maximum FAS being around 600 billion dollars observed between the United States and the UK. Turning to per affiliate statistics in panel B, we find that in a single country-pair, the average FAS is around 59 million dollars and the average number of workers employed is 200.

Figure 5 shows a bilateral flow diagram for our sample's "top 25" home and host countries. This particular figure illustrates the (time-averaged) relative numbers of affiliates created by a parent firm in a country on the left-hand side (LHS) into the host country on the right-hand side (RHS). We note several points. First, as expected, the USA is the largest investor (in terms of the number of foreign affiliates), followed by Japan, Germany, the UK, and France. Second, the figure indicates that the largest recipient of foreign affiliates is the UK, with significant MNE activity also seen in Japan, Germany, and France. Third, one can see the importance of distance from the figure. For example,

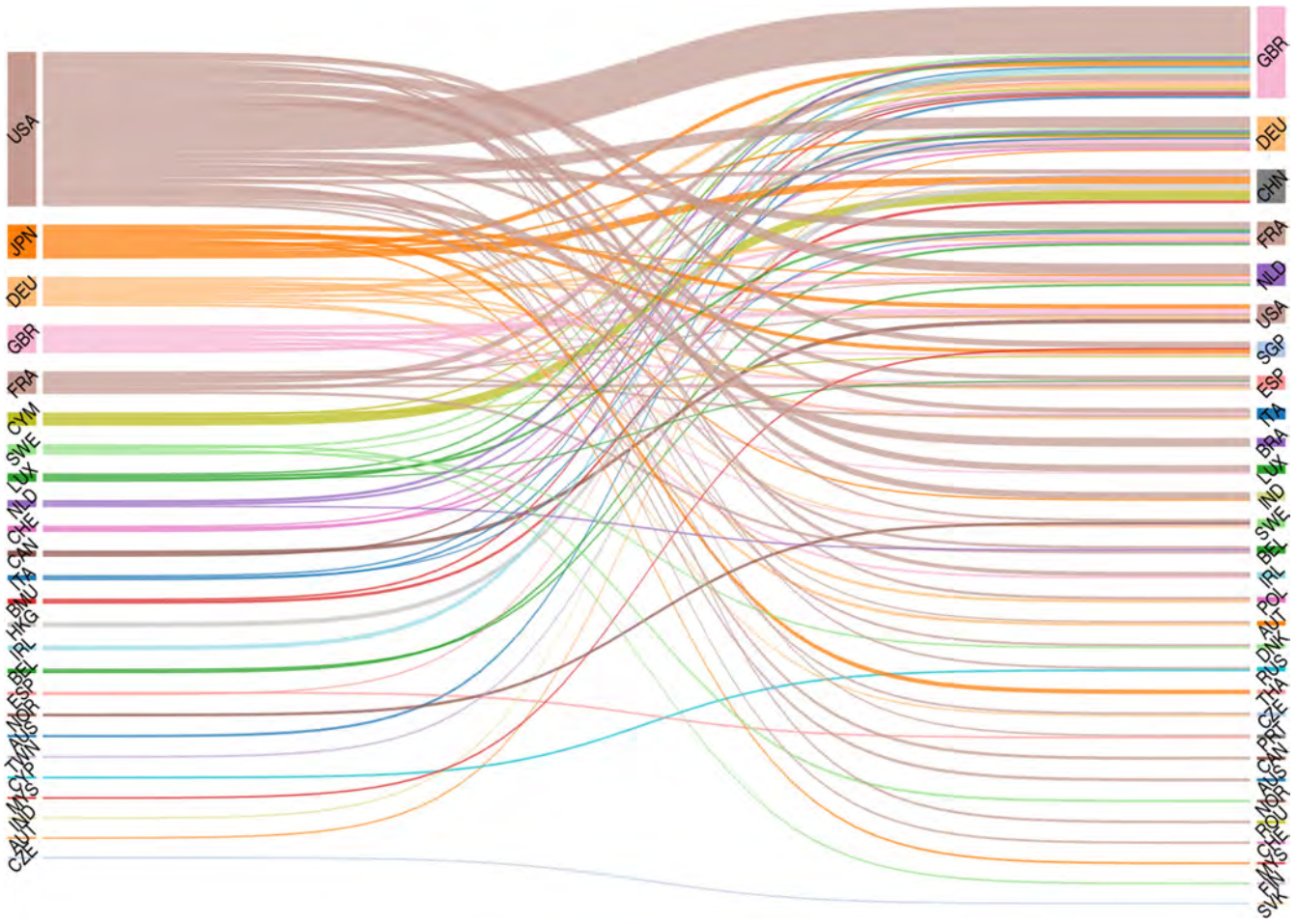

FIGURE 5 | Foreign affiliates flows of MNEs by top-25 country of origin (GUO) and destination. Bilateral flow Sankey diagram illustrating the (time-averaged) relative number of affiliates created by a parent in a country on the left-hand side into a foreign country on the right-hand side. The USA is the largest investor, while the United Kingdom is the largest destination for investment. [Colour figure can be viewed at wileyonlinelibrary.com]

the number of foreign affiliates in Thailand and the United States that are from GUOs based in Japan is relatively similar. So even though Thailand's economy is significantly smaller than the United States, its relative proximity to Japan makes it an attractive FDI destination for Japanese MNEs.

4.4 | Descriptive Statistics for MREID Sectors

We begin by describing the distribution of MNE activities in MREID across sectors. As discussed earlier, we aggregate our firm-level data to 25 two-digit NAICS sectors. Figure 6a–d of Figure 6 show how our four measures of FDI/MNE activity vary across *each* of the 25 sectors. The data is time-averaged across the 12 years of data, as was the case in Section 4.3 with the country-level data. Based on revenues and employees, we see a high degree of MNE activity in the following five sectors: Finance, Manufacturing of Finished Products, Information, Wholesale, and Manufacturing of Materials. However, the Finance and Management Services sectors comprise the bulk of the Total Assets and Fixed Assets in our data. For most sectors, domestic affiliates have higher revenues, number of employees, total assets, and fixed assets (in aggregate) than foreign affiliates, with the exception being in the manufacturing and wholesale sectors. Similarly, in Figure 6e, the number of affiliates with a domestic parent by sector exceeds those with a foreign parent. Lastly, Figure 6f shows that revenues per employee are typically larger for foreign affiliates than for their domestic counterparts in most sectors, with the largest gap seen in the mining sector for this measure of firm productivity.

Similar to Section 4.3, Figure 7 provides a bilateral flow diagram for the foreign affiliates of the top 25 source countries in our sample. However, this figure considers another dimension of FDI/MNE activities by also accounting for the sectors in the analysis. As before, the LHS lists the top 25 (largest) outward source countries of foreign affiliates, while the RHS lists the top 25 host countries in our sample.

To appreciate insights from this figure, consider the United States, the largest source of FDI in our data (cf., Figure B4, panels c and d in the Supporting Information). We knew from Figure 5 that the UK, China, and Germany were some of the top destinations of FDI for U.S. MNEs. With Figure 7, we can now also see that the foreign affiliates of U.S. MNEs are concentrated in the following sectors: Wholesale, Legal Services, and Management Services. Combining these two snippets of information, we can state that a large number of foreign affiliates in

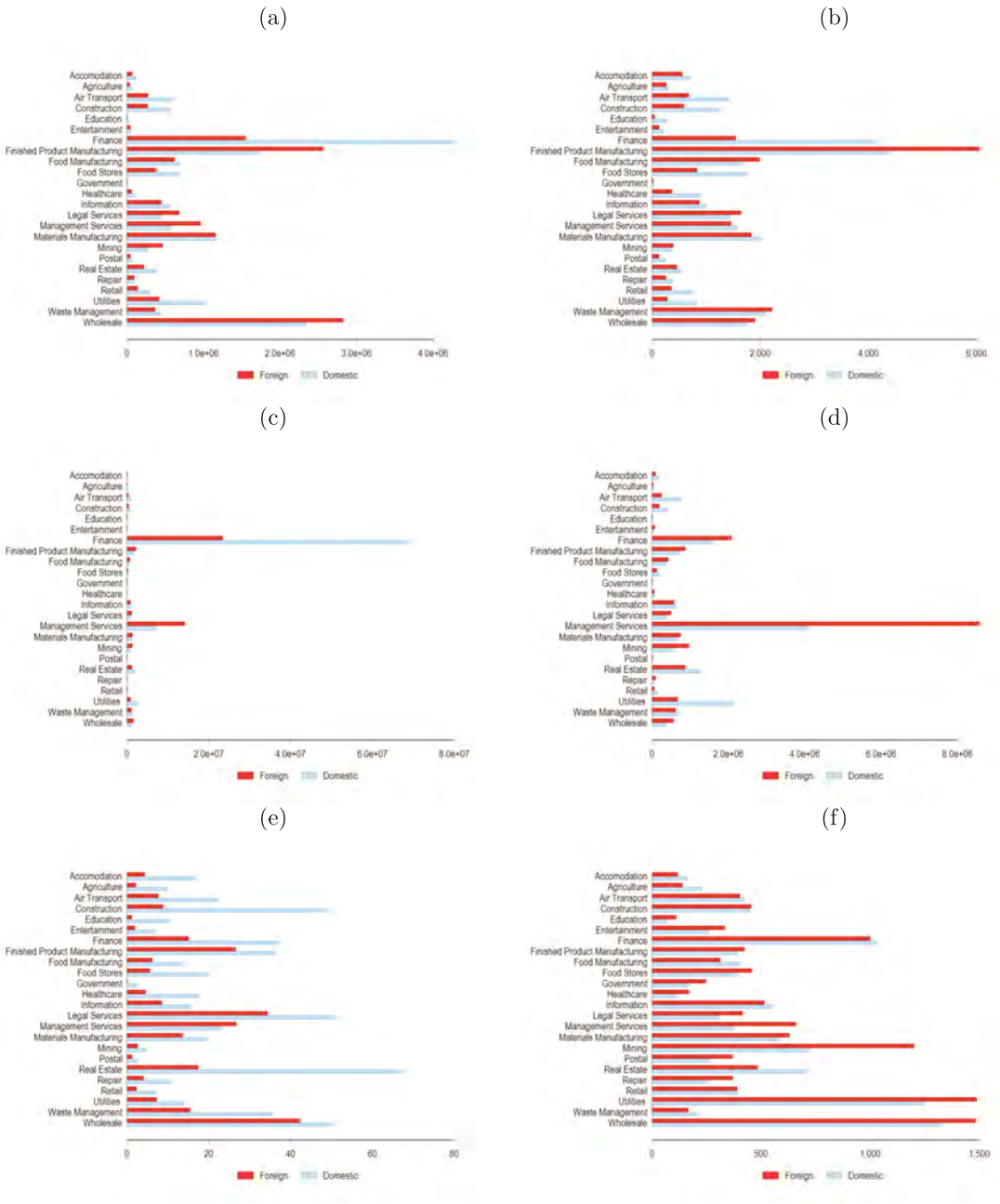

FIGURE 6 | MREID variables by sector and ownership (total). (a) Revenues (million USD), (b) Employees (thousand), (c) Total assets (million USD), (d) Fixed assets (million USD), (e) Sector affiliates (thousand), and (f) Revenues per employee. Bar charts showing time-averaged totals of revenue, employment, total assets, fixed assets, sector affiliates, and revenues per employee in each of the 25 sectors. [Colour figure can be viewed at wileyonlinelibrary.com]

the UK's Legal Services have a parent firm located in the United States. Thus, MREID can be used in this way to identify both the countries and sectors that are at the center of cross-border MNE activities.

4.5 | FDI by Entry Mode: Greenfield vs. M&As

A relevant and distinctive feature of the MREID dataset is information regarding the entry mode in foreign markets. Greenfield FDI refers to an investment made by a parent company into a *new* affiliate in the host country during the sample period. The second type of entry mode in foreign markets is through mergers and acquisitions (M&As) FDI. This investment refers to a parent firm's acquisition or merger with another firm in the host country.

We examine the differences between foreign affiliates that enter the host economy as greenfield investments vs. those that enter through M&A in MREID. Figure 8 shows the distributions (average per affiliate) of revenues, employees, and assets (total and fixed) in the host country of foreign affiliates by entry type. We observe some interesting patterns for several *per affiliate* measures of MNE activity. We see that the average M&A foreign

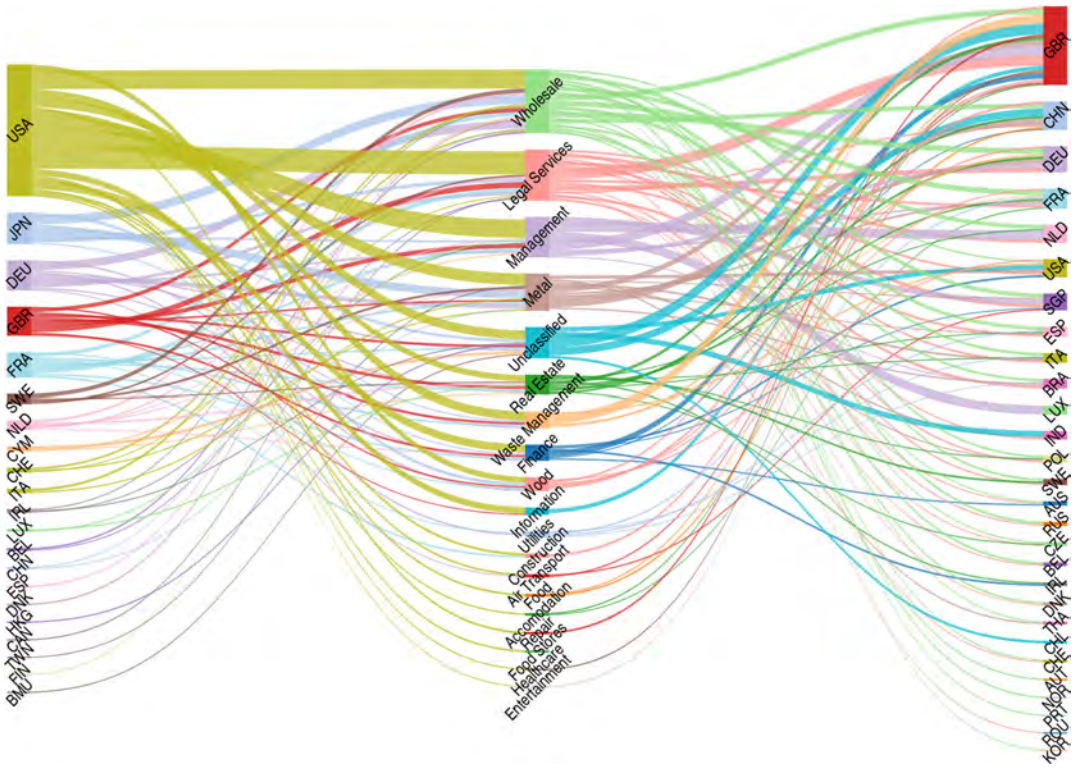

FIGURE 7 | Foreign affiliates flows by top-25 country of origin, sector, and destination. Bilateral flow Sankey diagram illustrating the (time-averaged) relative number of affiliates created by a parent in a country on the left-hand side into a foreign country on the right-hand side by sector. The USA is the largest investor, while the United Kingdom is the largest destination for investment. [Colour figure can be viewed at wileyonlinelibrary.com]

affiliate is larger, in terms of revenues, employees, and assets, than the average greenfield foreign affiliate. The distribution of revenues, employees, and assets of M&A affiliates in the host country has similarities to the distributions seen for all foreign affiliates in Figure 3. On the other hand, the distribution of the greenfield affiliates are shifted to the left (i.e., lower mean) and more spread out for revenues Figure 8a, employees Figure 8b and assets Figure 8c,d. However, for revenues per employee Figure 8e, there does not appear to be a significant difference in the mean between greenfield and M&A affiliates, though there is more heterogeneity for this measure for greenfield affiliates. This means that foreign greenfield affiliates are more heterogeneous in terms of revenue dispersion than domestic affiliates or established affiliates. Overall, these observed patterns are compatible with initial greenfield investments starting at lower levels, with the firm then scaling them up afterwards.

5 | Gravity Analysis With MREID

5.1 | Baseline Gravity Estimates

A long body of theoretical and empirical work has shown that a gravity approach has several desirable properties for modeling the cross-border flows of trade and investment (Anderson (2011); Anderson et al. (2019); Kox and Rojas-Romagosa (2020); Bergstrand and Egger (2007)). Accordingly, in this section, we test whether the gravity model is suitable for understanding the bilateral determinants of the different FDI measures captured in MREID. Our goal here is to ensure that the MREID variables follow the empirical patterns established in the literature so that researchers can confidently use MREID for conducting policy analysis under a gravity framework.

We first examine a standard gravity model without any policy variables with the following specification:

$$FDI_{ijt} = \exp(\beta_1 DIST_{ij} + \beta_2 CONTG_{ij} + \beta_3 LANG_{ij} + \beta_4 CLNY_{ij} + \lambda_{it} + \eta_{jt}) \times \mu_{ijt} \quad (1)$$

A few additional points. For the dependent variable, we use the following five MREID variables as our proxy of bilateral FDI: The number of affiliates home i has in host j; total revenues generated by affiliates of home i in host j; total number of workers employed by affiliates of home i in host j; and the total assets and fixed assets of affiliates of home i in host j. As is common in the trade literature, we use the log of distance along with dummy variables for contiguity, common language, and colonial relationships to capture the geographic, historic, and cultural characteristics between country pairs. Data on these bilateral gravity variables is obtained from the Dynamic Gravity Dataset (Gurevich and Herman 2018). We also include host-year and source-year fixed effects to better control for multilateral resistance terms in the estimations. Lastly, all estimations are conducted using a Poisson pseudo maximum likelihood (PPML) estimator, as proposed by Silva and Tenreyro (2006), to account for potential heteroskedasticity and instances where zero MNE activity is taking place between country pairs.

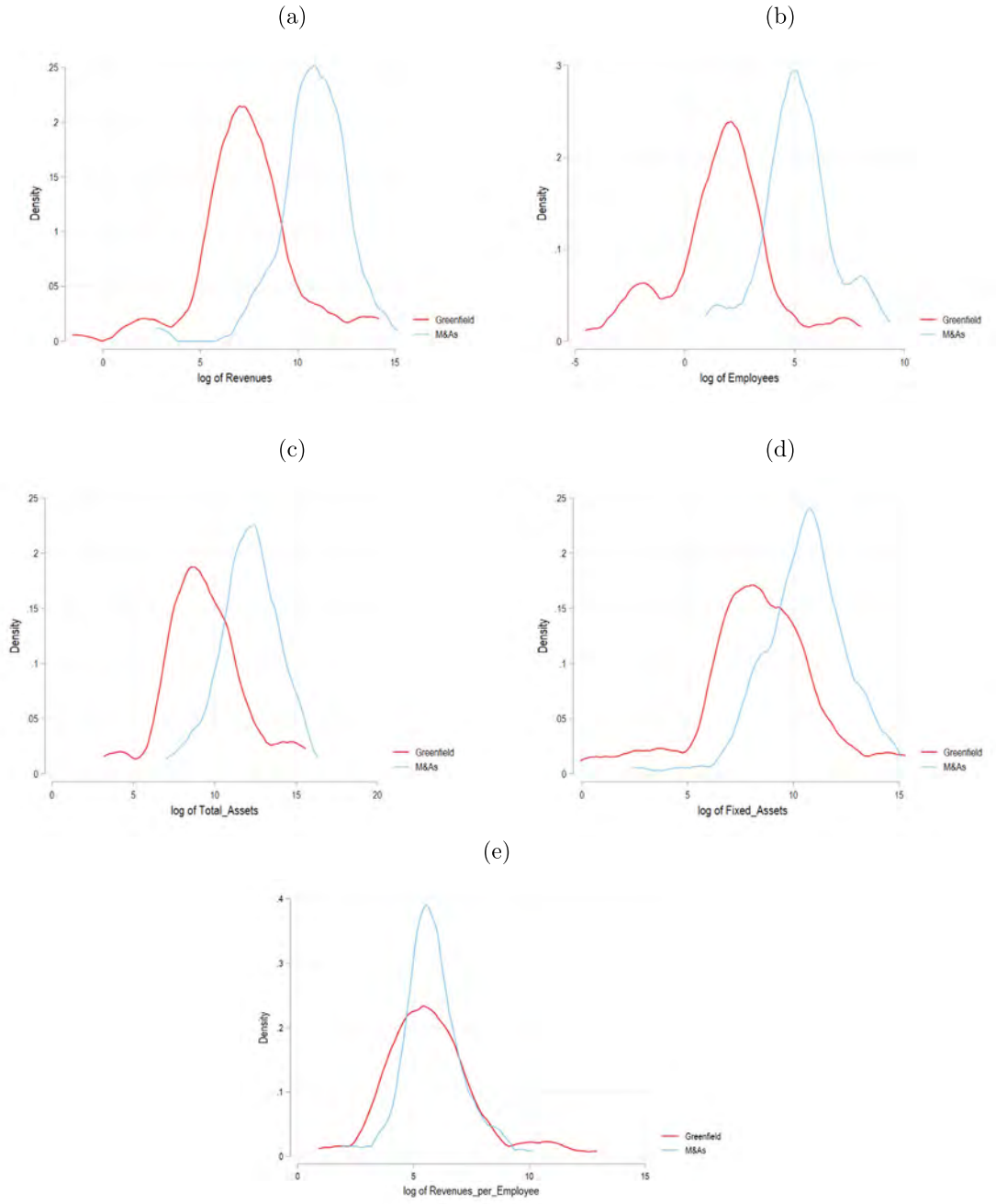

FIGURE 8 | Distribution of foreign affiliates in host country by entry type (M&As vs. Greenfield). (a) Revenues per affiliate, (b) Employees per affiliate, (c) Total assets per affiliate, (d) Fixed assets per affiliate, and (e) Revenues/employee per affiliate. These figures represent the kernel density plots per affiliate of the MREID variables in the host county by entry type (M&As vs. Greenfield). The distributions of M&As are consistently to the left of Greenfield, indicating larger volumes (except for revenues per affiliate). [Colour figure can be viewed at wileyonlinelibrary.com]

Table 5 reports our PPML estimates of Equation (1). We can first verify that distance, contiguity, common official language, and colonial relationships have the expected signs for all of our MREID variables. Moreover, distance and colonial relationships have a statistically significant effect on bilateral MNE activities for all the different MREID variables. For the other two explanatory variables, we find that contiguity only has a significant effect for the number of affiliates home i has in host j and for the number of employees affiliates of home i have in host j. For country pairs sharing a common language, we find that it has a significant effect only for the number of affiliates home i has in host j and the total revenues affiliates of home i generate in the host country j. Based on these estimates, we can infer that the traditional gravity variables have a stronger effect on the extensive margin of FDI, with the number of affiliates home i has in host j more responsive to contiguity and common language than the MREID variables capturing the intensive margin of MNE activities.

We next examine how the addition of policy variables may impact the estimates reported in Table 5. To this end, we now include in Equation (2) three additional variables:

TABLE 5 | MREID estimates with standard gravity co-variates.

	(1) Affiliates	(2) Revenues	(3) Employees	(4) Total assets	(5) Fixed assets
Distance	−0.575***	−0.527***	−0.508***	−0.395***	−0.473***
	(0.04)	(0.06)	(0.09)	(0.10)	(0.10)
Contiguity	0.447***	0.133	0.389*	0.420	0.241
	(0.12)	(0.18)	(0.23)	(0.28)	(0.26)
Language	0.263**	0.271*	0.154	0.302	−0.227
	(0.11)	(0.16)	(0.20)	(0.22)	(0.19)
Colony	0.542***	0.670***	0.890***	0.497***	0.339*
	(0.11)	(0.16)	(0.16)	(0.19)	(0.20)
Observations	41,799	40,794	39,171	40,840	38,486
R^2	0.89	0.84	0.82	0.84	0.88

Note: All gravity estimates reported using Pseudo Poisson Maximum Likelihood (PPML). The following MREID measures serve as the dependent variables across the columns: (1) the number of affiliates home i has in host j; (2) total revenues generated by affiliates of home i in host j; (3) total number of workers employed by affiliates of home i in host j; (4) total assets of affiliates of home i in host j, and (5) fixed assets of affiliates of home i in host j. All estimates are obtained with home-year and host-year fixed effects, with these estimates omitted for brevity. R^2 for PPML estimates are based on McFadden's R^2. Standard errors clustered at the home-host country level in parentheses with significance levels as *$p < 0.10$, **$p < 0.05$, ***$p < 0.01$.

$$FDI_{ijt} = \exp(\beta_1 DIST_{ij} + \beta_2 CONTG_{ij} + \beta_3 LANG_{ij} + \beta_4 CLNY_{ij}) \times \exp(\gamma_1 FTA_{ijt} + \gamma_2 EIA_{ijt} + \gamma_3 WTO_{ijt} + \lambda_{it} + \eta_{jt}) \times \mu_{ijt} \quad (2)$$

These new indicator variables capture if countries have a free trade agreement between them (FTA_{ijt}), if they have an economic integration agreement between them (EIA_{ijt}), and if they are both members of the World Trade Organization (WTO_{ijt}). Because of the small number of EIAs in our sample, we follow Baier et al. (2014) and also include currency unions and common markets such as the European Union in our definition of EIAs.

Since our objective here is to validate gravity coefficients using MREID variables, we follow the lead of Borchert et al. (2022) and estimate these specifications without any pair fixed effects. While pair fixed effects may assist in controlling for the potential self-selection of countries in forming international agreements, they would not allow us to determine the effect of standard gravity variables such as distance, contiguity, common language, and colonial relationships, as they do not vary over time. We thus only include host-year and source-year fixed effects in the estimation of (2) and leave the use of pair fixed effects for future works interested in examining the effects on international agreements on MNE activities covered under MREID.

Table 6 reports our estimates of Equation (2) that now includes additional dummy variables for bilateral policies between country pairs.[27] For the traditional gravity variables, we do not see much difference in either magnitude or statistical significance compared to Table 5. Distance and colonial relationships continue to have a strong effect on the different dimensions of MNE activities in MREID. We also see that the standard gravity variables have a stronger effect on the extensive margin of MNE activity, and that the effect of distance is less prominent for MNE activities related to total assets and fixed assets of affiliates in host countries.

Turning to the policy dummies, we find an interesting result in that the presence of an FTA between country pairs leads to a negative and statistically significant effect on MNE activities related to the intensive margin (revenues, employees, total assets, and fixed assets).[28] Other studies have also found similar negative results of FTA on FDI (Myburgh and Paniagua 2016; Paniagua et al. 2015). By reducing tariffs and other cross-border barriers, trade agreements can help to make exports a more profitable way for a firm to serve the foreign market than through its affiliates, and so can have a negative impact on FDI (Bergstrand and Egger 2007; Jang 2011).

However, when we look at the EIA dummy, it is positive and statistically significant for all the dimensions of MNE activities covered in MREID. EIAs often include deeper provisions targeting investment and other policy areas that go beyond reciprocal market access commitments, and so can outweigh the investment-diverting aspects of traditional FTAs. For instance, the USITC (2021) report shows that while trade agreements in general do not have a significant impact on the FDI stock between home country and host country, trade agreements with investment provisions can have a positive, significant impact.[29] Similarly, Osnago et al. (2019) find that deeper trade agreements lead to higher vertical FDI, investments characterized by where the affiliate produces an input for the parent firm to use in production, and that intra-EU cross-border investments exhibit higher merger and acquisition activity along with lower acquisition costs (Coeurdacier et al. 2009; Head and Mayer 2021).

5.2 | Potential Extensions

So far, we have shown that the gravity model can generate reasonable estimates on how traditional gravity variables such as distance, contiguity, common language, colonial status, and trade agreements may impact the bilateral FDI measures captured in MREID. The gravity coefficients reported in the previous section, however, were estimated at the aggregate level and did not differentiate between sectors. Given that a special feature of MREID is the ability to capture MNE activities at the disaggregated sector level, it can also serve as a resource for researchers interested

TABLE 6 | MREID estimates with gravity and policy co-variates.

	(1) Affiliates	(2) Revenues	(3) Employees	(4) Total assets	(5) Fixed assets
Distance	−0.527***	−0.465***	−0.464***	−0.290***	−0.364***
	(0.05)	(0.07)	(0.12)	(0.10)	(0.10)
Contiguity	0.457***	0.116	0.377*	0.391	0.257
	(0.12)	(0.18)	(0.22)	(0.28)	(0.26)
Language	0.260**	0.269*	0.180	0.320	−0.209
	(0.11)	(0.16)	(0.19)	(0.22)	(0.19)
Colony	0.583***	0.734***	0.961***	0.567***	0.364*
	(0.11)	(0.16)	(0.16)	(0.19)	(0.21)
FTA	−0.294	−0.411**	−0.751**	−0.474**	−0.431**
	(0.20)	(0.20)	(0.30)	(0.23)	(0.18)
EIA	0.464**	0.682***	0.956***	0.862***	0.793***
	(0.22)	(0.22)	(0.31)	(0.27)	(0.21)
WTO	0.009	0.386	−0.757	0.860	1.103*
	(0.48)	(0.83)	(0.80)	(0.57)	(0.64)
Observations	41,799	40,794	39,171	40,840	38,486
R^2	0.90	0.85	0.82	0.85	0.88

Note: All gravity estimates reported using PPML. Dependent variables are as defined in Table 5. All estimates include home-year and host-year fixed effects, but are omitted here for brevity. R^2 for PPML estimates are based on McFadden's R^2. Standard errors clustered at the home-host pair level in parentheses with significance levels as $^*p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

in investigating the bilateral determinants of FDI across sectors. While a full examination of gravity coefficients for all the sectors covered in MREID is beyond the scope of this paper, we provide some exploratory estimations to see how gravity performs for some key sectors in MREID.

With this goal in mind, we re-estimate Equation (1) for two broad sectors: Manufacturing and Services.[30] Table 7 reports the estimates for the traditional gravity variables with the top (bottom) panel showing the gravity coefficients for the manufacturing (services) sectors. We find that across the different dimensions of MNE activities in MREID, distance has a negative and significant effect for both the manufacturing and services sectors. Interestingly, the effect of distance on the total assets of affiliates is smaller for the services sectors than for the manufacturing sectors, indicating that for services firms, there may be other factors, such as favorable tax treatment, that can outweigh bilateral frictions in determining how much total assets its affiliates hold in host countries. Building on these estimates, a companion paper by Ahmad et al. (2024) is pursuing a structural gravity framework to identify phantom or conduit FDI using MREID data at the aggregate and sector level.

Moving to the other gravity co-variates in Table 7, we see that contiguity and languages affect MNEs in manufacturing differently from those operating in services.[31] Contiguity, for instance, only has an effect on the extensive margin for manufacturing MNEs, but it retains its significance for the number of affiliates as well as the revenues and employees of affiliates in the services sectors. As with trade agreements, geographic proximity may make it easier for some manufacturing firms to export their goods directly rather than through an affiliate, generating the lack of significant effect on MNE activities seen in the top panel of Table 7. On the other hand, services firms often require substantial cross-border movement of personal to facilitate transactions (Francois and Hoekman 2010) and so having a common border may encourage services firms to both set-up and expand their operations in the host country.[32] Similarly, our estimates indicate that common language has no effect on the activities of MNEs in manufacturing, but does influence the activities of MNEs operating in services sectors. Other studies have also found that a common language can have a strong effect on cross-border services trade (Benz and Jaax 2020) and on the number of greenfield investments of services firms (Jungmittag and Marschinski 2023).

Overall, our estimates in Table 7 show that there is value in using a gravity framework with MREID to systematically explore how MNEs function across different sectors. We end this discussion by identifying a couple of other areas where researchers may especially benefit from using MREID for sectoral data on MNE activities. First, MREID should help us better understand the impact of trade and investment policies have on FDI and MNEs at the sector level. For example, previous studies that have looked at the effects of international investment agreements (IIAs), such as bilateral investment treaties (BITs), on FDI have often done so in the aggregate, using total FDI flows, stocks, or affiliate sales (Egger and Merlo 2007; Myburgh and Paniagua 2016; Neumayer and Spess 2005; Rose-Ackerman and Tobin 2005). However, there is very little reason to presume that the effects of these agreements that aim to decrease investment risk would be the same across sectors. In particular, BITs and other IIAs may be most effective in sectors such as manufacturing and mining, where there are larger sunk costs and therefore a greater threat from expropriation. So MREID can assist researchers interested

TABLE 7 | MREID estimates with gravity co-variates (broad sector).

	Manufacturing sectors				
	(1) Affiliates	**(2) Revenues**	**(3) Employees**	**(4) Total assets**	**(5) Fixed assets**
Distance	−0.576***	−0.559***	−0.439***	−0.543***	−0.504***
	(0.05)	(0.07)	(0.09)	(0.08)	(0.09)
Contiguity	0.239**	−0.257	0.459	−0.253	−0.231
	(0.12)	(0.26)	(0.29)	(0.24)	(0.23)
Language	0.034	0.314	−0.339	0.188	0.140
	(0.11)	(0.21)	(0.27)	(0.21)	(0.22)
Colony	0.556***	0.573**	0.759***	0.510**	0.408*
	(0.11)	(0.24)	(0.20)	(0.23)	(0.25)
Observations	22,008	21,243	19,788	20,925	20,887
R^2	0.85	0.80	0.81	0.77	0.73
	Services Sectors				
	(6) Affiliates	**(7) Revenues**	**(8) Employees**	**(9) Total assets**	**(10) Fixed assets**
Distance	−0.545***	−0.457***	−0.532***	−0.352***	−0.489***
	(0.05)	(0.08)	(0.07)	(0.11)	(0.10)
Contiguity	0.498***	0.337*	0.386**	0.483	0.209
	(0.13)	(0.19)	(0.17)	(0.32)	(0.29)
Language	0.303**	0.228*	0.384**	0.296	−0.330*
	(0.12)	(0.16)	(0.15)	(0.25)	(0.19)
Colony	0.504***	0.609***	0.773***	0.469**	0.254
	(0.11)	(0.16)	(0.16)	(0.20)	(0.19)
Observations	38,332	37,348	35,557	37,367	34,284
R^2	0.89	0.84	0.83	0.84	0.90

Note: All gravity estimates reported using PPML. Estimates include home-year and host-year fixed effects, but are omitted here for brevity. Dependent variables are as defined in Table 5. Standard errors clustered at the home-host pair level in parentheses with significance levels as *$p < 0.10$, **$p < 0.05$, ***$p < 0.01$.

in identifying the heterogeneous impacts on affiliate establishments and their economic activities from IIAs across different sectors.

Second, the MNE activities covered by MREID can be easily combined with trade data to see how both trade and investment are affected by changes in policy. Bergstrand and Paniagua (2024) pursue such an approach by combining MREID with trade data, taken from the ITPD-E, to demonstrate that trade and FDI exhibit substitutability when it comes to the substantive provisions in EIAs. In particular, when all individual provisions that have positive (negative) effects on trade are grouped, these sets of provisions negatively (positively) affect FDI.[33] While this analysis was conducted at the aggregate level, it may be case that in some sectors, such as services, trade and FDI are more complementary than is the case for goods trade. Future studies can thus exploit the rich dimensions of the MREID dataset to uncover the mechanisms through which deep trade agreements can influence MNE activities and trade at the disaggregate sector level.

6 | Conclusion

Analyzing the impact of trade and investment policies on home and host countries requires comprehensive and consistent information on foreign and domestic multinational production. As noted in the literature on FDI and multinational production, there is a growing consensus that relying on national accounts data is insufficient for the analysis of multinational production. Most FDI data sources that rely on national account data capture a multinational's financing activity, which can include activity related to profit-shifting, instead of a subsidiary's production activity—limiting researchers' ability to answer questions related to the effect of production on individual countries. Additionally, many FDI datasets have limited sectoral data, which can prevent the analysis of policies on FDI, given that policies may have a larger impact on more capital-intensive industries. As such, it is increasingly preferable to use firm-level financial data, including revenues, total assets, and employment, that better account for the production activity of affiliates in the host economy.

This paper introduces the Multinational Revenue, Employment, and Investment Database (MREID), a comprehensive source of information on the financial activities of affiliates of multinational enterprises (MNEs) for 185 countries and 25 sectors over a period of 12 years (2010 through 2021). MREID offers key economic variables of interest at the bilateral sector level that can provide researchers with a comprehensive overview of the MNE activities taking place in the global economy.

We further demonstrate the suitability of MREID for structural gravity estimation. The usual covariates like distance, contiguity, common language, and colony show the expected signs. The estimated coefficients of policy-related variables (FTAs, EIAs, and WTO membership) are in line with economic intuition. Thus, researchers can confidently rely on MREID to analyze the effect of policies on the economic activities of MNEs under a gravity framework.

Future studies can leverage the sectoral dimension of MREID to explore similarities and differences in the estimated impact of traditional gravity variables on trade at the disaggregated sector level, following the approach of trade studies such as (Borchert et al. 2022). The combination of the ITPD-E and MREID, as proposed by Bergstrand and Paniagua (2024), might pave the way for intriguing new research avenues exploring multifaceted international economic flows. Moreover, the detailed insights on MNE activities provided by MREID can be especially beneficial in designing targeted policies that can address sector-specific investment barriers and enhance international economic integration.

Acknowledgements

The authors thank John Fry, Bill Powers, David Riker, and Peter Herman for helpful comments and suggestions. The views expressed in this paper are strictly those of the authors and do not represent the opinions of the U.S. International Trade Commission or any of its Commissioners.

Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

The data that support the findings of this study are openly available in the USITC Gravity Portal at https://doi.org/10.71894/wjf6-ra65.

Endnotes

[1] The MREID dataset is available for download from the United States International Trade Commission's (USITC) Gravity Portal: https://www.usitc.gov/data/gravity/mreid.htm.

[2] Consequently, researchers should be aware that MREID may not be sufficient if their focus is to capture MNE activities occurring in certain parts of Africa and Asia.

[3] Orbis does provide some estimates when financial data of a firm are unavailable, but these are not based on an econometric model.

[4] Their approach builds on the framework developed by Beverelli et al. (2024) and Heid et al. (2021) to estimate the impact of unilateral trade policies and institutions on trade and development.

[5] See Borchert et al. (2021) for more details on the construction of the ITPD-E.

[6] Some official sources such as the BEA are compiled through surveys, which might also be prone to measurement error.

[7] In particular, they show that by ignoring sectoral heterogeneity in multinational production and their relationship to a country's comparative advantage, one-sector models may underestimate the gains from multinational production and trade.

[8] A firm is considered as foreign-controlled if its Global Ultimate Owner in the Orbis database is registered in a country outside the EU.

[9] For example, domestic investment is important in identifying the border costs of greenfield FDI (Carril-Caccia et al. 2023) and of M&As (Carril-Caccia et al. 2022).

[10] For instance, Ramondo et al. (2015) create a database of multinational production from published and unpublished data from UNCTAD, which includes foreign affiliate sales, the number of foreign affiliates, and affiliate employment and assets. They provide stylized facts for multinational production and trade related to gravity, openness, and the current account.

[11] See also Kalemli-Özcan et al. (2022, 2023).

[12] Focusing on the GUO lets us bypass some of the offshore issues that plague official FDI statistics that are based on the direct owner.

[13] The Fifth Edition of the IMF Balance of Payments Manual defines the owner of 10% or more of a company's capital as a direct investor. However, the majority control threshold (50.01%) aligns with the IMF and OECD definition of FDI to obtain a *lasting* interest by a resident entity of one economy in another.

[14] We use the Orbis' variable date of incorporation to fix the entry criteria of an affiliate.

[15] Recently, Moody's has launched the Orbis Crossborder Investment Monitor, a similar dataset to FDIMarkets, which tracks greenfield investment by following firm announcements. Linask and Waddle (2023) summarized the trends and features of this dataset.

[16] Detailed accounting items and formulas are accessible here: https://help.bvdinfo.com/mergedProjects/65_EN/Data_Osiris/Understanding_Osiris_data_and_formats/DataFormulas/globalformatalltemus_nonus.htm.

[17] The stock variation is the difference between the value of the initial inventory and the end of the fiscal year. According to international accounting practices, if the stock valuation at the beginning of the fiscal year is lower than at the end of the fiscal year, this difference must be reflected as income.

[18] Some reported turnover might contain negative values. As stated earlier, we have dropped them.

[19] Further detail of the variables included in MREID is available here: https://www.usitc.gov/data/gravity/mreid_1.0_codebook.pdf.

[20] The estimation procedure is described in detail here: https://help.bvdinfo.com/mergedProjects/65_EN/Data/Financial/Estimates.htm. Any missing financial data from Orbis is treated as a zero in the country-sector aggregation.

[21] See also Casella et al. (2024) who provide a survey of the various FDI datasets used in the literature to proxy MNE production. The authors mention MREID as one of the latest datasets available for researchers studying FDI and MNE activities.

[22] The gravity model has been shown to be a desirable framework for analyzing the determinants of FDI (Bergstrand and Egger 2007; Anderson et al. 2019).

[23] These countries are Aruba, Antigua and Barbuda, Brunei, Central African Republic, Dominica, Korea, North, San Marino, Suriname, Turkmenistan, Saint Vincent and the Grenadines, Samoa, and Yemen.

[24] These countries are Burundi, Benin, Burkina Faso, Cameroon, Republic of the Congo, Djibouti, Guinea, Grenada, Kyrgyzstan, Maldives, Mali, Mauritania, Sao Tome and Principe, and Swaziland.

[25] All domestic affiliates that fulfill the entry requirements are included. Some parent companies might have only domestic affiliates and not foreign ones.

[26] Figure B11 shows the distributions of the (time-averaged) variables in Table 2 (totals per host country). Figure B11a shows that the distribution of foreign affiliate sales is similar to that of domestic affiliate sales; this figure confirms visually that a larger share of the distribution of foreign affiliate revenues is at smaller values relative to domestic revenues. However, the left tail of the domestic revenue's distribution is longer than that of the foreign distribution.

[27] Since MREID complements data on cross-border MNE activities with their domestic counterparts, we can re-estimate (2) using a sample that also includes domestic investment. As in Borchert et al. (2022), the gravity estimations now include a set of country-specific dummy variables that take a value of 1 for domestic investment and a value of 0 for foreign investment. These estimates are shown in Table B.9 and are not meaningfully different from those estimated using only cross-border investment activities in MREID.

[28] The effect of an FTA on the number of affiliates a home country has in the host country is not statistically significant.

[29] Bergstrand and Paniagua (2024) explore the impact of individual provisions in EIAs on the MNE activities covered in MREID and find that having an EIA with the mean number of substantive provisions increases the number of affiliates from home i to host j by 4 percent.

[30] MREID sectors with NAICS classifications 31-31 are categorized as manufacturing, while those with NAICS classifications 42 and higher are categorized as services.

[31] We do not see much difference in the coefficients for colonial relationships between the two sectors.

[32] See also Sleuwaegen and Smith (2021) on how the heterogeneous nature of services can affect the choice between exports and FDI for firms operating in different services sectors.

[33] Similarly, when all individual provisions that have positive (negative) effects on FDI are grouped, they find that these sets of provisions negatively (positively) affect trade.

References

Ahmad, S., J. Bergstrand, J. Paniagua, and H. Wickramarachi. 2024. *Phantom FDI. Working Paper*.

Alabrese, E., and B. Casella. 2020. "The Blurring of Corporate Investor Nationality and Complex Ownership Structures." *Transnational Corporations Journal* 27, no. 1: 115–137.

Alfaro, L., and M. X. Chen. 2018. "Selection and Market Reallocation: Productivity Gains From Multinational Production." *American Economic Journal: Economic Policy* 10, no. 2: 1–38.

Alviarez, V. 2019. "Multinational Production and Comparative Advantage." *Journal of International Economics* 119: 1–54.

Aminadav, G., and E. Papaioannou. 2020. "Corporate Control Around the World." *Journal of Finance* 75, no. 3: 1191–1246.

Anderson, J. 2011. "The Gravity Model." *Annual Review of Economics* 3, no. 1: 133–160.

Anderson, J. E., M. Larch, and Y. V. Yotov. 2019. "Trade and Investment in the Global Economy: A Multi-Country Dynamic Analysis." *European Economic Review* 120: 103311.

Arkolakis, C., N. Ramondo, A. Rodriguez-Clare, and S. Yeaple. 2018. "Innovation and Production in the Global Economy." *American Economic Review* 108, no. 8: 2128–2173.

Baier, S. L., J. H. Bergstrand, and M. Feng. 2014. "Economic Integration Agreements and the Margins of International Trade." *Journal of International Economics* 93, no. 2: 339–350.

Bajgar, M., G. Berlingieri, S. Calligaris, C. Chriscuolo, and J. Timmis. 2020. *Coverage and Representativeness of Orbis Data. Technical Report*. OECD.

Benz, S., and A. Jaax. 2020. *The Costs of Regulatory Barriers to Trade in Services: New Estimates of Ad Valorem Tariff Equivalents. Technical Report*. OECD.

Bergstrand, J., and P. Egger. 2007. "A Knowledge-And-Physical-Capital Model of International Trade Flows, Foreign Direct Investment, and Multinational Enterprises." *Journal of International Economics* 73: 278–308.

Bergstrand, J., and J. Paniagua. 2024. *Do Deep Trade Agreements Provisions Actually Increase–or Decrease–Trade and/or FDI? CESifo Working Paper No. 11526*.

Beverelli, C., A. Keck, M. Larch, and Y. V. Yotov. 2024. "Institutions, Trade, and Development: Identifying the Impact of Country-Specific Characteristics on International Trade." *Oxford Economic Papers* 76, no. 2: 469–494.

Borchert, I., M. Larch, S. Shikher, and Y. V. Yotov. 2021. "The International Trade and Production Database for Estimation (Itpd-e)." *International Economics* 166: 140–166.

Borchert, I., M. Larch, S. Shikher, and Y. V. Yotov. 2022. "Disaggregated Gravity: Benchmark Estimates and Stylized Facts From a New Database." *Review of International Economics* 30, no. 1: 113–136.

Carril-Caccia, F., A. Garmendia-Lazcano, and A. Minondo. 2022. "The Border Effect on Mergers and Acquisitions." *Empirical Economics* 62, no. 3: 1267–1292.

Carril-Caccia, F., J. Milgram-Baleix, and J. Paniagua. 2023. "Does Terrorism Affect Foreign Greenfield Investments?" *Defence and Peace Economics* 34, no. 6: 827–844.

Casella, B., M. Borga, and M. K. Wacker. 2024. "Measuring Multinational Production With Foreign Direct Investment Statistics: A Survey of Challenges and Recent Developments." *Journal of Economic Surveys*: 1–26.

Coeurdacier, N., R. A. De Santis, and A. Aviat. 2009. "Cross-Border Mergers and Acquisitions and European Integration." *Economic Policy* 24, no. 57: 56–106.

Cravino, J., and A. A. Levchenko. 2017. "Multinational Firms and International Business Cycle Transmission." *Quarterly Journal of Economics* 132, no. 2: 921–962.

Damgaard, J., T. Elkjaer, and N. Johannesen. 2019. "Phantom Investments." *IMF Finance & Development* 56: 1–3.

Egger, P., and V. Merlo. 2007. "The Impact of Bilateral Investment Treaties on Fdi Dynamics." *World Economy* 30, no. 10: 1536–1549.

Egger, P., A. Pirotte, and C. Titi. 2023. "International Investment Agreements and Foreign Direct Investment: A Survey." *World Economy* 46, no. 6: 1524–1565.

Fonseca, L., K. Nikalexi, and E. Papaioannou. 2023. "The Globalization of Corporate Control." *Journal of International Economics* 146: 103754.

Francois, J., and B. Hoekman. 2010. "Services Trade and Policy." *Journal of Economic Literature* 48, no. 3: 642–692.

Fukui, T., and C. Lakatos. 2012. *A Global Database of Foreign Affiliate Sales. Technical Report*. U.S. International Trade Commission Working Paper.

Garcia- Bernardo, J., J. Fichtner, F. W. Takes, and E. M. Heemskerk. 2017. "Uncovering Offshore Financial Centers: Conduits and Sinks in the Global Corporate Ownership Network." *Scientific Reports* 7, no. 1: 1–10.

Gopinath, G., Ş. Kalemli-Özcan, L. Karabarbounis, and C. Villegas-Sanchez. 2017. "Capital Allocation and Productivity in South Europe." *Quarterly Journal of Economics* 132, no. 4: 1915–1967.

Gurevich, T., and P. Herman. 2018. *The Dynamic Gravity Dataset: 1948–2016. USITC Working Paper, 2018–02–A*.

Guvenen, F., R. J. Mataloni Jr., D. G. Rassier, and K. J. Ruhl. 2022. "Offshore Profit Shifting and Aggregate Measurement: Balance of Payments, Foreign Investment, Productivity, and the Labor Share." *American Economic Review* 112, no. 6: 1848–1884.

Head, K., and T. Mayer. 2021. "The United States of Europe: A Gravity Model Evaluation of the Four Freedoms." *Journal of Economic Perspectives* 35, no. 2: 23–48.

Heid, B., M. Larch, and Y. V. Yotov. 2021. "Estimating the Effects of Non-Discriminatory Trade Policies Within Structural Gravity Models." *Canadian Journal of Economics/Revue Canadienne D'économique* 54, no. 1: 376–409.

Jang, Y. J. 2011. "The Impact of Bilateral Free Trade Agreements on Bilateral Foreign Direct Investment Among Developed Countries." *World Economy* 34, no. 9: 1628–1651.

Jungmittag, A., and R. Marschinski. 2023. "Service Trade Restrictiveness and Foreign Direct Investment—Evidence From Greenfield Fdi in Business Services." *World Economy* 46, no. 6: 1711–1758.

Kalemli-Özcan, S., B. Sorensen, C. Villegas-Sanchez, V. Volosovych, and S. Yesiltas. 2015. *How to Construct Nationally Representative Firm Level Data From the Orbis Global Database: New Facts and Aggregate Implications. Technical Report*. National Bureau of Economic Research.

Kalemli-Özcan, S., B. Sorensen, C. Villegas-Sanchez, V. Volosovych, and S. Yesiltas. 2022. *How to Construct Nationally Representative Firm-Level Data From the Orbis Global Database: New Facts and Aggregate Implications. Technical Report*. National Bureau of Economic Research.

Kalemli-Özcan, S., B. E. Sørensen, C. Villegas-Sanchez, V. Volosovych, and S. Yesiltas. 2023. "How to Construct Nationally Representative Firm Level Data From the Orbis Global Database: New Facts on Smes and Aggregate Implications for Industry Concentration." *American Economic Journal: Macroeconomics* 16, no. 2: 353–374.

Kox, H. L., and H. Rojas-Romagosa. 2020. "How Trade and Investment Agreements Affect Bilateral Foreign Direct Investment: Results From a Structural Gravity Model." *World Economy* 43, no. 12: 3203–3242.

Linask, M., and A. Waddle. 2023. *Trends in Foreign Direct Investment*. University of Richmond.

Myburgh, A., and J. Paniagua. 2016. "Does International Commercial Arbitration Promote Foreign Direct Investment?" *Journal of Law and Economics* 59, no. 3: 597–627.

Neumayer, E., and L. Spess. 2005. "Do Bilateral Investment Treaties Increase Foreign Direct Investment to Developing Countries?" *World Development* 33, no. 10: 1567–1585.

Osnago, A., N. Rocha, and M. Ruta. 2019. "Deep Trade Agreements and Vertical Fdi: The Devil Is in the Details." *Canadian Journal of Economics/Revue Canadienne D'économique* 52, no. 4: 1558–1599.

Paniagua, J., E. Figueiredo, and J. Sapena. 2015. "Quantile Regression for the Fdi Gravity Equation." *Journal of Business Research* 68, no. 7: 1512–1518.

Ramondo, N., and A. Rodriguez-Clare. 2013. "Trade, Multinational Production, and the Gains From Openness." *Journal of Political Economy* 121, no. 2: 273–322.

Ramondo, N., A. Rodriguez-Clare, and F. Tintelnot. 2015. "Multinational Production: Data and Stylized Facts." *American Economic Review* 105, no. 5: 530–536.

Rose-Ackerman, S., and J. Tobin. 2005. "Foreign Direct Investment and the Business Environment in Developing Countries: The Impact of Bilateral Investment Treaties." *Yale Law & Economics Research Paper*: 293.

Rungi, A., G. Morrison, and F. Pammolli. 2017. "Global Ownership and Corporate Control Networks." *IMT Lucca EIC Working Paper Series* 7.

Silva, J. S., and S. Tenreyro. 2006. "The Log of Gravity." *Review of Economics and Statistics* 88, no. 4: 641–658.

Sleuwaegen, L., and P. M. Smith. 2021. "Service Characteristics and the Choice Between Exports and Fdi: Evidence From Belgian Firms." *International Economics* 168: 115–131.

U.S. International Trade Commission. 2021. *Economic Impact of Trade Agreements Implemented Under Trade Authorities Procedures, 2021 Report*.

Wildmer, G., N. Michela, N. Nathalie, and R. Michela. 2019. *Foreign Investment in the EU the Fown Dataset. Technical Report*. Publications Office of the European Union.

Yotov, Y. V. 2022. "On the Role of Domestic Trade Flows for Estimating the Gravity Model of Trade." *Contemporary Economic Policy* 40, no. 3: 526–540.

Supporting Information

Additional supporting information can be found online in the Supporting Information section. **Data S1.** Supporting Information.