PHANTOM FDI: A STRUCTURAL GRAVITY ANALYSIS USING MREID

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Abstract

Foreign direct investment (FDI) measured by public sources includes investments made by firms for financial and accounting related (or nonproduction-based) reasons, typically concentrated in offshore financial centers (OFCs). Recent studies suggest that profit-shifting may also occur in non-OFC regions. Consequently, many datasets used to understand the economic factors behind a firm's decision to shift production activities across countries may still contain such "phantom FDI." As a result, researchers have developed analytical methods to remove phantom FDI flows and improve the accuracy of FDI measures. In this paper, we propose a structural gravity approach to identify and measure phantom FDI using the new Multinational Revenue, Employment, and Investment Database (MREID). We use this approach to provide estimates of phantom FDI for a number of developed countries in our sample. Our baseline results are then validated using an alternative production-function approach.

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1 Introduction

In an effort to capture production-based foreign direct investment (FDI) of multinationals, many FDI datasets allow researchers to isolate FDI flows related to special purpose entities (SPEs). These SPEs are often set up in offshore financial centers (OFCs), but have little impact on "real" economic activity. As a result, researchers often exclude these financial or profit-shifting flows from their analyses, allowing for a more explicit analysis to be conducted on the "real" elements behind FDI flows.

Data sources that provide this level of granularity include the OECD, Eurostat, and the International Monetary Fund's Balance of Payments/International Investment Position (BOP/IIP) data. The United Nations Conference on Trade and Development (UNCTAD) also directly excludes SPEs from their reported FDI data whenever feasible. In theory, FDI data without SPEs should do a better job in matching "real" indicators of multinational activity (sales, assets). [1]

While identifying and excluding OFCs is a necessary step in capturing production-based FDI, it is not sufficient on its own. Recent research shows that profit-shifting activities might occur from Multinational Enterprises (MNEs) transferring their intangible assets to subsidiaries in low-tax jurisdictions (Santacreu and Stewart, 2024). So, even after the exclusion of OFCs, the FDI datasets used in the literature can still contain phantom (or conduit) FDI (Casella et al., 2024). Given these circumstances, analytical methods continue to be developed to remove conduit FDI flows from bilateral data so that FDI flows can be measured more precisely in economic studies. These methods, as noted in Casella et al. (2024) and Brandt (2023), involve the use of estimation techniques and alternative data to detect and exclude phantom FDI.

This paper contributes to this literature by introducing a well-established theoretical

[1] The IMF's Coordinated Direct Investment Survey (CDIS) does not offer this distinction.

approach (structural gravity) to identify and measure "Phantom FDI."[2]. Expanding on Damgaard et al. (2024), we define phantom FDI as investment in empty corporate shells or subsidiaries where the investment is not motivated by considerations related to local production and is thus not explicitly tied to local economic activities. Our first contribution is on identifying phantom FDI in the outward investment activities of U.S. MNEs in various destination countries. To validate our results, we also use a production-function approach that delivers estimates similar to those using the gravity-equation approach for the U.S. MNEs. A second contribution is an application of our methods to identify inward phantom FDI of a very large set of advanced countries. The third contribution, and one of the advantages of combining our methods with the exhaustive Multinational Revenue, Employment, and Investment Database (MREID) described in Ahmad et al. (2023), is evaluating phantom FDI for multiple measures of FDI: numbers of affiliates, revenues, and investments in total assets, fixed assets, tangible fixed assets, and intangible fixed assets.

The paper is organized as follows. Section 2 reviews the literature on phantom FDI. Section 3 describes our methods to estimate phantom FDI. Section 4 describes the various measures of MNEs' activities provided by MREID. Section 5 reports the main results using outward U.S. FDI while section 6 explores this approach for non-U.S. countries. Section 7 concludes.

2 Literature Background

The identification of phantom foreign direct investment (FDI) can be approached using several methods, each with a distinctive statistical foundation. The most common methods are those proposed by the International Monetary Fund (IMF) and the United Nations

[2]The gravity equation is a widely used model in the international trade literature that predicts trade and investment flows between two countries is related to their economic sizes and the bilateral frictions between them

Conference on Trade and Development (UNCTAD).

The IMF method, proposed by Damgaard et al. (2024), estimates both real and phantom FDI by utilizing reported data on SPEs. This method incorporates known information to isolate phantom investments. The IMF method uses Orbis data from 2016 to match "real" FDI, interpreted as Multinational Production (MNP), with OECD statistics. This approach assumes that Orbis data reflects the structure and changes in FDI accurately, even if it may not be precise in terms of absolute levels. By relying on these datasets, the method seeks to identify the genuine economic activity underlying FDI flows, distinguishing it from phantom FDI, which is typically designed for tax optimization rather than actual production. They find that phantom FDI has grown at a faster pace than real FDI over the last decade and accounts for around $15 trillion, almost 40 percent of total global FDI.

In contrast, UNCTAD offers the "implied investment method," as discussed by Bolwijn et al. (2018) and Casella (2019). This approach establishes a direct linear relationship between the logarithm of FDI stock (either inward or outward) and the logarithm of gross domestic product (GDP). The UNCTAD method introduces a distinct analytical approach to derive bilateral FDI stocks by ultimate investors. This method is grounded in Markov chain results, which provide a probabilistic model for tracing FDI flows back to their ultimate sources. Unlike traditional methods, which may rely on reported data or correlations with economic variables like GDP, Casella's approach offers a novel way to map FDI more accurately by capturing the flow of investments across borders through a sequence of intermediate steps. Looking at a dozen recipient countries, the estimated distribution used in Casella (2019) more clearly reflects the reported distribution of ultimate investors than it does for bilateral FDI accounting for direct investors. This indicates that their methodology accounts for the substantial conduit FDI normally reflected in bilateral statistics.

Both methodologies, however, are inherently "a-theoretical," as they are based on statistical correlations rather than an underlying economic theory. They integrate empirical data with estimation techniques to differentiate between real economic activity and phantom investments designed for tax optimization or regulatory arbitrage.

Other methods for identifying and analyzing phantom FDI expand upon different analytical frameworks and datasets. The OECD Economic Impact Assessment, as developed by Turban et al. (2020), uses a fully estimated method that diverges from the implied investment approach. Instead, conduit FDI is estimated by extrapolating data from economies that report on ultimate investors. This method employs a set of matrices that map the locations of profit and economic activities of multinational enterprises (MNEs), offering a comprehensive view of global FDI patterns.

Haberly and Wójcik (2015) apply principal component analysis (PCA) to decompose the global bilateral FDI anomaly matrix into its primary constituent sub-networks. This approach allows for the identification of regional blocks and imperial legacies, helping to map the global offshore FDI network and reveal the structural patterns that contribute to the concentration of FDI in specific regions or countries.

Furthermore, UNCTAD's 2015 World Investment Report introduces an FDI-driven approach through the Offshore Investment Matrix. This method categorizes self-declared SPE countries and tax havens, focusing on identifying the role of these jurisdictions in facilitating offshore investment, thereby offering another perspective on the relationship between FDI and phantom investment. Each of these methodologies provides unique insights into the complexities of global FDI flows and their implications for economic governance.

Related to the identification of phantom FDI, Guvenen et al. (2022) employ a profit-shifting method using firm-level data to reattribute earnings between U.S. Direct Investment Abroad (USDIA) and the respective foreign affiliates of U.S. multinational enterprises (MNEs). This reattribution method is based on a theoretical model of profit-maximizing firms, wherein the total worldwide earnings of an MNE are distributed among its parent company and affiliates according to their shares of the MNE's global wage bill, physical capital stock, or intangible capital stock. The key innovation in this approach lies in its foundation on economic theory, unlike the other methods that rely more heavily on empirical data correlations. By attributing profits according to these measurable factors, the model allows for a more realistic estimate of where profits are actually generated, as opposed to where they are reported for tax purposes. This method helps uncover the extent of profit shifting within MNEs, providing a clearer picture of the actual economic contributions of both the parent companies and their foreign affiliates.

Their results show that the largest sectors involved in profit shifting are computers, petroleum and chemicals, pharmaceuticals, and R&D, largely due to the shifting of intellectual property. They find that R&D-intensive industries have experienced faster productivity growth compared to non-R&D-intensive industries, suggesting that the decline in productivity is primarily driven by non-R&D-intensive industries. Further, they estimate that 38 percent of the profits reported by US MNEs as being earned abroad can be considered as generated in the US; accordingly, accounting for profit shifting reduces the return on US direct investment abroad.

The impact of this profit shifting in the United States has been significant. Clausing (2020) estimates that one-third of U.S. corporate income taxes, equivalent to \$100 billion in revenue, are lost annually due to this practice. Tørsløv et al. (2023b) estimate that the amount of globally shifted profit is 36% of multinational profit and calculate that the U.S. loses around 15% of its corporate tax revenues due to the relocation of profits to low-tax jurisdictions. Further, fiscal authorities of high-tax countries may lack the incentives to combat profit shifting to tax havens (Tørsløv et al., 2023a).

3 Methodology

3.1 The Gravity Equation for Trade and FDI

In this paper, we employ well-established theoretical foundations for "structural gravity" (cf., Anderson and Van Wincoop (2003), Baier et al. (2017) and Anderson et al. (2019)) to address the phantom FDI issue. The gravity equation is a widely used model in the international trade literature that (initially) predicted bilateral trade flows between two countries based on their economic sizes and the distance between them. Similar to Newton's Law of Gravitation, the (naive) trade gravity model suggests that trade between two countries is proportional to their economic masses — typically represented by exporter and importer GDPs — and inversely related to the trade costs, which often were captured by geographic distance, tariffs, and other trade barriers. Tinbergen (1962) was the first to use the gravity equation applied to bilateral aggregate trade flows, estimating for a single year using Ordinary Least Squares (OLS) and positive trade flows:

$$\ln TRADE_{ij} = \beta_0 + \beta_1 \ln Y_i + \beta \ln Y_j + \beta_3 \ln Dist_{ij} + \beta_4 EIA_{ij} + \ln \epsilon_{ij} \tag{1}$$

where $\ln TRADE_{ij}$ was the natural logarithm of the (nominal) bilateral trade flow (in U.S. dollars) from country i to country j, Y_i (Y_j) was nominal GDP in U.S. dollars in country i (j), $Dist_{ij}$ was the bilateral distance in nautical miles between the two countries' economic centers, EIA_{ij} was a dummy variable taking the value 1 if the two countries had an economic integration agreement, or EIA (such as a free trade agreement) and 0 otherwise, and ϵ_{ij} was an error term.

A multitude of studies over subsequent years estimated gravity equations similar to equation (1), especially to find estimates of β_4, the coefficient on the presence or absence of an EIA. Along the way, researchers introduced additional control variables, such as dummies for having a common land border, common official language, and/or common legal origins, or being an island or landlocked.

However, formal theoretical *microeconomic* foundations for the gravity equation did not surface until 1979 with the models in Anderson (1979) and Bergstrand (1985). While focusing on different dimensions of the theoretical foundation for equation (1), both papers provided complementary elements that – once properly synthesized in Anderson and Van Wincoop (2003) – led to what is now referred to as "structural gravity," cf., the Introduction in Bergstrand (2019) or Online Supplement Appendix B in Bergstrand et al. (2023). A standard structural gravity equation for a given year can be represented as:

$$TRADE_{ij} = \frac{Y_i E_j}{Y^W} \left(\frac{t_{ij}}{\Pi_i P_j} \right)^{1-\sigma} \epsilon_{ij}^{T}, \tag{2}$$

where Y_i (E_j) is nominal GDP (aggregate expenditures) in i (j), Y^W is world GDP (captured by a constant), t_{ij} is an *ad valorem* measure of bilateral trade costs (which can be replaced by an EIA dummy), and Π_i (P_j) is the outward (inward) multilateral price index of producers (consumers) in country i (j), cf., Baier et al. (2017). This trade gravity equation has become a workhorse for understanding determinants of bilateral trade flows. In the presence of zeros and potential heteroskedasticity, researchers in this area now commonly estimate equation (2) by Poisson pseudo maximum likelihood (PPML), cf., Baier et al. (2017).

A key strength of the structural gravity model is that it is rooted in economic theory and accommodates frictions and policy variables empirically while maintaining a microeconomic foundation. This allows researchers to evaluate the effects of trade agreements, tariffs, or non-tariff barriers on bilateral trade flows by explicitly modeling the costs associated with moving goods between countries. The model's consistent structural form facilitates the estimation of elasticities of bilateral trade with respect to bilateral trade costs, and it is robust to various extensions, such as incorporating multiple sectors, heterogeneous firms, or additional dimensions of trade costs like cultural and institutional differences.

Another key advantage of the gravity equation is its flexibility in accommodating non-trade bilateral flows, such as foreign direct investment (FDI) and migration, making it a versatile tool for analyzing various forms of bilateral economic interactions between countries. When applied to FDI, the gravity model effectively captures the determinants of cross-border investment flows by accounting for both the size of a pair of economies and the costs associated with one country investing abroad in another country. The first formal theoretical economic foundation for the gravity equation applied to bilateral FDI was Bergstrand and Egger (2007), which solved for a gravity equation using a Knowledge-and-Physical-Capital extension of the Knowledge Capital model of Markusen (2002). Similar to trade flows, larger economies are expected to engage in higher volumes of FDI, while geographic distance, institutional barriers, and other frictions can impede investment. The model can be extended to include additional factors that affect FDI, such as bilateral investment treaties, regulatory environments, or political risk, allowing researchers to assess how these variables influence capital allocation across borders. This adaptability makes the gravity equation a powerful framework for studying FDI in addition to its traditional application to trade. Anderson et al. (2019) solved for a structural gravity equation for FDI akin to equation (2). Ignoring the transition dynamics in Anderson et al. (2019), the determinants of the (steady state) bilateral FDI from origin country i to affiliates in destination country j in some year (FDI_{ij}) is the gravity equation:

$$FDI_{ij} = \frac{\beta\phi^2\eta_i^2}{1-\beta+\beta\delta_{j,M}}\omega_{ijt}\frac{E_i}{P_i}\frac{Y_j}{M_i}\epsilon_{ij}^F, \tag{3}$$

if $FDI_{ij} = \omega_{ij}M_i > 1$ (and 0 otherwise), where E_i is total expenditures in origin country i (on consumption goods, physical capital investments, and technology capital investments), P_i is a multilateral index of prices in country i on all types of goods, Y_j is a measure of national output in destination country j, M_i is the technology capital stock in i, ω_{ij} is a measure of (policy and non-policy) openness of country j to country i's technology capital, β is the standard time-discount factor, ϕ is the (Cobb-Douglas) share of the global technology capital stock used in production of output, η_i is the share of country i's technology capital as a share of country j's global technology capital stock, and $\delta_{j,M}$ is the technology capital "adjustment cost," analogous to the standard physical capital adjustment costs (in the physical capital accumulation literature).

In empirical analysis, the structural gravity equation is often estimated using data on bilateral trade, FDI, GDP, distance measures between countries, and other bilateral costs discussed above. Recently, Bergstrand and Paniagua (2024) have investigated the partial and general equilibrium effects of various provisions in "deep" trade agreements on bilateral trade, bilateral FDI stocks, and various measures of MNEs' "activities" (i.e., affiliates costs, revenues, employment, and assets) using the structural gravity-equation approach. Overall, the structural gravity equation is a powerful tool for understanding the determinants of FDI patterns and the effects of international policies in a globalized economy. We will use equation (3) as the theoretical gravity equation undergirding the empirical specifications that follow.

3.2 Measuring Phantom FDI with Structural Gravity

We next explain how "phantom FDI" can be identified using the structural gravity approach discussed in the previous section. Based on the theoretical model given in (3), we specify our baseline gravity equation as:

$$FDI_{ij} = \exp\left(\alpha + \lambda_i + \lambda_j + \beta\omega_{ij}\right) \times \epsilon_j, \tag{4}$$

where FDI_{ij} represents a measure of MNE activity taking place between the Global Ultimate Owner (GUO) in source country i and its affiliate in country j. Consistent with equation (3), the RHS includes ω_{ij} where openness is captured by standard gravity-equation variables (log of distance and dummies for common language, common legal origin, island, and landlocked). We also include the following policy-related dummies in ω_{ij} : if i and j are members of the World Trade Organization, if they are members of the European Union; if they have a free trade agreement between them; and if they have a bilateral investment treaty between them. λ_i (λ_j) represent the fixed effects for the source (host) country with λ_i capturing total expenditures and prices in source i and λ_j accounting for the GDP of host j along with the influence of $\delta_{j,M}$ on bilateral FDI. Following best practices, the above specification is estimated using Poisson pseudo maximum likelihood (PPML).

The predicted values of FDI_{ij} from the estimation of (4) gives us a measure of potential FDI—the level of FDI that should be taking place between source i and host j if there were no other factors determining bilateral FDI beyond those listed in (3). In reality, unobservable factors can cause observed FDI to differ from predicted FDI. So in cases where observed FDI is higher than predicted FDI, we compute Phantom FDI as:

$$FDI_{ij}^{Phantom} = FDI_{ij} - \widehat{FDI_{ij}}. \tag{5}$$

It is worthwhile here to take stock of the underlying assumptions behind our Phantom FDI measure. First, we consider any FDI_{ij} that exceeds the Potential FDI predicted from (4) as lacking microeconomic foundations and so is classified as non-productive or phantom FDI.[3] Secondly, our strategy to identify phantom FDI rests on the explanatory variables being uncorrelated with the error term in 4. If that is the case, then the standard gravity variables predict the real FDI that should be taking place between two countries, while the

[3] Since the focus of the paper is on identifying phantom FDI, we do not analyze the cases where FDI_{ij} is less than Potential FDI, so that non-economic factors are suppressing FDI.

residual is capturing non-economic considerations. Thirdly, our measure of Phantom FDI is bilateral in nature and so should not be affected by the inclusion of country-specific fixed effects, such as their tax treatment of MNEs, as that should attract inward FDI to the host country from all source countries.[4]

Lastly, our method focuses positive Phantom FDI, that is, when the residual is positive or $FDI_{ij} > \widehat{FDI_{ij}}$. By construction, there is an equal amount of negative Phantom FDI because the mean of the error term is zero. However, one of the advantages of the structural gravity equation is that the PPML estimator is robust to heteroskedasticity (Santos Silva and Tenreyro, 2006). Therefore, positive and negative Phantom FDI may have different variances. We can exploit this feature of the PPML estimator to identify Phantom FDI with the positive error terms by assuming that the negative error term has a lower variance (i.e., it is normally distributed) in the vein of Rigobon (2003).

Along with levels, we also calculate "FDI ratio" for each destination with:

$$FDI_{ij}^{Ratio} \equiv \frac{FDI_{ij}}{\widehat{FDI}_{ij}}. \tag{6}$$

The FDI ratio in equation (6) gives us a ranking of countries with actual FDI higher or lower than the theoretically predicted FDI from the gravity equation. The FDI ratio can be informative; if the predicted value of FDI is very low, the FDI ratio will be very high. Moreover, FDI_{ij}^{Ratio} "normalizes" the relative importance of phantom FDI across countries so that the economic sizes of countries do not distort the importance of phantom FDI.

[4] A future extension would be to explore the effect tax rates and other country-specific policies may have on λ_j in a second stage regression.

4 Data description

4.1 MREID

The Multinational Revenue, Employment, and Investment Database (MREID), constructed by Ahmad et al. (2023), provides comprehensive and consistent information on both international *and domestic* revenues, employment, and investment of affiliates operated by MNEs of a source country in a host destination. This information is provided at the bilateral level for the pairings of 185 countries across 25 industries, and (initially) 12 years (2010-2021). Covering a wide range of agriculture, mining, energy, manufacturing and services industries, MREID provides a novel and comprehensive panel of sectoral-level bilateral foreign direct investment (and domestic investment) and foreign affiliate sales activities; we use the term "foreign direct investment" (FDI) broadly for now, but also narrow the definition later. Furthermore, MREID can distinguish greenfield investment from merger and acquisition (M&A) investment. Since MREID is based on firm-level data, it allows us to bypass some of the issues present in official FDI statistics related to offshore activities.[5]

MREID has data on FDI for 185 countries; hence, there are potentially 34,410 (=184x185) bilateral FDI "measures" of activity. However, FDI data are characterized by many zeros; hence, the raw MREID database is unbalanced. For the estimates of U.S. phantom FDI, we restrict the analysis to 111 destinations with non-zero FDI in the year 2019.

4.2 U.S. Outward FDI Trends

Since our primary focus is on identifying phantom FDI in the investment activities of U.S. MNEs, we next describe the outward FDI measures found in MREID for U.S. firms. In

[5]The underlying firm-level data used in MREID comes from Orbis. Orbis is Moody's flagship-company database with data from more than 425 million companies worldwide. It focuses on private company information and presents companies' variables in a comparable formats; information is sourced from over 170 different providers but is standardized into comparable cross-country information.

Table 1, "affiliates" refers to the number of affiliates. This forms the basis for our benchmark results later. We note that from 2010 to 2019 there has been nearly a doubling of U.S. affiliates as well as a sharp jump in revenues, assets and employment of U.S. multinationals. The global pandemic that began in 2020 saw a decline in the overseas economic activity of U.S. firms as countries imposed stringent measures to stop the spread of the COVID-19 virus.

Table 1: Annual Outward FDI of U.S. MNEs in MREID

Year	Affiliates	Revenue	Employees	Total Assets	Fixed Assets
2010	50,689	515	682,641	4,069	728
2011	54,127	1,945	3,248,606	7,854	2,614
2012	57,667	3,151	4,572,539	10,313	3,996
2013	61,485	3,408	4,991,396	13,103	4,689
2014	65,787	3,569	5,343,777	13,695	4,881
2015	70,308	3,450	5,998,080	14,143	6,371
2016	74,924	3,624	6,339,269	16,326	7,905
2017	79,878	4,467	6,785,568	19,900	9,415
2018	85,075	5,016	7,192,457	27,228	15,591
2019	90,033	4,965	7,190,422	21,810	10,497
2020	93,377	4,768	7,139,845	23,636	11,390
2021	94,421	2,022	2,966,898	13,041	4,290

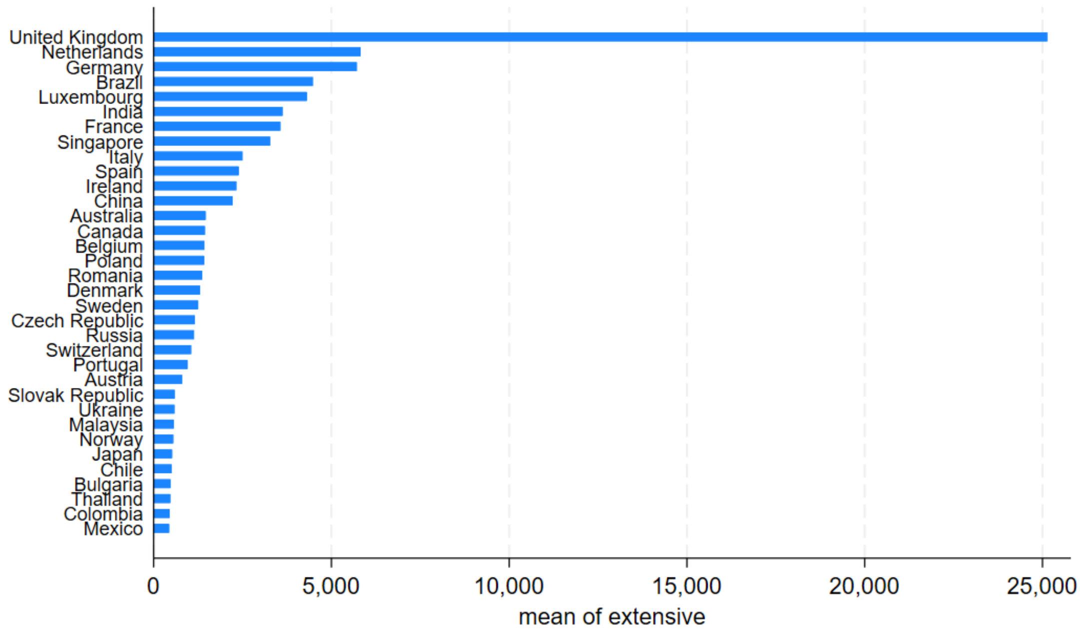
Note: Revenues, Total Assets and Fixed Assets in Billions of dollars.

Figure 1 shows the top destination countries of American outward investment for several variables of the MREID dataset.[6] Most of the American affiliates concentrate in Western Europe. As shown in Figure 1a, the following are the rankings of the top destinations for American affiliates abroad: United Kingdom (1st), Netherlands (2nd), Germany (3rd), and France (7th). Emerging economies like Brazil (4th) and India (6th) also occupy the top list. Even in Orbis data, which mostly captures "real" FDI, tax havens appear to be a significant investment hub for American foreign affiliates. Luxembourg (5th) and Singapore (8th), usually classified as tax havens, appear as top destinations for U.S. MNEs.

[6] The public MREID dataset does not distinguish between tangible and intangible fixed assets.

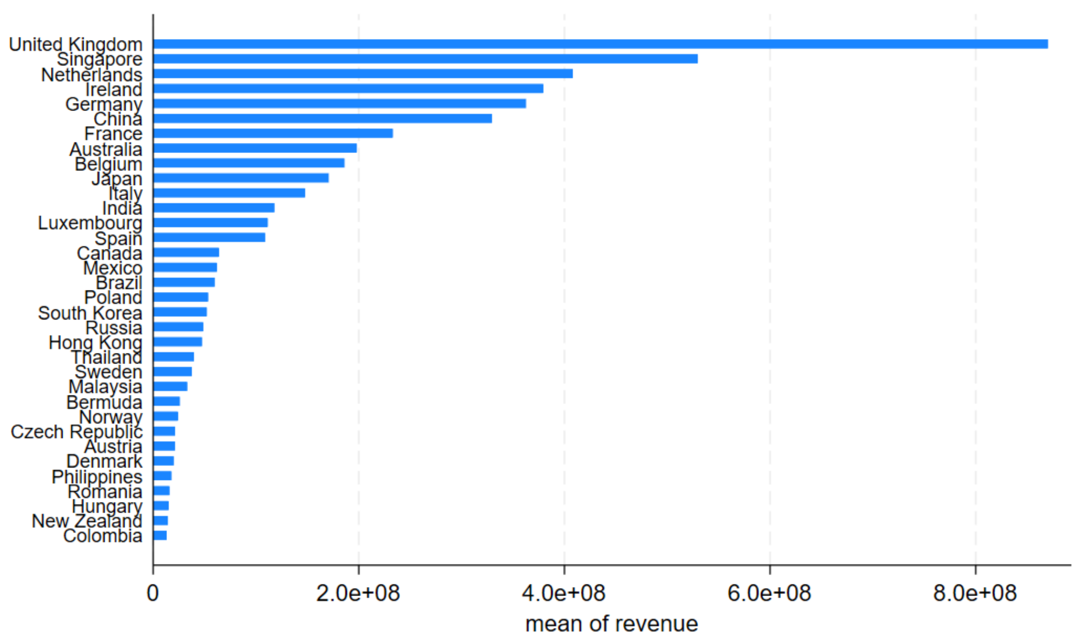
Figure 1: USA's Outward FDI (MREID dataset)

(a) Number of Affiliates



a

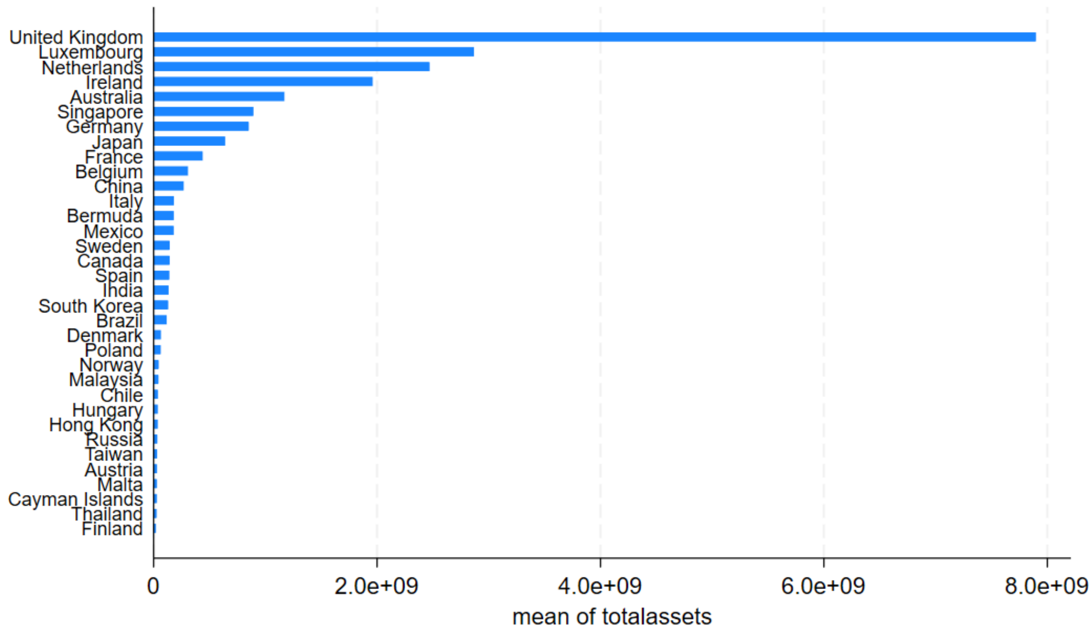
(b) Revenues from Affiliates



b

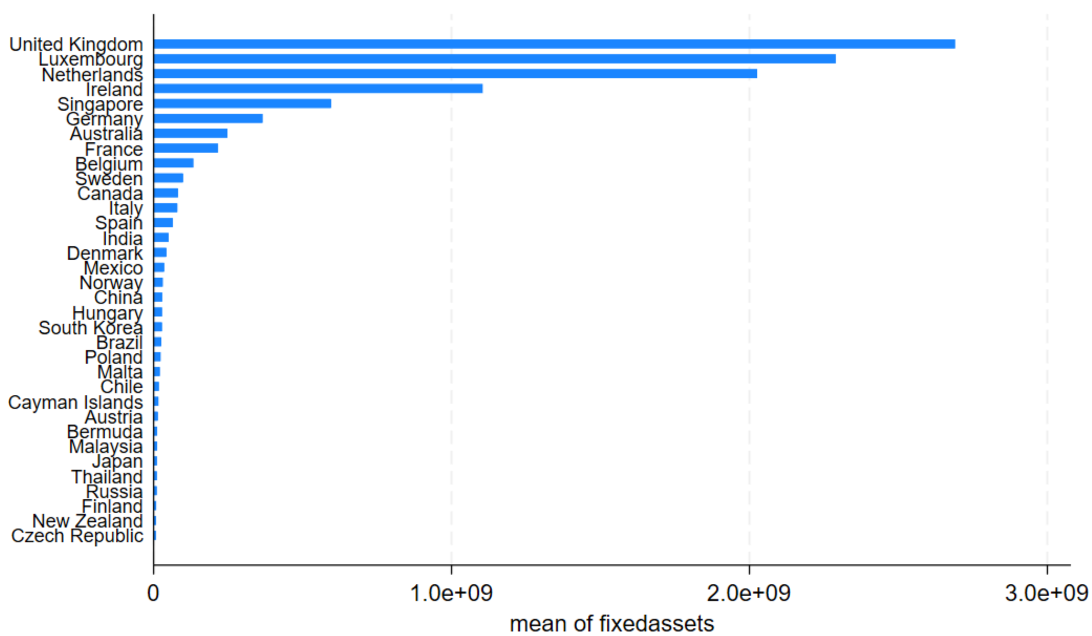
Figure 1: USA's Outward FDI (MREID dataset) (cont.)

(c) Total Assets in Foreign Countries



c

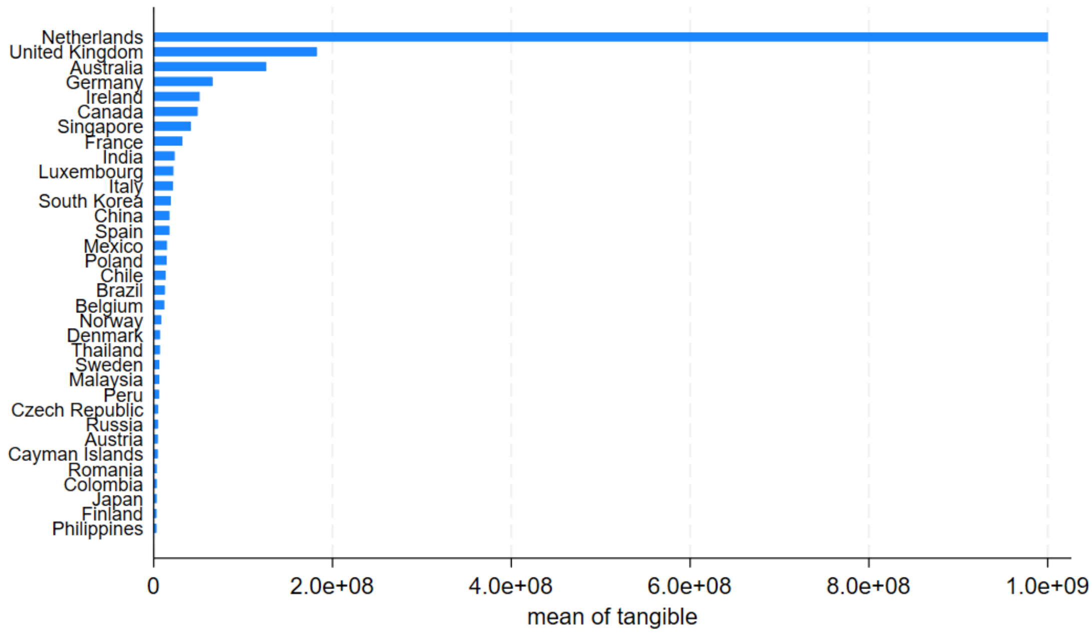
(d) Fixed Assets in Foreign Countries



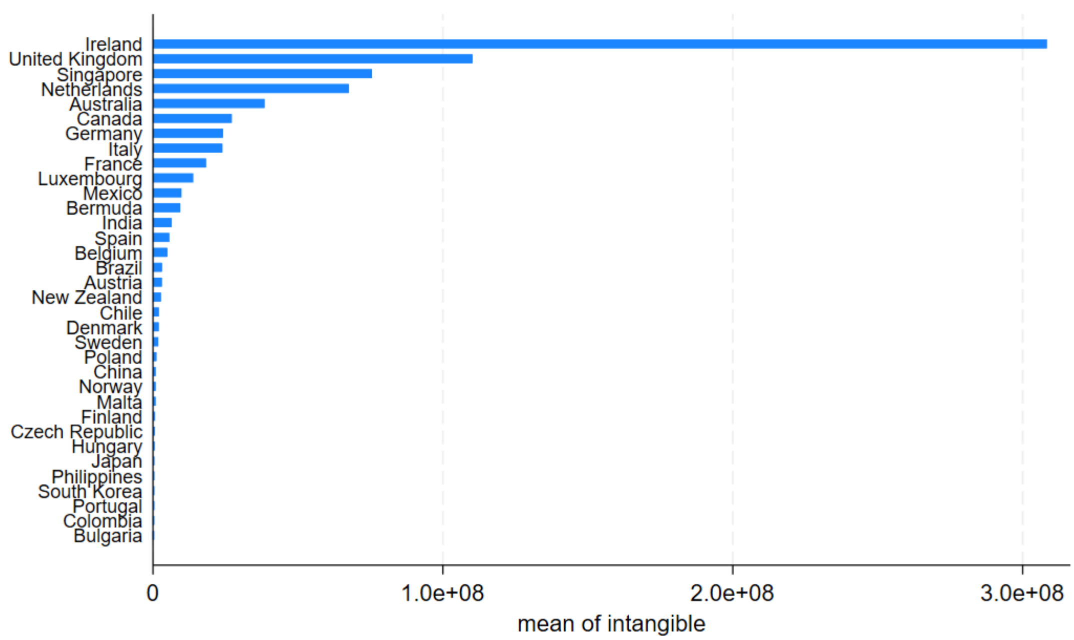
d

Figure 1: USA's Outward FDI (MREID dataset) (cont.)

(e) Tangible Fixed Assets in Foreign Countries



(f) Inangible Fixed Assets in Foreign Countries



Focusing on revenues in Figure 1b, we observe several interesting traits. Singapore has the second highest concentration of U.S. MNEs' foreign revenues, only after the United Kingdom (1st). Netherlands (3rd), known for favorable holdings regulations, and Ireland (4th), with one of the lowest corporate tax rates in the EU, follow.

The picture of American assets abroad (total assets in Figure 1c and fixed assets in 1d) depicts a similar pattern, with Luxembourg, the Netherlands, Ireland, and Singapore occupying the top ranks. When we distinguish between tangible (Figure 1e) and intangible fixed assets (Figure 1f), we observe similar distributions. The Netherlands is the absolute champion in tangible fixed assets, followed by the United Kingdom. Ireland and Singapore (with the United Kingdom between them) lead the country ranking with most of the U.S. foreign intangible fixed assets.

MREID allows us to examine the sectors that are the targets of U.S. MNE activity. Table 2 lists the top 10 country-sectors receiving U.S. investment based on total assets. Finance and Insurance (NAICS 52) and Management of Companies and Enterprises (NAICS 55) are the two main sectors. Given that NAICS 55 mainly comprises activities related to holding companies, Table 2 suggests that tax avoidance may be a significant motivation for outward U.S. investment in known tax havens such Luxembourg, Netherlands, and Ireland.

4.3 Other Data Sources for Regressions

The gravity regressions use covariates to control for country-pair heterogeneity, specifically for factors that influence ω_{ij}. For our benchmark regressions that estimates U.S. bilateral outward FDI, we include the following variables: the log of (nominal) gross domestic product (GDP) at the destination (ln GDP), the log of the physical distance (weighted by population) between the home and host countries (ln Distance), a dummy variable that takes the value of 1 if the host is an island and zero otherwise (Island), a dummy variable that takes the value of 1 if the host is a landlocked country and zero otherwise (Landlocked),

Table 2: Outward FDI of U.S. MNEs by Top Destinations and Sectors

Country	NAICS	Affiliates	Revenue	Employees	Total Assets	Fixed Assets
UK	52	1,497	85	78,209	3,363	174
UK	55	2,239	78	105,788	1,913	854
Luxembourg	55	2,576	36	4,647	1,591	1,334
Netherlands	55	2,029	89	71,602	1,262	1,117
China	52	78	14	29,330	536	494
Japan	52	50	54	13,382	458	2
Ireland	52	385	14	14,962	326	64
UK	56	2,384	67	712,368	302	178
Ireland	55	243	19	14,044	266	206
Germany	55	621	32	92,393	214	128

Notes: Revenues, Total Assets and Fixed Assets in Billions of dollars. All variables averaged over time.
NAICS sectors 55: Management of Companies and Enterprises.
NAICS sectors 52: Finance and Insurance.

a binary indicator that takes a value of 1 if the home and host countries share a common legal system and zero otherwise (Common Legal Origin), a dummy variable that takes the value of 1 if the home and host countries share a common language and zero otherwise (Common Language), a binary indicator that takes a value of 1 if the host country is a member of the World Trade Organization and zero otherwise (WTO Member), a binary variable with the value of 1 if the host country is a member of the European Union and zero otherwise (EU Member), a dummy variable that takes the value of 1 if the home and host countries have a free trade agreement in force and zero otherwise (FTA), and a binary indicator with the value of 1 if the home and host countries have a bilateral investment treaty in force and zero otherwise (BIT).

The source for all variables (except BIT) is the Dynamic Gravity Dataset (DGD) at the USITC's Gravity Portal (Gurevich and Herman, 2018). BIT came from UNCTAD.

5 Phantom FDI in outward U.S. investment activities

5.1 Benchmark Estimates with Structural Gravity

Table 3 presents the gravity-equation coefficient estimates of (4) for various measures of U.S. outward FDI activity. Each column in table 3 represents a different FDI measure in MREID: number of affiliates, revenues, total assets, fixed assets, tangible fixed assets, and intangible fixed assets. The right-hand-side (RHS) variables of interest include traditional gravity model components like geographic distance, common legal origin, contiguity, colonial history, free trade agreements, and bilateral investment treaties. Recall that these regressions also include home and host country fixed effects, λ_i and λ_j, respectively.

We find that the coefficient estimates for distance are negative and statistically significant across all specifications, indicating that greater geographic distance reduces FDI—consistent with the predictions of the gravity model. Contiguity, colonial history, and shared legal origin display various relationships across the dependent variables. However, the only statistically significant coefficients for these variables are positive (as expected). Notably, the variable capturing colonial history has a strong positive impact on tangible fixed assets, suggesting that historical ties may influence specific types of capital allocation. In these results, only fixed asset investments have a statistically significant relationship with the FTA variable, and it is negative.[7]

Since the results reported in Table 3 use both origin and destination country fixed effects, they can account for any unobserved heterogeneity at the country-level. This is reflected in the relatively high R^2 values seen across specifications and indicates that the gravity model explains a substantial portion of the observed variance in the activities of MNEs across destination countries. The good fit of the gravity model suggests that we should obtain

[7]For more evidence of FTAs having negative effects on FDI, see Bergstrand and Egger (2007) and Bergstrand and Paniagua (2024).

accurate estimates of phantom FDI.

We now turn to our estimates of phantom FDI for U.S. MNEs using the gravity estimates in table 3. Table 4 provides values of the total FDI and the phantom FDI linked to U.S. foreign affiliates. The table showcases different FDI components, including numbers of affiliates,revenues, total assets, fixed assets, tangible fixed assets, and intangible fixed assets. The first row reports the actual values in MREID across these FDI measures. For instance, foreign affiliates of U.S. MNES collectively represent 89,901 units, with total revenues of $4,964,481 million and total assets of $21,801,645 million. Among these assets, $10,493,457 million are fixed assets, while tangible and intangible fixed assets account for $1,837,439 million and $769,051 million, respectively. The second row highlights the level of FDI that can be classified as phantom FDI based on calculations from equation (5). The bottom row provides the shares of total U.S. FDI that we estimate to be as phantom FDI. We find that Phantom FDI constitutes a significant share of total FDI across various categories, notably making up 23.3% of total revenues, 25.4% of total assets, 18.4% of fixed assets, and an even higher proportion of intangible assets (32.0%). We note here that the share of phantom FDI in total revenues of U.S. affiliates is close to what was found by Guvenen et al. (2022). Overall, Table 4 underscores the pervasive influence of phantom FDI within U.S. outward FDI, reflecting both tax-motivated structures and strategic financial positioning of U.S. MNEs.

While Table 4 provides the aggregate value of phantom FDI undertaken by U.S. MNEs, we can also explore the level of outward U.S. phantom FDI by host countires. Figure 2 shows the details of phantom FDI for the first 35 country destinations of American FDI using all countries in the sample. The figure reports the level of phantom FDI being generated by foreign affiliates of U.S. GUOs across these FDI categories: numbers of affiliates, revenues, total assets, fixed assets, tangible fixed assets, and intangible fixed assets.

Figure 2a shows that the United Kingdom, Luxembourg, and Netherlands are the top three destinations of U.S. outward phantom FDI, based on their number of U.S. affiliates.

Table 3: Gravity-Equation Coefficient Estimates (All Country-Pairs)

	(1) Affiliates	(2) Revenues	(3) Total assets	(4) Fixed assets	(5) Tangible fixed	(6) Intangible fixed
lnDistance	-0.5761***	-0.4003***	-0.3754***	-0.4862***	-0.3703***	-0.3063*
	(0.05)	(0.05)	(0.10)	(0.09)	(0.08)	(0.16)
Common Legal Origin	0.3707**	0.2911	0.3936*	-0.0850	-0.4595	1.2459***
	(0.17)	(0.20)	(0.23)	(0.25)	(0.31)	(0.33)
Contiguity	0.5557***	0.2581	0.4727*	0.0964	0.6769***	-0.0637
	(0.11)	(0.17)	(0.27)	(0.27)	(0.24)	(0.34)
Colony	0.4113***	0.5161***	0.2472	0.1018	1.3021***	-0.4863
	(0.15)	(0.20)	(0.22)	(0.25)	(0.27)	(0.37)
FTA	-0.1139	0.0573	-0.0608	-0.4031*	0.0830	-0.2357
	(0.13)	(0.14)	(0.18)	(0.21)	(0.16)	(0.34)
BIT	0.0035	-0.2467	-0.2502	-0.0572	-0.0187	0.2454
	(0.15)	(0.18)	(0.22)	(0.17)	(0.16)	(0.31)
Observations	3225	3225	3225	3135	3135	3077
R^2	0.888	0.825	0.838	0.883	0.824	0.781

PPML, Robust standard errors in (), clustered by country pair

Cross section, year 2019. Origin and destination country fixed effects included

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 4: Quantification (USA using All Country-Pairs)

	Affiliates	Revenue	Total Assets	Fixed Assets	Tangible	Intangible
Total FDI	89,901	4,964,481	21,801,645	10,493,457	1,837,439	769,051
Phantom FDI	15,542	1,159,094	5,553,177	1,931,544	380,683	245,789
Phantom FDI/Total FDI	0.178	0.233	0.254	0.184	0.207	0.320

Notes: Affiliates: number of foreign affiliates. Rest of variables in million USD

The actual number of U.S. affiliates in these three countries exceeds the number predicted by structural gravity by more than 10,000 affiliates. Focusing on the revenues of foreign affiliates of U.S. MNEs, Figure 2b shows that Ireland, Netherlands, and Singapore are the top three destinations for U.S. outward Phantom FDI with actual revenues exceeding predicted revenues by around $300 billion, $150 billion, and $100 billion respectively. Rounding out the top 10 countries associated with Phantom revenues are the United Kingdom, Belgium, Germany, Luxembourg, Japan, India, and Italy.

Moving towards the assets of U.S. foreign affiliates, figure 2c finds a similar pattern with Luxembourg, UK, and Ireland being the top three destinations of U.S. outward Phantom FDI. For each of these three countries, the actual value of total assets held by U.S. MNEs through their foreign affiliates in MREID exceeded the value predicted by structural gravity by more that a $1 trillion. Results are similar when we move beyond total assets, as seen in figure 2d, to fixed assets, with Luxembourg, Ireland, and Netherlands being the top three destinations of U.S. outward Phantom FDI.

MREID also allows us to distinguish between fixed assets as either tangible or intangible. Figures 2e and 2f highlight a diverse set of motivations may be behind phantom FDI. Both Netherlands and the Ireland are considered to have favorable investment regimes. Yet, U.S. MNEs prefer to hold tangible assets in the Netherlands and keep intangible assets in Ireland. This reflects the importance of tax considerations and the regulatory and legal environment facilitating holding structures, emphasizing the role of firm-specific optimization strategies in shaping FDI in this category. Future studies can further focus on these differences to better understand how certain polices are better at attracting investments aimed at maximizing global profits through tax mitigation strategies.

5.2 Estimates with a Production-Function Approach

As a robustness exercise, we next apply a production-function approach to measure U.S. phantom FDI to various destinations (j) using the data from MREID. The methodology we use is similar to the methodology developed in Guvenen et al. (2022). In this approach, we impute the revenues of each destination's foreign affiliates of U.S. MNEs. We do this by estimating the relationship between the revenues of these U.S. foreign affiliates with the capital and labor inputs used by these foreign affiliates. Specifically, we use the Cobb-Douglas production function:

$$R^{imp}_{USA,j} = \gamma K_j^{\alpha} L_j^{1-\alpha}$$

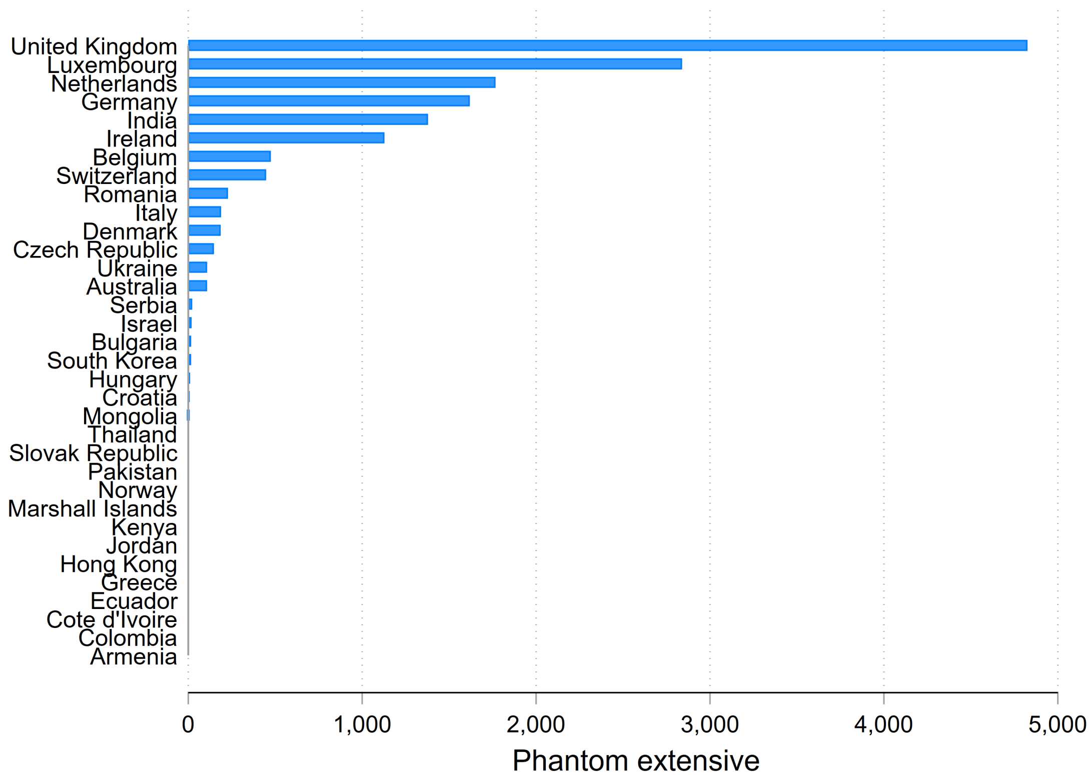
where $R^{imp}_{USA,j}$ represents the imputed revenue for U.S. affiliates in j, K_j denotes the capital stock, and L_j represents labor stock. The parameters α and $1 - \alpha$ represent, respectively, the share of income going to capital and to labor, and γ is a constant term representing productivity. This approach estimates revenues based on observable inputs and can be compared to *actual* reported revenues ($R^{act}_{USA,j}$) to identify potential discrepancies associated with phantom FDI. We choose $\alpha = 0.4$ and calibrate $\gamma = 25.933$ to match U.S. domestic revenues and factor endowments. Accordingly, phantom FDI can be represented by:

$$R^{Phantom}_{USA,j} \equiv R^{act}_{USA,j} - R^{imp}_{USA,j}. \tag{7}$$

The results obtained with the production-function approach reported in Figure 3 are qualitatively and quantitatively similar to those obtained with the gravity-equation approach in section 5. Singapore and Ireland are the leading countries in both cases. The gravity-

Figure 2: USA's Outward Phantom FDI (using Structural Gravity with All Country-Pairs)

(a) Number Affiliates



(b) Revenue from affiliates

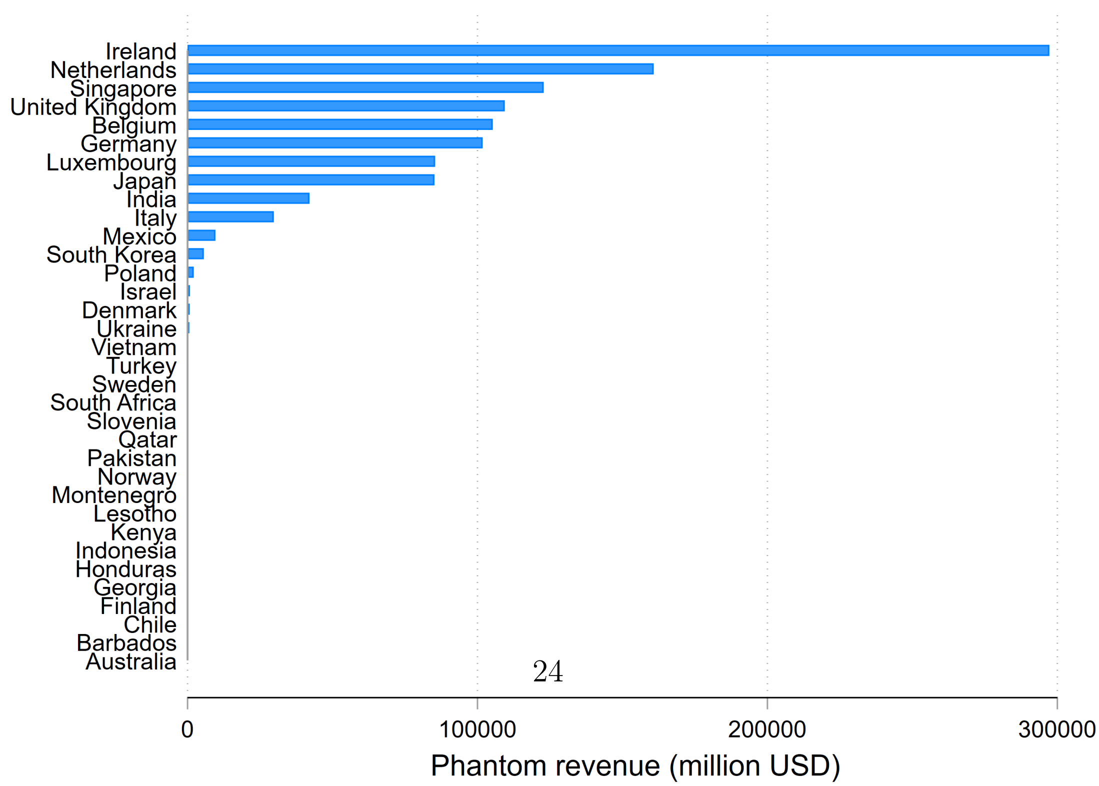
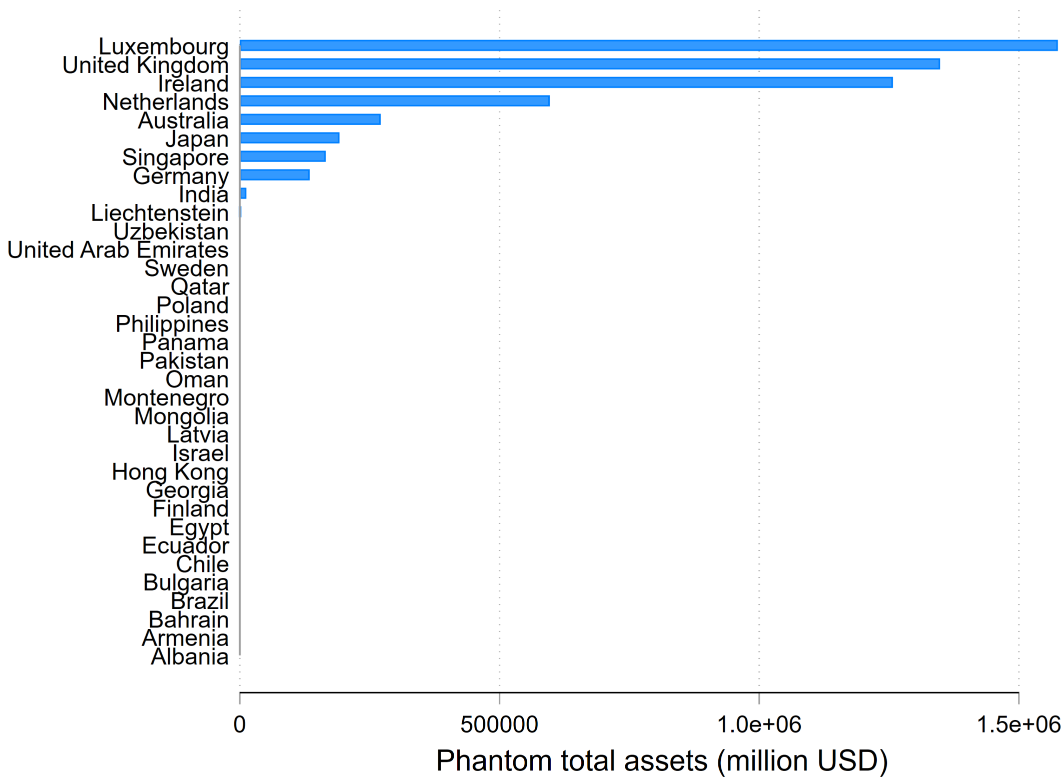


Figure 2: USA's Outward Phantom FDI (using Structural Gravity with all countries) (cont.)

(c) Total Assets



(d) Fixed Assets

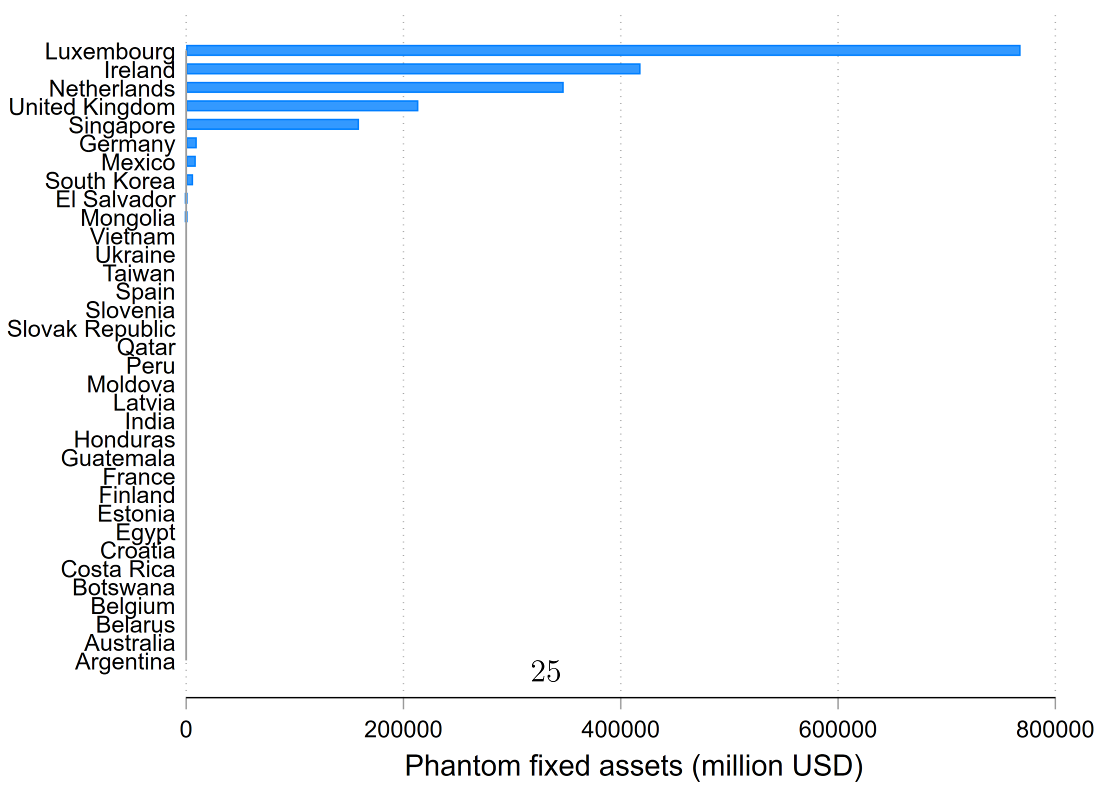
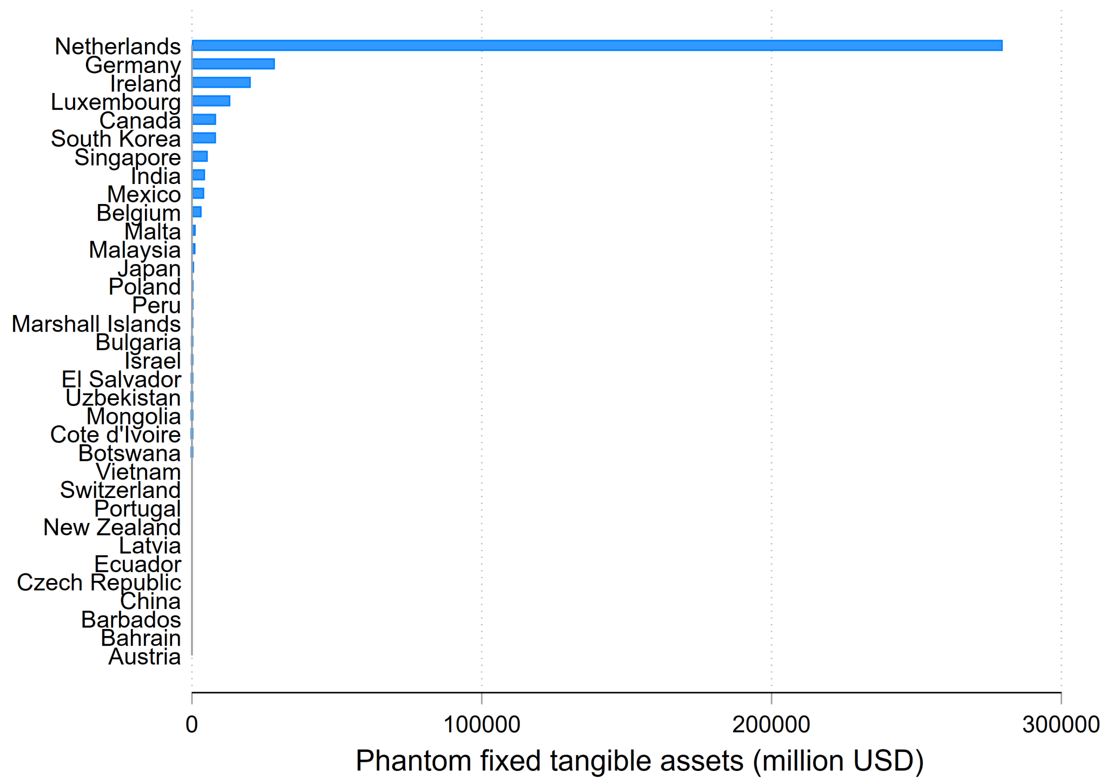


Figure 2: USA's Outward Phantom FDI (using Structural Gravity with all countries) (cont.)

(e) Tangible Fixed Assets



(f) Intangible Fixed Assets

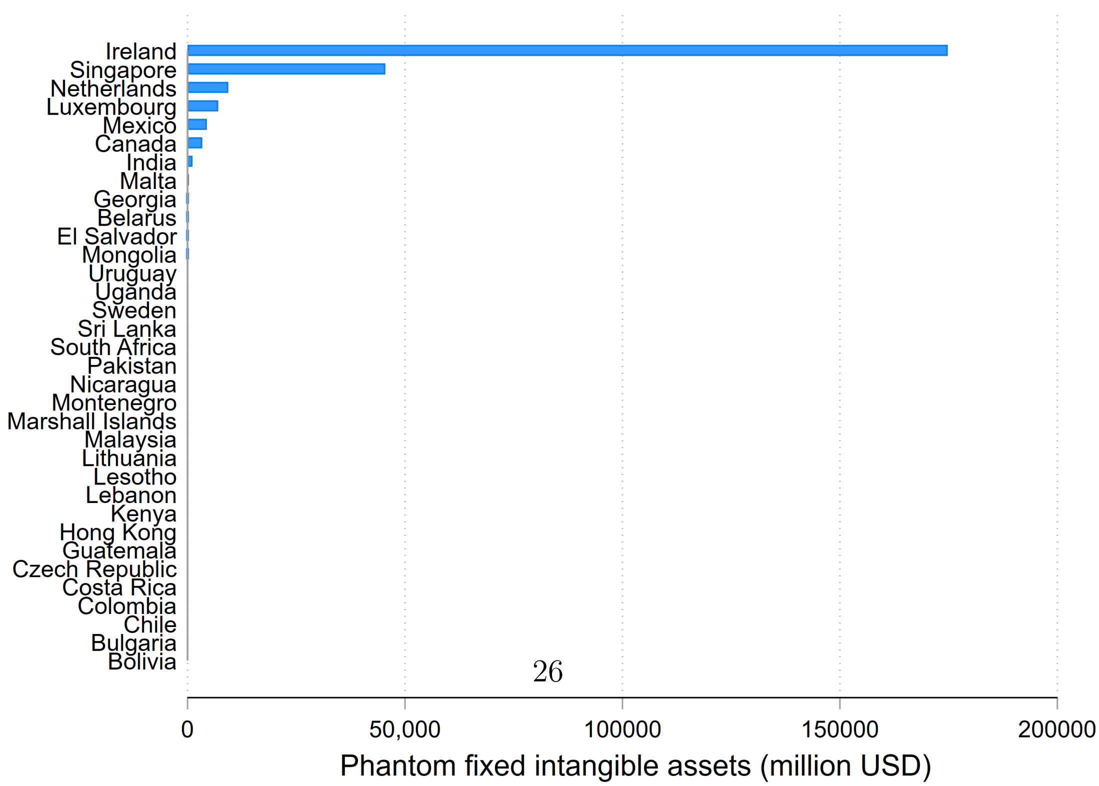
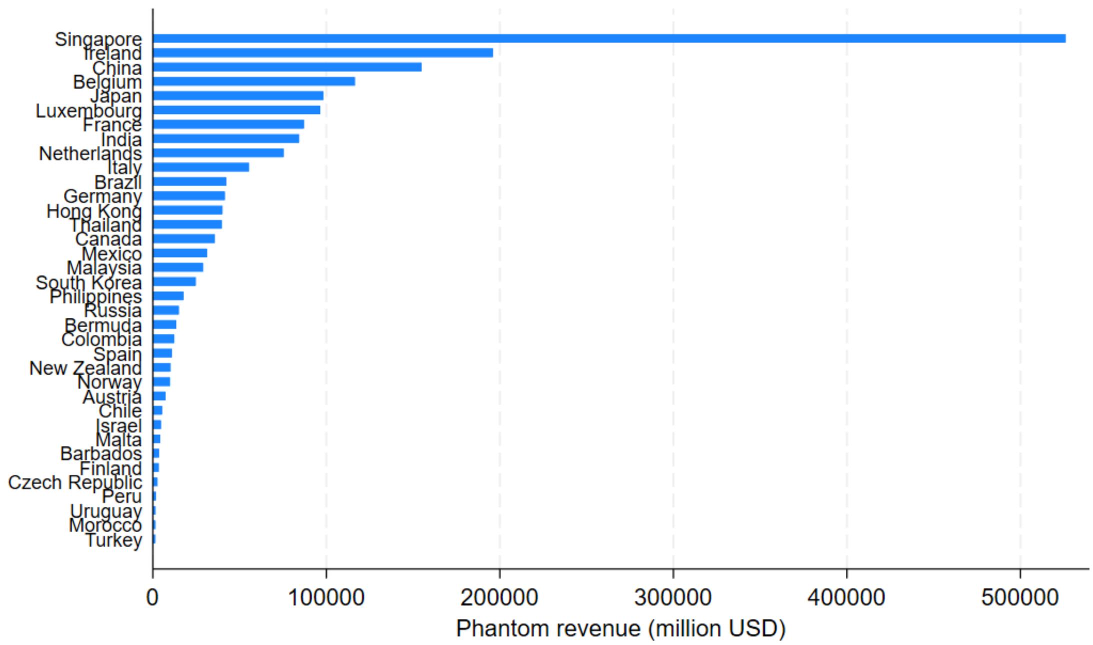


Figure 3: Phantom Revenues (Production-Function Approach)



equation approach seems more conservative than the production-function approach regarding Singapore's phantom FDI. The production-function result indicates that American affiliates' actual revenues in Singapore exceed by more than \$500,000 million the predicted revenues. With the structural gravity estimate using all countries, the estimate is around \$100,000 million. Considering that Singapore's GDP was \$377,000 million in 2019, the structural gravity approach seems more reasonable.

Table 5 quantifies the total revenues from all destinations using the production-function approach and comparing the results to those obtained earlier with the gravity-equation approach. The results confirm that Phantom FDI, as measured by the revenues of U.S. foreign affiliates, are much lower using the structural gravity approach than the production-function approach.

The structural gravity approach delivers the most conservative estimates, with only 23.3% of phantom FDI in terms of revenues, 12.4 percentage points lower than the production-

Table 5: Gravity-Equation vs. Production-Function Approaches for Phantom FDI

	Structural Gravity	Production Function
Total FDI	4,964,481	4,964,481
Phantom FDI	1,159,094	1,906,369
Phantom FDI Fraction	0.233	0.384
Million USD		

function approach. These results suggest that the production-function approach in previous studies in the literature might overestimate the value of phantom FDI. This might be due to two reasons. On the one hand, there might be uncertainty regarding the parameter γ used to calibrate the production function. Furthermore, the production-function approach does not control for third-country effects. Interestingly, when we do not control for these effects, the one-country gravity-equation and the production-function approaches yield closer results than when using structural gravity with all country pairs.

6 Inward Multilateral Phantom FDI for Non-U.S. Countries

We can also use our structural gravity-equation results to provide estimates of inward multilateral phantom FDI for non-U.S. countries. Using our estimates from structural gravity of bilateral phantom FDI, we can calculate:

$$FDI_j^{Phantom} \equiv \sum_{i=1, i\neq j}^{N} \left(FDI_{ij} - \widehat{FDI_{ij}} \right). \tag{8}$$

where $\widehat{FDI_{ij}}$ is the predicted FDI flow from equation (4).

The results of applying our gravity-equation methodology to identify phantom FDI on a global scale are reported in Figure 4, which contains the results for the numbers of affiliates, revenues, total assets, fixed assets, tangible fixed assets, and intangible fixed assets.

Figure 4 reports the inward multilateral phantom FDI for numerous non-U.S. countries. Regarding the number of affiliates in Figure 4a, China (1st), United Kingdom (2nd), and Netherlands (3rd) lead the ranking of the phantom FDI. The value of phantom FDI suggests, for instance, that the number of foreign affiliates in China exceeds by more than 9,000 affiliates the predicted theoretical value obtained from the gravity equation. However, the value of the phantom FDI is *not* a ratio; thus, small countries are weighted relatively less with this approach.

The value of phantom FDI of revenues (Figure 4b), total assets (Figure 4c), fixed assets (Figure 4d), tangible fixed assets (Figure 4e) and intangible fixed assets (Figure 4f) show a different picture from the rankings in Figure 4a. China is followed by the United Kingdom, Singapore, France, and Ireland in ranking phantom FDI by revenues. The revenues of non-U.S. foreign affiliates in China exceed the FDI potential by 800,000 million USD. The United Kingdom, Luxembourg, Hong Kong and China lead the rankings in total assets, and Luxembourg, IK and Netherlands in fixed assets. The Netherlands, the UK, and Australia lead the tangible fixed asset ranking. Ireland, Netherlands, and Brazil lead the ranking using fixed intangible assets. Finally, Table 6 reports the fractions of total FDI that are estimated to be phantom FDI for each of the six dependent variables.

Table 6: Quantification (Inward Multilateral FDI for Non-U.S. Countries)

	Affiliates	Revenue	Total Assets	Fixed Assets	Tangible	Intangible
Total FDI	331,642	19,700,000	68,600,000	27,300,000	6,008,717	2,074,382
Phantom FDI	75,730	6,367,864	23,900,000	7,810,626	2,159,687	935,735
Phantom FDI/Total FDI	0.228	0.323	0.349	0.285	0.359	0.451

Notes: Affiliates: number of foreign affiliates. Rest of variables in million USD

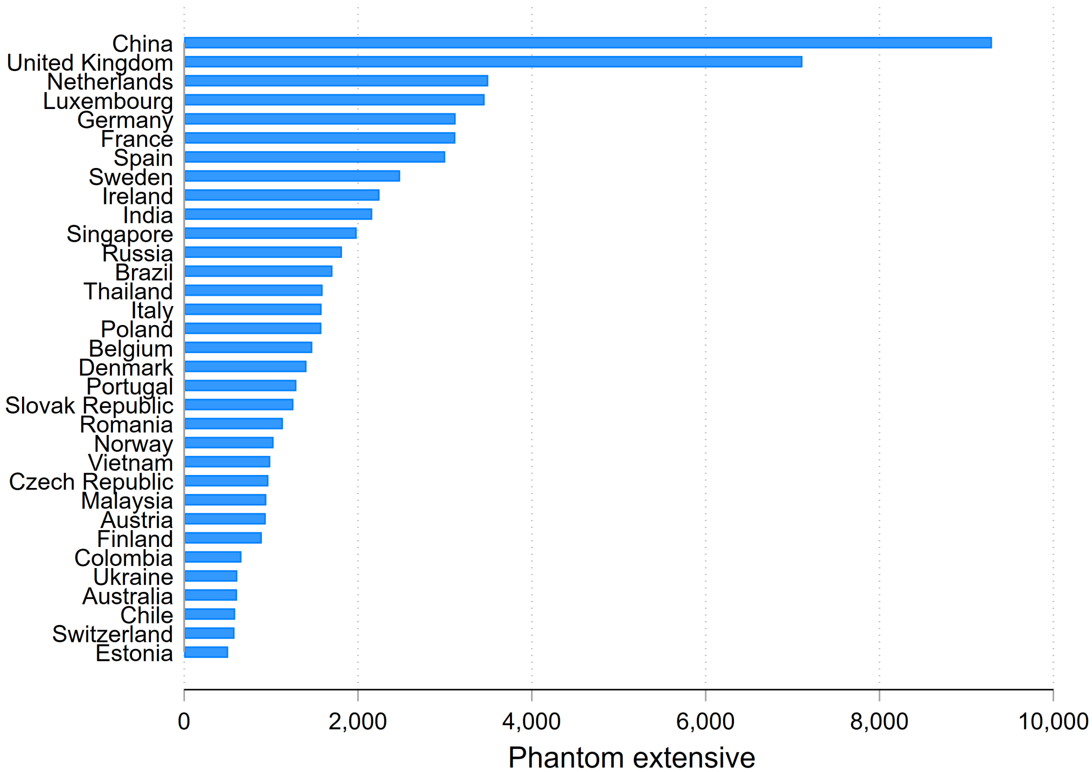
7 Conclusion

This paper applies a structural gravity approach to identify and quantify the presence of phantom FDI, which refers to investment flows that are motivated by factors other than those related to the production opportunities in host country. Focusing on the United States, our findings demonstrate that the structural gravity approach identifies several key destinations as significant recipients of Phantom FDI: Luxembourg, Netherlands, Ireland, Singapore and the United Kingdom. Some of these countries have been identified as prominent tax havens in other studies (Damgaard et al., 2024). Regarding the dollar value of Phantom FDI, Ireland, Singapore, and the Netherlands rank first in terms of affiliate revenues. Moreover, the results indicate that the decision to hold assets in overseas subsidiaries are influenced by a mix of policy advantages, geo-strategic factors, and favorable tax holding laws, with the Netherlands and Ireland standing out as key destinations for U.S. MNEs.

Overall, this study suggests that the structural gravity framework – founded upon well-established theoretical foundations – is useful in identifying phantom FDI flows. We show that the results using structural gravity-equation estimates are more conservative – and perhaps more realistic – than previous approaches used by the literature, cf., Guvenen et al. (2022). This provides a valuable framework for researchers wanting to better understand the underlying drivers of FDI and to assess the importance of political and geographical considerations, in addition to tax factors, that are behind these Phantom FDI flows.

Figure 4: Inward Phantom FDI of Non-U.S. Countries, 2019

(a) Number Affiliates



(b) Revenue from affiliates

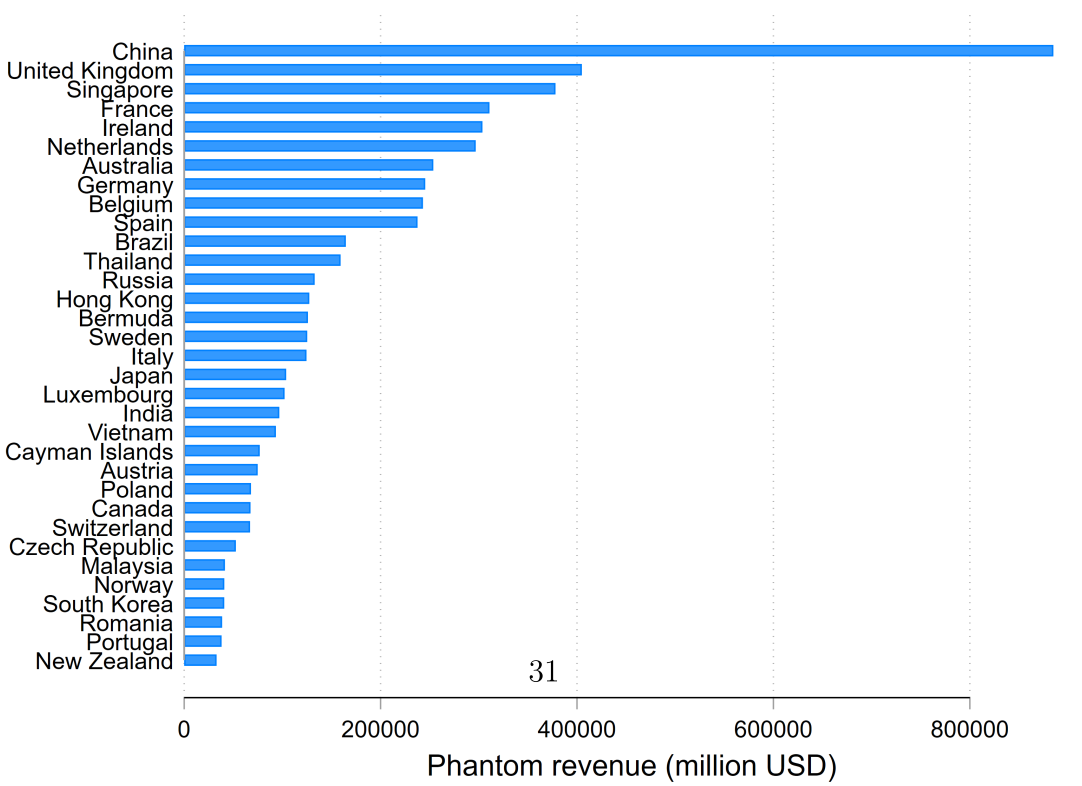
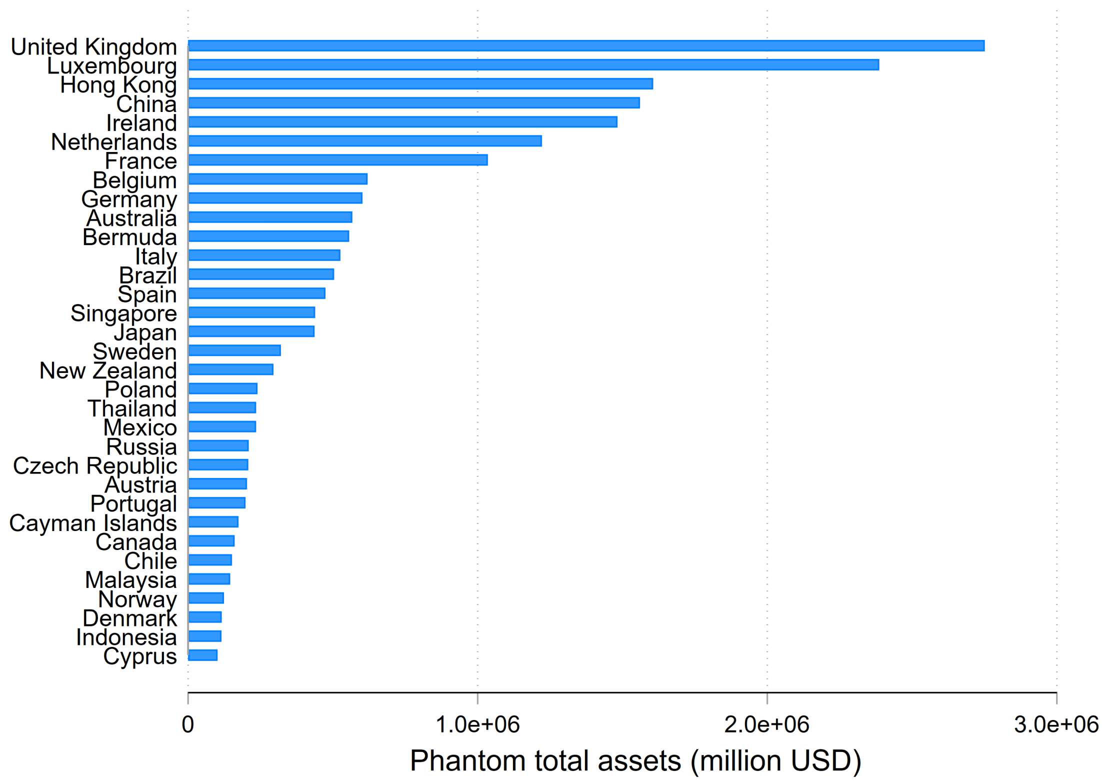


Figure 4: Inward Phantom FDI of Non-U.S. Countries, 2019 (cont.)

(c) Total Assets



(d) Fixed Assets

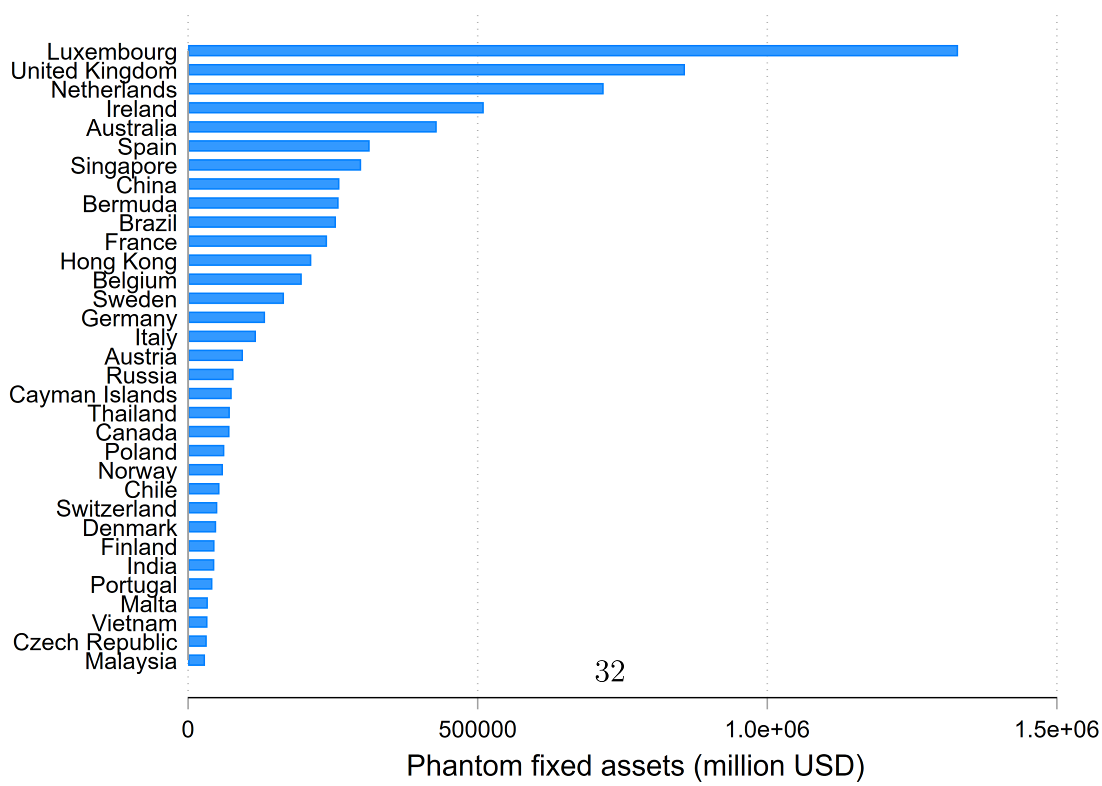
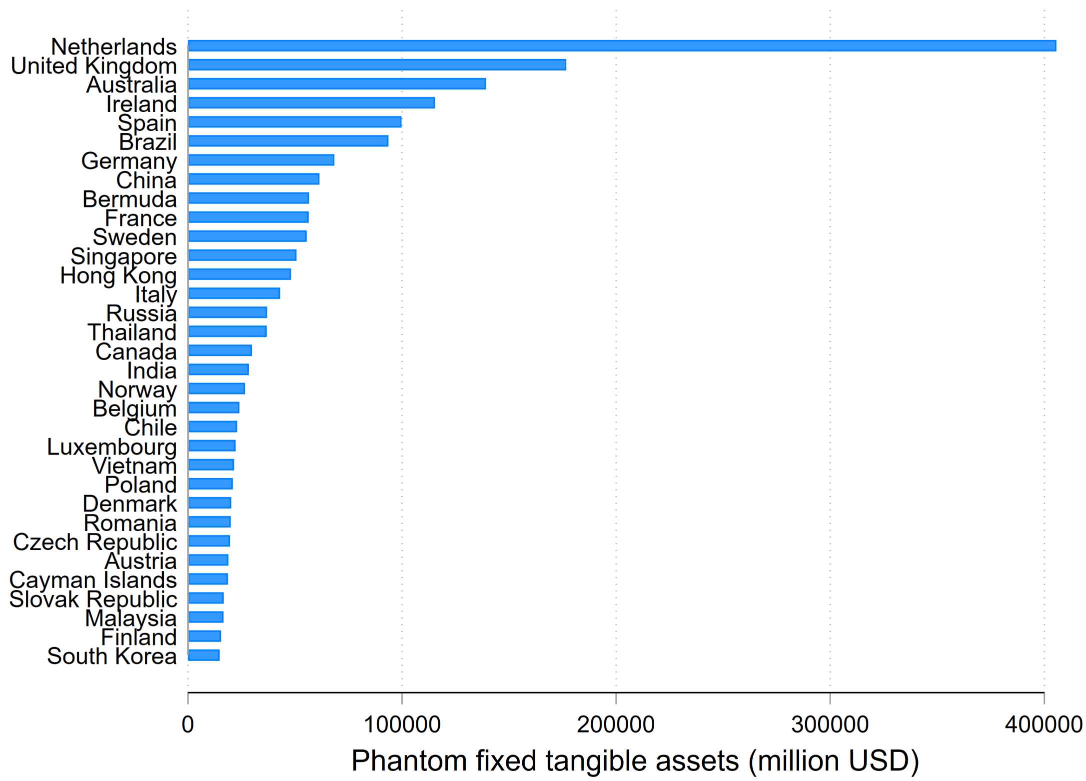
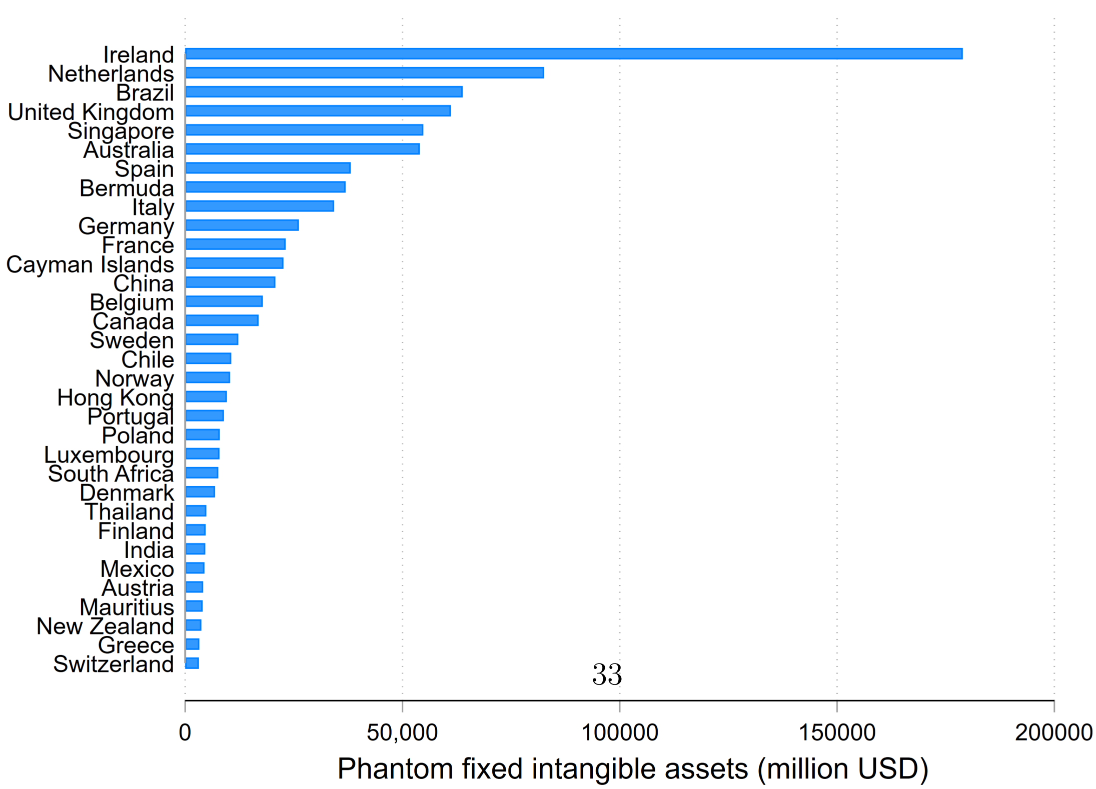


Figure 4: Inward Phantom FDI of Non-U.S. Countries, 2019 (cont.)

(e) Tangible Fixed Assets



(f) Inangible Fixed Assets



References

Ahmad, S., Bergstrand, J., Paniagua, J., and Wickramarachi, H. (2023). The multinational revenue, employment, and investment database (mreid). *USITC Economics Working Paper 2023–11-B*.

Anderson, J. E. (1979). A theoretical foundation for the gravity equation. *The American Economic Review*, 69(1):106–116.

Anderson, J. E., Larch, M., and Yotov, Y. V. (2019). Trade and investment in the global economy: A multi-country dynamic analysis. *European Economic Review*, 120:103311.

Anderson, J. E. and Van Wincoop, E. (2003). Gravity with gravitas: A solution to the border puzzle. *American economic review*, 93(1):170–192.

Baier, S., Kerr, A., and Yotov, Y. (2017). Gravity, distance, and international trade. In Blonigen, B. and Wesley, W., editors, *Handbook of International Trade and Transportation*. Edward Elgar Publishing.

Bergstrand, J., Cray, S., and Gervais, A. (2023). Increasing marginal costs, firm heterogeneity, and the gains from 'deep' international trade agreements. *Journal of International Economics*, 144.

Bergstrand, J. and Egger, P. (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. H. (1985). The gravity equation in international trade: some microeconomic foundations and empirical evidence. *The Review of Economics and Statistics*, pages 474–481.

Bergstrand, J. H. (2019). *Understanding Globalization Through the Lens of Gravity*. World Scientific Publishing, Singapore.

Bergstrand, J. H. and Paniagua, J. (2024). Do deep trade agreements' provisions actually increase – or decrease – trade and/or fdi? *Unpublished manuscript.*

Bolwijn, R., Casella, B., and Rigo, D. (2018). Establishing the baseline: estimating the fiscal contribution of multinational enterprises. *Transnational Corporations*, 25(3):111–143.

Brandt, K. (2023). Illicit financial flows and developing countries: A review of methods and evidence. *Journal of Economic Surveys*, 37(3):789–820.

Casella, B. (2019). Looking through conduit FDI in search of ultimate investors–a probabilistic approach. *Transnational Corporations*, 26(1):109–146.

Casella, B., Borga, M., and Wacker, M. K. (2024). Measuring multinational production with foreign direct investment statistics: A survey of challenges and recent developments. *Journal of Economic Surveys*.

Clausing, K. A. (2020). Profit shifting before and after the tax cuts and jobs act. *National Tax Journal*, 73(4):1233–1266.

Damgaard, J., Elkjaer, T., and Johannesen, N. (2024). What is real and what is not in the global fdi network? *Journal of International Money and Finance*, 140:102971.

Gurevich, T. and Herman, P. (2018). The dynamic gravity dataset: 1948-2016. *USITC Working Paper 2018-02-A*.

Guvenen, F., Mataloni Jr, R. J., Rassier, D. G., and Ruhl, K. J. (2022). Offshore profit shifting and aggregate measurement: Balance of payments, foreign investment, productivity, and the labor share. *American Economic Review*, 112(6):1848–84.

Haberly, D. and Wójcik, D. (2015). Regional blocks and imperial legacies: Mapping the global offshore fdi network. *Economic Geography*, 91(3):251–280.

Markusen, J. (2002). *Multinational Firms and the Theory of International Trade*. The MIT Press, Cambridge, Massachusetts.

Rigobon, R. (2003). Identification through heteroskedasticity. *Review of Economics and Statistics*, 85(4):777–792.

Santacreu, A. M. and Stewart, A. (2024). The impact of the 2017 tax cuts and jobs act on us multinationals' intangible assets. *Federal Reserve Bank of St. Louis Working Paper 2024-020*.

Santos Silva, J. and Tenreyro, S. (2006). The log of gravity. *The Review of Economics and statistics*, pages 641–658.

Tinbergen, J. (1962). *Shaping the World Economy: Suggestions for an International Economic Policy*. The Twentieth Century Fund, New York.

Tørsløv, T., Wier, L., and Zucman, G. (2023a). Externalities in international tax enforcement: Theory and evidence. *American Economic Journal: Economic Policy*, 15(2):497–525.

Tørsløv, T., Wier, L., and Zucman, G. (2023b). The missing profits of nations. *The Review of Economic Studies*, 90(3):1499–1534.

Turban, S., Sorbe, S., Millot, V., and Johansson, Å. (2020). A set of matrices to map the location of profit and economic activity of multinational enterprises. *OECD Taxation Working Papers, No. 52*.

United Nations (2015). *Reforming International Investment Governance*. World investment report. UN.

A Additional Tables

Table A.1: Sensitivity Analysis: Restricted Model and Correlations

	(1) Affiliates	(2) Revenues	(3) Total assets	(4) Fixed assets	(5) Tangible fixed	(6) Intangible fixed
lnGDP	0.7053***	0.7324***	0.5847***	0.4791***	0.5517***	0.5758***
	(0.10)	(0.08)	(0.11)	(0.11)	(0.11)	(0.10)
lnDistance	-0.7471**	-0.2782	-1.0589**	-1.3208*	-1.2253	-0.6463*
	(0.35)	(0.45)	(0.49)	(0.70)	(0.80)	(0.35)
Island	0.2444	0.3634	1.2606**	0.5775	0.2974	0.2631
	(0.46)	(0.34)	(0.50)	(0.59)	(0.96)	(0.58)
Landlocked	0.7064	-0.4498	1.2063	1.3012	-1.6339	-1.0213
	(0.46)	(0.68)	(0.92)	(0.95)	(1.01)	(0.97)
Common Legal Origin	1.9260***	0.9659**	1.8395***	2.3577***	1.3562	0.4432
	(0.49)	(0.42)	(0.66)	(0.90)	(1.26)	(0.54)
Common Language	-0.3969	-0.0787	-0.5662	-1.0605	-1.5025	0.9725
	(0.39)	(0.45)	(0.75)	(0.99)	(1.33)	(0.76)
Correlation	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999
Observations	111	111	111	111	111	111
R^2	0.678	0.572	0.554	0.364	0.358	0.282

Robust US outward FDI, year 2019. Correlations with the predicted values of the unrestricted regressions

PPML, Robust standard errors in parenthesis, clustered by country pair

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$