Multinational Networks and Trade Participation*

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Abstract

This paper provides a novel explanation for the dominant role of multinational corporations (MNCs) in international trade: after being acquired by an MNC, firms face lower trade frictions in and around the network of countries in which their parent has a presence. We develop a model of firms' export and import choices that isolates "MNC network effects" from other channels through which multinational ownership can affect trade participation. We bring the model to the data by combining rich information on the universe of Belgian firms and on MNCs' global networks. The results show that acquired firms are more likely to start trading with countries that belong to their parents' network or are exogenously added to it. Network effects extend beyond the boundaries of the multinational, dominate traditional firm-level channels in explaining affiliates' entry in new markets, and account for a large share of their growth.

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1 Introduction

Multinational corporations (MNCs) dominate international trade, accounting for almost two thirds of the value of global trade flows (Miroudot and Rigo, 2021). For example, in Belgium, multinational affiliates represent only 1% of the entire population of firms, but are responsible for 60% of aggregate exports and 65% of imports.

In this paper, we set out a novel mechanism that contributes to this dominance. We show that multinational ownership reduces country-specific frictions, making it more likely for acquired firms to start trading with countries in which their parent has other affiliates.[1] We label this mechanism "MNC network effects", and we isolate it theoretically and empirically from firm-specific channels suggested in the literature through which multinational ownership can affect affiliates' trade participation, such as productivity increases due to technological or managerial transfers or the alleviation of financial frictions.[2] We show that MNC network effects explain a larger share of the variance in new affiliates' entry in foreign markets than standard firm-level effects and account for a large share of their growth. We also provide systematic evidence that the effects of MNC ownership are not confined to the boundaries of the multinational. For example, they extend to countries that are close—but do not belong—to the parental network.

We start by confirming previous findings about the effects of MNC ownership on overall trade participation. Using rich data from the National Bank of Belgium (NBB) on production, trade, and Foreign Direct Investment (FDI), we find that firms acquired by foreign multinationals are more likely to export and import, have higher total values of exports and imports, and export to and import from more countries. Non-trade outcomes are also affected: acquired firms become larger (in terms of sales and employment) and more productive. These effects are identified comparing acquired firms with never acquired and not yet acquired firms and account for selection effects through re-weighting methods that allow

[1]Much empirical work in international trade demonstrates that bilateral frictions hamper trade. Some of these frictions are product-country-specific, such as tariffs and various types of non-tariff barriers (e.g. rules of origins, product standards). For example, Caliendo and Parro (2015) and Conconi *et al.* (2018) respectively study the effects of tariff reductions and rules of origin following the entry into force of NAFTA. Others are country-specific, such as information frictions related to local market conditions and regulations, and tend to increase (decrease) with distance (common language). A large literature reviewed by Disdier and Head (2008) and Head and Mayer (2014) emphasizes the negative effect of distance on bilateral trade. Melitz and Toubal (2004) show that common language boosts trade by improving the ability to communicate and reducing information frictions.

[2]Existing work shows that MNCs can increase affiliates' productivity through transfers of technology or managerial know-how (e.g., Bloom *et al.*, 2012; Bircan, 2019); this can lead affiliates to select into the different margins of international trade (e.g., Melitz, 2003; Helpman *et al.*, 2004; Guadalupe et al, 2012; Antràs *et al.*, 2017). MNC ownership can also boost trade participation by alleviating the financial constraints of acquired firms (e.g., Harrison *et al.*, 2004; Manova *et al.*, 2015).

us to create a group of untreated firms that is indistinguishable from the group of treated firms in terms of different moments of the distribution (mean, variance, and skewness) of a large set of observables.[3]

Our main contribution is to isolate theoretically and empirically a novel network-specific mechanism behind the effects of MNC ownership. We first develop a theoretical model in which firms choose from which countries to source their inputs to minimize production costs and where to sell their final goods to maximize profits. MNC ownership can affect export and import decisions of new affiliates at the extensive and intensive margins, through firm-specific channels (e.g., increased productivity through technology transfers) and firm-country specific channels (e.g., reduction of trade barriers in countries in which the parent already has a presence). The model delivers structural firm-level gravity equations that can be estimated to identify the network effects of multinational ownership.

We next bring the model to the data, combining firm-level information from the NBB with the Orbis and Historical Orbis datasets from Bureau van Dijk to construct the parental networks of multinational affiliates, i.e., the set of countries in which the foreign parent of each Belgian affiliate has a presence at the time of the acquisition.[4] The results of the firm-level gravity regressions provide evidence of MNC network effects at the extensive margin: the probability that a new affiliate starts exporting to (importing from) a country in its parental network increases by 2.9 (1.6) percentage points, which corresponds to a 17% (16%) increase in the value of the unconditional probability of export (import) entry. We find no evidence of network effects at the intensive margin: new affiliates do not significantly increase the value of their exports to (and imports from) countries they were already trading with before being acquired. Overall, our analysis suggests that multinational ownership alleviates country-specific trade frictions that operate at the extensive margin: new affiliates face lower entry costs in the foreign markets where their parent already operates.

Our baseline estimates are identified exploiting variation across affiliates in the geographical structure of their parents' networks. We also exploit network variation within affiliates, driven by mergers and acquisitions (M&As) that result in plausibly exogenous changes in

[3]The weights used to construct the control group are based on a large set of firm-level time-varying characteristics. These variables capture differences across firms in terms of size and performance (e.g., lagged sales, in levels and growth rates), trade participation (e.g., lagged export and import values and number of export and import countries, in levels and in growth rates), and trade networks (e.g., average distance, longitude, latitude, and the GDP per capita of the countries with which a firm trades). Post re-weighting, various "non-targeted" covariates, such as the number of imported and exported products, are also indistinguishable across treated and untreated firms.

[4]Belgian affiliates are often part of large and diverse multinational networks, and the geographical structure of these networks varies significantly across parents. As an illustration, of the acquired Belgian firms that have their direct parents in the Netherlands, one parent firm has a presence in 63 countries and another has a presence in 52 countries, with limited country overlap.

their global ultimate owner (GUO). We focus on Belgian affiliates that are only indirectly controlled by the companies involved in these transactions and that are peripheral to their primary line of business. The identifying assumption is that the trade activities of these affiliates are orthogonal to the reasons behind the M&A deals.[5]

We provide systematic evidence that the effects of multinational ownership extend beyond the boundaries of the multinational, i.e., acquired firms do not simply start trading with other affiliates of the same parent. Four sets of results support this argument. First, acquired firms are more likely to start trading not only with countries in which other affiliates are located, but also with countries that are close—but do not belong—to their parents' network. By definition, these "extended MNC network effects" operate outside the boundaries of the multinational, as they involve countries in which the parent has no presence. These effects can be due to geographical or cultural closeness to the MNC affiliate, or similarity in market conditions and access, in a similar vein to the extended gravity effects shown in Morales *et al.* (2019, 2023). Second, network effects increase with geographical or cultural distance of the foreign country from the country of the acquired firms, suggesting that MNC ownership alleviates trade frictions related to gravity. If the effects were driven by global supply chains within the multinational, we would expect a *decrease* with distance: new affiliates should be *less* likely to start exporting to and importing from other affiliates of their parent when these are further away. Third, network effects are persistent: firms continue to trade with countries that exit their parental network following exogenous ownership changes. This result confirms that the effects of multinational ownership are not restricted to trade between affiliates and suggests that market fixed costs are sunk after initial entry. Finally, if the network effects were driven by supply chain linkages within MNCs, we would expect them to be stronger when the activities of affiliates are vertically-related. We show that the probability that an acquired firm starts exporting to (and importing from) a country that belongs to its parental network does not depend on how upstream (downstream) its activities are relative to those of its parent's affiliates in that country.

When we decompose the total variance of trade participation into its components, we find that our novel network channel is quantitatively more important than traditional firm-level mechanisms in explaining new affiliates' export and import entry. Combining the structure of our theoretical model with our estimates, we also perform back-of-the-envelope calculations of the impact of MNC network effects on firm growth (in terms of sales and employment). These indicate that, through MNC network effects, acquired firms experience an annual growth rate that is more than twice as large as the median growth observed in the data.

[5] This is similar to the strategy used by Atalay *et al.* (2019) to identify the impact of vertical integration on trade between U.S. establishments.

Our paper is related to three main streams of literature. The first stream studies the effects of multinational ownership. Much of this literature focuses on productivity effects on acquired firms (e.g., Aitken and Harrison, 1999; Arnold and Javorcik, 2009),[6] or on the productivity spillovers of multinationals.[7] A few studies show that multinational ownership can alleviate the financial constraints faced by acquired firms (e.g., Harrison *et al.*, 2004; Manova *et al.*, 2015). Within this stream of literature, the closest papers to ours is Guadalupe *et al.* (2012). Using a panel dataset of Spanish manufacturing firms, they show that firms acquired by MNCs conduct more product and process innovation, adopting new machines and organizational practices, but only when they are more likely to export through their parent's distribution network. Our paper emphasizes more general effects of multinational ownership on trade participation: new affiliates are more likely to start exporting to and importing from countries in which their parent already operates and other countries connected to them.[8]

We also contribute to the literature on networks in trade. Some studies show that social and ethnic networks can reduce information frictions between buyers and sellers (e.g., Rauch, 1999; Rauch and Trindade, 2002). Others model frictions in networks (e.g., Jackson and Rogers, 2007; Chaney, 2014). Some of our results relate to the literature on extended gravity, which shows that reducing trade barriers in one country can increase entry in other connected countries (Albornoz, *et al.*, 2012; Morales *et al.*, 2019; Alfaro-Ureña *et al.*, 2023).[9] Ours is the first paper to identify network and extended network effects of multinational ownership.

Finally, our paper is related to the literature on cross-border M&As. Most studies focus on a small number of transactions in specific industries.[10] For example, Ashenfelter and

[6]Using data on Venezuelan plants, Aitken and Harrison (1999) find that foreign equity participation is positively correlated with plant productivity, but this relationship is only robust for small enterprises. Arnold and Javorcik (2009) use micro data from Indonesia to examine the relationship between MNC ownership and various aspects of plant performance. There is also evidence that affiliates of MNCs adopt better management practices (Bloom *et al.*, 2012).

[7]Haskel *et al.* (2007) and Keller and Yeaple (2009) document positive spillovers in the same industry in the United Kingdom and United States. Using firm-level data from Lithuania and Romania, respectively, Javorcik (2004) and Javorcik and Spatareanu (2008) find evidence of positive productivity spillovers from FDI, resulting from relationships between foreign affiliates and their local suppliers in upstream sectors. Alfaro-Ureña *et al.* (2022) study the effects of becoming a supplier to MNCs. Using tax firm-to-firm transactions data from Costa Rica, they show that domestic firms experience strong and persistent gains in performance after supplying to a first MNC buyer. Méndez and Van Patten (2022) study the effects of large-scale FDI in Costa Rica on the the development of local education and health infrastructure.

[8]Some of our empirical findings also resonate with Antràs *et al.* (2024). Using cross-sectional data on U.S. firms' trade and multinational activity, they find that MNCs are more likely to trade with countries in which they have affiliates and other countries in the same region. The panel structure of our data allows us to exploit changes in MNC ownership to identify network and extended network effects.

[9]There is also an emerging literature on the dynamics of buyer-seller relationships (e.g., Bernard and Moxnes, 2018; Bernard *et al.*, 2022). Other studies emphasize the role of managers in reducing search, information, and trust frictions in trade relationships (e.g., Mion *et al.*, 2014; Patault and Lenoir, 2024).

[10]One exception is the paper by Blonigen and Pierce (2016), who use confidential data from the U.S.

Hosken (2010) look at five consumer products mergers to assess the effectiveness of US horizontal merger policy. Miller and Weinberg (2017) study the price effects of MillerCoors, a joint venture of SABMiller PLC and Molson Coors Brewing that combined the operations of these brewers in the United States. Alviarez *et. al* (2024) study the competition effects of multinational acquisitions in beer and spirits. None of these papers examines how multinational acquisitions affect affiliates' trade participation.

The rest of the paper proceeds as follows. Section 2 presents the data used in the paper. Section 3 documents facts about new affiliates' trade participation. The model of how MNC networks affect affiliate trade is set out in Section 4. Section 5 evaluates the model predictions and Section 6 estimates the relative importance of MNC network effects. Section 7 concludes.

2 Data

This section describes our data sources, sample selection criteria, and how we construct foreign affiliates' multinational networks.

2.1 Datasets

National Bank of Belgium Datasets

We obtain information about the characteristics, ownership structure, and international trade activities of the universe of firms registered in Belgium between 1997 and 2014 from the National Bank of Belgium (NBB). The first set of firms' characteristics comes from the Annual Accounts, which contain information on the number of firms' full-time equivalent employees, labor cost, sales, value-added, input expenditure, and fixed assets. All flow variables are annualized to map to the calendar years in the other datasets.

Ownership information comes from the annual Survey on Foreign Direct Investment, which is mandatory for all foreign-owned firms active in Belgium. This dataset allows us to identify Belgian affiliates of foreign multinationals: for each Belgian firm with a foreign parent, the survey reports the parent's equity share, location, name, and year of acquisition. We can distinguish Belgian firms with a foreign parent (inward FDI) from Belgian firms that own equity abroad (outward FDI).

Data on international trade in goods come from the Foreign Trade dataset. This provides information on firm-level exports or imports starting from 1993, collected separately for intra-EU (Intrastat) and extra-EU (Extrastat) trade. The Extrastat dataset is based on customs declarations and covers virtually all trade transactions. The Intrastat dataset covers all

Census Bureau to study the impact of domestic M&As on productivity and market power.

firms whose annual trade flows (overall receipts or shipments) exceed a certain threshold.[11] For each importer and/or exporter in Belgium, we observe the traded product (8-digit CN code), its value in Euros, and destination or source country. We code the trade data at the firm-year-destination or firm-year level depending.

Finally, we obtain information on the main economic activity (NACE code) of the firm from the Crossroads Bank for Enterprises (CBE). The CBE reports the main NACE code at the five-digit industry, which we aggregate to four and to two digits. All NACE codes are concorded over time and reported in the NACE Rev 2 (2008) version. We link all data sources using each firm's unique Enterprise Identification Number, allowing unambiguous merging across datasets.[12]

Bureau van Dijk Datasets

We gather information about the corporate structure of the multinational parents of each Belgian affiliate using the Orbis and Historical Orbis datasets from Bureau van Dijk (BvD). We use the first dataset to find the identifier for the Belgian firms' direct or global parents. We then use the second to find the countries where the multinational parents have other affiliates. Section 2.2 presents a detailed explanation of the construction of the multinational networks.

Other Data

We gather information about the characteristics of the countries in which the multinational parents of the Belgian firms are present from the CEPII gravity database (see Mayer and Zignago, 2011). This dataset contains information about international trade flows between country pairs as well as the characteristics of each country, such as GDP per capita, population size, geographical coordinates, and distance from Belgium in kilometers. Information on the cultural distance from Belgium, measured as the share of people speaking French or Dutch in the other country, comes from Melitz and Toubal (2004).

[11]Thresholds are set by individual member states so that reported trade covers at least 97% of total dispatch value (intra-EU exports) and 93% of total arrival value (intra-EU imports). These thresholds can vary across member states, across arrivals and dispatches and over time, and can be found here: https://marosavat.com/intrastat-thresholds/.

[12]We impose two criteria to avoid losing observations due to missing values. First, we interpolate missing values in the annual accounts. However, we do so only if the length of the missing spell is no longer than three consecutive years. Second, some firms always appear in the annual accounts but are in the Foreign Trade dataset only in some years. This may happen if firms did not engage in international trade or if their activities did not exceed the minimum reporting threshold in those years. Since we cannot distinguish between these two cases, we treat all such missing trade values as zeros.

2.2 Sample

Broad Sample

We apply several broad criteria to select the Belgian firms to include in our analysis. We exclude firms that do not report at least one full-time equivalent employee in at least one year. This removes small firms that are unlikely to be credible counterfactuals for those that are acquired. Our analysis focuses on firms that operate in tradable good sectors, i.e., those that report a NACE code in agriculture, mining and quarrying, or manufacturing as their main activity. We exclude firms operating in non-tradable service sectors, whose trade participation is likely to be limited, and operating in tradable service sectors due to changes in the NBB data collection procedures for services trade during our sample period.[13] We also exclude Belgian multinationals that engage in outward FDI. This allows us to focus on firms acquired by foreign multinationals and study changes in their trade participation exploiting the Belgian firm-level trade data.[14]

We find $22,938$ Belgian firms that satisfy the above sample selection criteria. Of these, $22,626$ are always domestic and 312 are foreign affiliates for at least part of the sample period.[15] Section A-1.1 of the Appendix provides descriptive statistics on this broad sample of Belgian firms. In line with previous literature (e.g., Arnold and Javorcik, 2009; Bloningen *et al.*, 2014; Guadalupe *et al.*, 2012; Bircan, 2019), Table A-1 shows that there are systematic differences between acquired and non-acquired firms in terms of the mean, variance, and skewness of a large set of observables. As shown in Figure A-1, even before acquisition, future multinational affiliates outperform always-domestic firms in many dimensions.

New Foreign Affiliates and Their Parental Network

To examine the role of MNC ownership, we identify new foreign affiliates as firms that switched from domestic to foreign ownership during our sample period. To this end, we apply three additional selection criteria to the broad sample. First, we exclude firms already under foreign control in 1997, for which we cannot determine the acquisition date. After imposing this criterion, we are left with 182 foreign affiliates. Second, since we are interested in

[13] The NBB provides a quasi-exhaustive picture of the firms, type of services, and destinations involved in services trade up to 2005. After 2005 the collection system has become survey-based (see Ariu *et al.*, 2020).

[14] The model in Section 4 also gives predictions for the trade participation of firms that switch from being domestic to being owned by a Belgian multinational. However, the NBB data does not allow us to identify these firms.

[15] To define affiliates of foreign MNCs, we follow the International Monetary Fund (IMF) definition and consider a firm to be an affiliate of a foreign parent if at least 10% of its total equity in a given year is directly owned by a firm located outside Belgium. As discussed below, however, the average foreign ownership share of affiliates in our sample is close to 90%.

the effects of changes from domestic to foreign ownership, we exclude firms that are "born" with foreign investment (greenfield FDI). Brownfield FDI is by far the most prevalent form of multinational entry, with around 95% of FDI in Belgium being via acquisition. After imposing this criterion, we are left with 174 distinct foreign affiliates. Last, we exclude firms that switch between domestic and foreign ownership multiple times, whose trade participation can be affected by the reversal of their (treatment) status. In total, 115 affiliates satisfy this additional criterion.

Focusing on firms that switched from domestic to foreign ownership only once during our sample period allows us to identify the effects of MNC ownership on trade participation. Our main empirical analysis exploits cross-country variation in the geographical presence of the affiliates' parents to identify the network effects of MNC ownership. Despite the relatively small number of affiliates satisfying our selection criteria, the set of potential affiliate-country export and import partner countries is thus much larger.

Section A-1.2 of the Appendix presents descriptive statistics on the new foreign affiliates included in our analysis. As mentioned before, the NBB FDI survey provides the name of the direct parent (DP) of each affiliate, its home country, and its ownership share of the Belgian firm. Table A-2 reports the number of affiliates by sector. The most common NACE sectors are those between C19 and C22, which involve the manufacturing of coke, chemicals, pharmaceuticals, and rubber. Table A-3 illustrates the distribution of average equity share across the years that foreign parents own their Belgian affiliates. Multinational parents typically own the majority of their affiliates' equity share (the mean ownership share is 89.12% and the median is 99.98%). In same cases, affiliates report more than one DP per year.[16] Therefore, our sample of 115 foreign affiliates includes 188 distinct DPs. Figure A-2 illustrates the number of affiliates by country of the parent. Consistent with the empirical regularity that FDI follows gravity (e.g., Antràs and Yeaple, 2014), the Netherlands is the most frequent headquarters country of the DP.

We next combine data from the NBB and Bureau van Dijk (BvD) to construct each Belgian foreign affiliate's multinational network. In our main empirical analysis, we focus on the network of the affiliate's DP. In robustness checks, we use information on the network of its global ultimate owner (GUO).

We construct the global footprint of each DP in two steps. First, we manually search for each DP's BvD identifier in the online version of the Orbis database. We are able to match 127 of the 188 parents of new foreign affiliates. Second, we retrieve the corporate structure

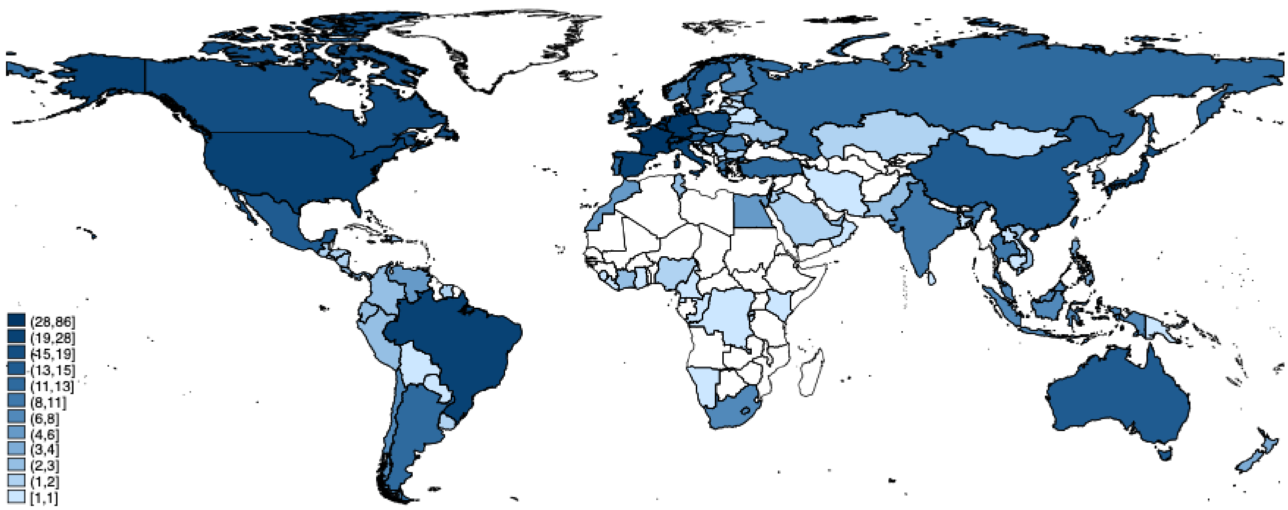
[16] For example, a Belgian firm producing fabricated metal products reports two DPs in 2010: one is located in Luxembourg has owns 72% of the shares, the other is located in France and owns the remaining 28%.

of each parent from Historical Orbis (HO).[17] For each direct parent p, we define the binary indicator $In\ MNC_{cp}$, which is equal to 1 if p (the multinational parent acquiring firm i) has at least one subsidiary in country c and equal to 0 otherwise. Since HO information is only available as of 2007, we code this variable for the year in which firm i is acquired or in 2007, whichever is later. None of the new affiliates has the same direct parent, so each parent p is associated with the acquisition of one Belgian affiliate i.

Figure 1 illustrates the set of countries in which the DPs of new Belgian affiliates have a presence. Countries marked with darker colors are those in which more parents have affiliates. By construction, all parents have a presence in Belgium. There are some countries in which no parent has an affiliate (e.g., Angola, Libya, Mongolia). There is variation across all other countries. For example, 28 direct parents have at least one affiliate in the United States, while 16 direct parents have a presence in Japan.

Figure 1

Global Presence of Direct Parents



The figure illustrates the countries in which the parents of Belgian firms acquired during our sample period have a presence.

Figure 2 further illustrates the geographical variation of parents' networks by focusing on two affiliates, denoted by A and B. In both cases, the direct parent is located in the Netherlands. However, the parents' networks differ not only in size (63 countries for the direct parent of affiliate A, 52 for the direct parent of affiliate B), but also in their geographical structure: there are countries in which only the parent of affiliate A has a presence (e.g., Czech Republic, United Emirates, Nigeria); and others in which only the parent of affiliate

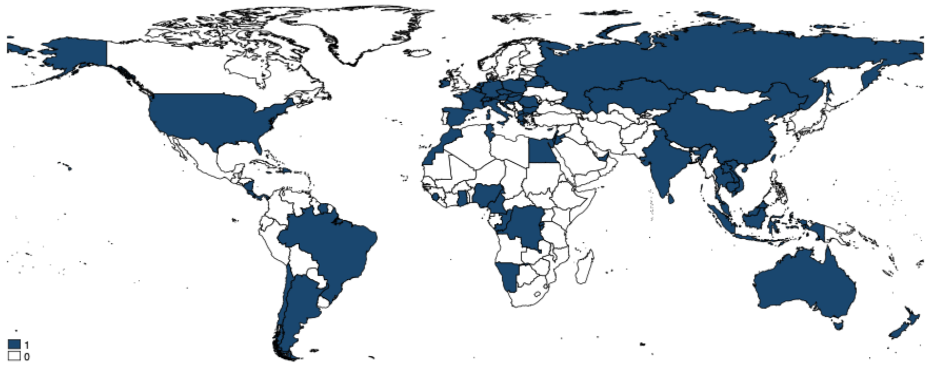
[17] This dataset provides information on ownership in each year from 2007. The files are arranged by country and by year. We look for the BvD identifiers of the DP in the relevant country-year shareholder HO files. This gives us a list of subsidiaries of the DP.

B has a presence (e.g., Mexico, Canada, and Japan).

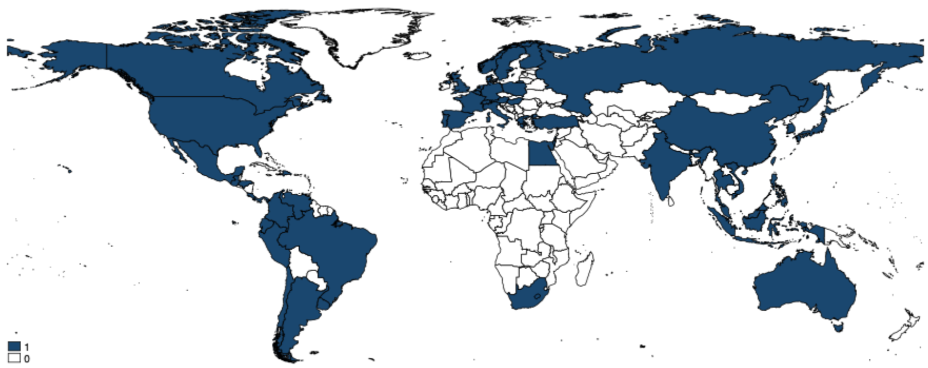
Figure 2

Comparing the Networks of two Affiliates with a Dutch Parent

Affiliate A



Affiliate B



The figure illustrates (in blue) the countries in which the Direct Parent of Belgian affiliates A and B have a presence.

We also construct the multinational network of the GUO of each foreign affiliate, using the subsidiary files in Historical Orbis to find the GUO of the DP of each Belgian affiliate. This is given by the BvD identifier of the firm that owns at least 25% of the DP. We collect this information for the GUOs of all Belgian firms acquired from 2007. For acquisitions made before 2007, we are restricted to finding the GUO of the DP in 2007, the earliest year of the subsidiary HO files.[18]

To collect the multinational network of each GUO, we look for the BvD identifier in the HO files where the shareholder is the main unit of observation and that contain information on each subsidiary owned by a given shareholder. Of the 137 GUO BvD identifiers linked to new Belgian affiliates, we find subsidiary relationships for 125 of them in the shareholder HO files. We can map out the countries where each of the GUOs has a network presence using the BvD identifier of each subsidiary.

[18]For 24 of the 188 DPs of new Belgian affiliates, the DP and the GUO coincide.

Section A-1.2 of the Appendix reports descriptive statistics of the Belgian affiliates DPs' and GUOs' multinational networks. Table A-4 provides descriptive statistics about the size of multinational networks. Direct parents have a presence in 10 countries on average, and the largest multinational network includes 75 countries. The GUO's network is larger by construction (it includes an average of 24 and a maximum of 103 countries). Figure A-3 shows that most Belgian affiliates' GUOs are headquartered in countries geographically close to Belgium or in the United States.

3 MNC Ownership and Overall Trade Participation

In this section, we provide systematic evidence that firms switching from domestic to foreign ownership increase trade participation along different margins. Our results confirm what previous studies have found in other contexts (e.g., Arnold and Javorcik, 2009; Guadalupe *et al.*, 2012; Bloningen *et al.*, 2014; Bircan, 2019). While the existing literature focuses on firm-level mechanisms behind the effects of MNC ownership (e.g., increases in productivity, alleviation of financial frictions), in the following sections we will highlight a novel explanation: after the acquisition, multinational affiliates face lower trade frictions in and around the network of countries in which their parent has a presence.

3.1 Empirical Strategy

We start by estimating the following equation on the broad sample of domestic firms and new foreign affiliates:

$$y_{it} = \theta MNC_{it} + \delta_i + \delta_t + u_{it}. \tag{1}$$

y_{it} is the trade outcome of interest for firm i at time t, and MNC_{it} is an indicator variable equal to 1 after firm i is acquired by a foreign multinational. The variables δ_i and δ_t are firm and year fixed effects, respectively. Under the (parallel trend) assumption that never- and not-yet-acquired firms are a credible counterfactual for those acquired, conditional on the fixed effects, the coefficient θ measures how MNC ownership changes affiliates' trade participation.

As discussed in the previous section, firms acquired by MNCs are systematically different from non-acquired firms, so the parallel trends assumption is likely to be violated.[19] In the absence of experimental variation in Belgian firms' ownership, we rely upon re-weighting methods to create a group of credible counterfactual domestic firms for those that are ac-

[19]In Section A-2.1 of the Appendix, we confirm the presence of pre-trends by estimating a dynamic version of equation (1) that includes lags and leads of the MNC_{it} indicator.

quired.

We employ Hainmueller (2012)'s entropy balance re-weighting algorithm for this purpose. The key advantage of this method is that, unlike more standard algorithms such as nearest-neighbor and propensity score matching, it guarantees that the treatment and control groups are similar not only in terms of average characteristics but also in higher moments of the distribution of their covariates. This further mitigates the concern that the post-acquisition changes in acquired firms' trade participation are due to pre-existing differential trends at the firm-level.[20]

For each year, we consider firms acquired in that year as treated and never-acquired firms as control units. We pool treated and control units across all years and assign a weight to each firm based on a wealth of observed characteristics: fixed assets, number of employees (full-time equivalents), total sales, number of export and import countries, export and import values, in levels and also in growth rates, and characteristics countries with which they trade (i.e., distance from Belgium, GDP per capita in PPP, longitude, and latitude). All the variables refer to the year before the acquisition.

Entropy balance re-weighting allows us to create a group of treated firms that is indistinguishable from the group of untreated firms in terms of the different moments of the distribution of all variables after applying the re-weighting procedure (see Table A-5).[21] After re-weighting, the two groups are also similar in terms of the first three moments of the distribution of other characteristics that we do not target to create the weights (the number of exported and imported products, and other trade-related variables at the bilateral level), which further appeases the concern that our procedure may fail to account for unobserved heterogeneity (see Table A-6).

3.2 Results

Table 1 shows the results of estimating equation (1) after entropy balance re-weighting. The coefficient on MNC_{it} is positive and significant at the 1% level across all specifications,

[20]See Egger and Tarlea (2020) for an example of the same re-weighting strategy.

[21]The initial sample includes 22,357 single firms. Due to missing values in some characteristics 5,391 of them (24%) receive a positive weight. Among these are the 115 acquired firms. We assign a weight equal to 1 to each of them. All the other domestic firms get a weight between 0 and 1, and Hainmueller (2012)'s algorithm constrains their sum to be equal to 1. The average weight among firms in the latter group is 0.017, and the standard deviation is 0.077.

indicating that MNC ownership increases new affiliates' trade participation.

Table 1
MNC Ownership and Trade Participation
(Entropy Balance Re-Weighting)

	(1)	(2)	(3)
	Exporter Dummy	Export Values	Export Countries
MNC_{it}	0.046***	0.788***	0.108**
	(0.013)	(0.266)	(0.045)
	(4)	(5)	(6)
	Importer Dummy	Import Values	Import Countries
MNC_{it}	0.038***	0.819***	0.122***
	(0.010)	(0.229)	(0.033)
Firm FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Estimator	OLS	OLS	OLS
Re-weighting	Yes	Yes	Yes
Observations	93,171	93,171	93,171

The table reports the results of estimating equation (1). We compute the entropy balance weights as a function of all the observables in Table A-5. Heteroscedasticity robust standard errors in parenthesis. In columns 2 and 3 and 5 and 6, the dependent variable is the dependent variable is $\log(1 + y_{it})$. Significance levels: *** 0.01, ** 0.05, * 0.1.

In terms of magnitude, the estimates imply that MNC ownership increases the probability of exporting (importing) by 4.6 (3.8) percentage points, increases the average value of exports and imports by 79% (82%), and increases the number of export (import) countries by 10% (12%).[22]

It is interesting to compare the results of Table 1 with the corresponding results in Table A-8, in which we estimate equation (1) without re-weighting the sample. The coefficients are more than twice as large than in Table 1, emphasizing the importance of accounting for selection effects: for example, re-weighting decreases the coefficient of the exporter dummy decreases from 0.127 to 0.046; for the number of export countries (export values), the coefficient decreases from 2.259 to 0.788 (from 0.263 to 0.108).

We also expect multinational ownership to change other firm-level outcomes beyond trade participation. For example, firms that increase exports to foreign markets may increase their overall size (in terms of sales and employment) and become more productive. We employ again the entropy balance re-weighting algorithm to study the effects of MNC ownership

[22] Table A-9 in the Appendix shows that the results are robust to using the more traditional propensity score re-weighting algorithm in Guadalupe *et al.* (2012). Table A-7 reproduces Table A-5 using the propensity score re-weighting algorithm used in Guadalupe *et al.* (2012). As expected, that algorithm accurately matches groups in terms of their average characteristics but not in terms of higher moments of their distribution.

on other firm-level outcomes. The results reported in Table 2 indicate that new affiliates become larger, in terms of both employment and sales, and also increase value added and productivity. Table A-10 reports the corresponding results without re-weight the sample. As expected, the coefficients are larger without re-weighting, again emphasizing the importance of accounting for selection effects.

Table 2
MNC Ownership and Other Firm-Level Outcomes
(Entropy Balance Re-Weighting)

	(1)	(2)	(3)	(4)
	Employment	Sales	Value Added	Productivity
MNC_{it}	0.198***	0.323***	0.199***	0.168***
	(0.037)	(0.059)	(0.041)	(0.047)
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Estimator	OLS	OLS	OLS	OLS
Re-weighting	Yes	Yes	Yes	Yes
Observations	71,979	75,645	73,964	71,347

The table reports the results of estimating (1). The dependent variable is the log of $Employment_{f,t}$, $Sales_{f,t}$, $Value\ Added_{f,t}$, and $Productivity_{f,t}$. We compute the entropy balance weights as a function of all the observables in Table A-5. Heteroscedasticity robust standard errors in parenthesis. Significance levels: *** 0.01, ** 0.05, * 0.1.

4 A Model of Multinational Ownership and Trade

The previous section shows that MNC ownership increases new affiliates' overall trade participation. This section develops a theoretical model that allows us to identify a novel network mechanism that can drive these results: MNC ownership alleviates trade frictions in countries that belong to the parental network. For example, in countries in which the parent already operates, new affiliates may face lower country-specific fixed costs associated with learning about local market conditions. Crucially, the model allows us to tease apart the network-specific mechanism from affiliate-level mechanisms highlighted in the existing literature, such as productivity increases due to technological or managerial transfers from the parent to the acquired affiliate firm.

4.1 Set Up

The global economy consists of a finite set of countries, denoted by c, each populated by a continuous measure of firms, denoted by i. There is an infinite sequence of periods, denoted by t. Every period, firms make two decisions. First, they choose domestic and foreign inputs to minimize production costs. Second, conditional on their input choice, they decide where to sell final goods to maximize profits.[23] Both sourcing foreign inputs and serving foreign countries entails country-specific fixed costs.[24] We solve the model by backward induction.

4.2 Environment

Demand

Demand in country c at time t is given by a constant-elasticity-of-substitution (CES) aggregator:

$$Q_{ct} = \left[\sum_{i \in N_{ct}} \left(\zeta_{ict} q_{ict} \right)^{\frac{\eta-1}{\eta}} \right]^{\frac{\eta}{\eta-1}}, \quad \eta > 1. \tag{2}$$

q_{ict} denotes the quantity sold by firm i to country c at time t, and ζ_{ict} is a firm-country-year specific demand shifter. This variable captures the quality of the firms' products and their attractiveness to buyers. N_{ct} is the set of firms exporting to c at time t, and η is the elasticity of substitution between products. P_{ct} is the price index associated with equation (2).

Production Technology

Firms produce output q_{it} with CES technology:

$$q_{it} = z_{it} \left[\left(\xi_{iLt} L_{it} \right)^{\frac{\sigma-1}{\sigma}} + \sum_{c \in S_{it}} \left(\xi_{ict} x_{ict} \right)^{\frac{\sigma-1}{\sigma}} \right]^{\frac{\sigma}{\sigma-1}}, \quad \sigma > 1. \tag{3}$$

L_{it} is firm i's domestic labor at time t and x_{ict} denotes firm i's material inputs from country c (including the home country) at time t. S_{it} is the set of countries firm i sources material inputs from at time t. We denote by σ the elasticity of substitution between inputs of production. z_{it} is firm i's Hicks-neutral productivity at time t, whereas ξ_{iLt} and ξ_{ict} are firm-level

[23] We assume that individual firms solve these problems even when they belong to a multinational group. However, as we clarify below, we let multinational-owned firms take into account group-level complementarities when making their export and import decisions.

[24] In the model, we do not distinguish between sunk and per-period fixed costs. We provide empirical evidence that input and export fixed costs are at least partially sunk in Section 5.3.

labor and source-country specific shifters at time t, respectively. These variables capture, for example, factor-biased productivity, input quality, and home-bias in input demand. The cost function associated with equation (3) is given by:

$$c_{it}\left(S_{it}\right) = \frac{B_{it}\left(S_{it}\right)}{z_{it}}, \qquad B_{it}\left(S_{it}\right) = \left[\left(w_t/\xi_{iLt}\right)^{1-\sigma} + \sum_{c \in S_{it}} \left(b_{ict}/\xi_{ict}\right)^{1-\sigma}\right]^{\frac{1}{1-\sigma}}. \tag{4}$$

w_t is labor wage in the home country, and b_{ict} is the price of material inputs. Trade involves iceberg trade costs $\tau_{ict} \geq 1$, so that marginal cost of selling to country c at time t is $c_{ict} = \tau_{ict} c_{it}\left(S_{it}\right)$.

Input Choice

Firms are price takers in all input markets. Each period, firm i chooses labor (L_{it}), a set of source countries (S_{it}), and a vector of material inputs ($\mathbf{x_{ict}}$), to minimize production costs:

$$\min_{L_{it}, S_{it}, \mathbf{x_{ict}}} w_t L_{it} + \sum_{c \in S_{it}} (b_{ict} x_{ict} + w_{ct} F^m_{ict}). \tag{5}$$

w_{ct} is labor wage in source country c at time t and F^m_{ict} denotes the fixed cost faced by firm i when sourcing from country c at time t. Sourcing fixed costs are paid in terms of foreign labor. We assume that there are no fixed costs when sourcing inputs domestically.

Profit Maximization

Firms are monopolistically competitive. Each period, they choose a set of export destinations (C_{it}) and a vector of prices ($\mathbf{p_{ict}}$) to maximize profits, separable by destination:

$$\pi_{it} = \max_{C_{it}, \mathbf{p_{ict}}} \sum_{c \in C_{it}} \left[\underbrace{\left(p_{ict} - c_{ict}\right) q_{ict}}_{\equiv \pi_{ict}} - w_t F^x_{ict}\right]. \tag{6}$$

p_{ict} is the price set by firm i in country c at time t. π_{ict} and F^x_{ict} denote gross profits and fixed costs faced by firm i when selling to country c at time t, respectively. We assume that there are no fixed costs associated with domestic sales and normalize domestic wages w_t to one.

4.3 Equilibrium

The model delivers equilibrium expressions for the extensive and intensive margins of firms' export and sourcing choices, which we characterize below.

Export Probability

Equation (2) implies that firm i faces demand from country c at time t equal to $q_{ict} = E_{ct} P_{ct}^{\eta-1} p_{ict}^{-\eta} \zeta_{ict}^{\eta-1}$. Profit maximization from equation (6) delivers an optimal price schedule $p_{ict} = \bar{\eta} \tau_{ict} c_{it}(S_{it})$, where $\bar{\eta} = \eta/(\eta-1)$. Therefore, variable export profits are $\pi_{ict} = (\bar{\eta}-1)\,\bar{\eta}^{-\eta} E_{ct} P_{ct}^{\eta-1} \left(\tau_{ict} c_{it}(S_{it})\right)^{1-\eta} \zeta_{ict}^{\eta-1}$. Firm i exports to country c at time t if and only if variable profits exceed fixed costs of exporting, i.e., $\pi_{ict} \geq F_{ict}^{x}$. We can express the probability that this inequality holds as:

$$\Pr\left(\underbrace{\log(\bar{\eta}-1)\bar{\eta}^{-\eta}}_{k^x} + \underbrace{\log E_{ct} P_{ct}^{\eta-1}}_{\varphi_{ct}^{x}} + \underbrace{(1-\eta)\log c_{it}(S_{it})}_{\varphi_{it}^{x}} + \underbrace{(\eta-1)\left(\log \zeta_{ict} - \log \tau_{ict}\right)}_{\varphi_{ict}^{x}} \geq \underbrace{\log F_{ict}^{x}}_{f_{ict}^{x}}\right). \tag{7}$$

Equation (7) states that the probability that firm i exports to country c at time t depends on a constant term (k^x), a country-time specific component common to all firms (φ_{ct}^{x}), a firm-year component common across destinations (φ_{it}^{x}), a firm-country-year component reflecting firms' demand shifters relative to variable costs (φ_{ict}^{x}), and a firm-country-year component capturing the fixed cost that firm i faces when selling to country c at time t (f_{ict}^{x}). Because there are no fixed costs associated with domestic sales, all firms serve the home country.

Export Values

Conditional on exporting to a country, the value of exports of firm i to country c at time t is $r_{ict} \equiv p_{ict} q_{ict} = E_{ct} P_{ct}^{\eta-1} \zeta_{ict}^{\eta-1} \left(\bar{\eta} \tau_{ict} c_{it}(S_{it})\right)^{1-\eta}$. Taking logs delivers the following equation for the intensive margin of exports:

$$\log r_{ict} = \underbrace{(1-\eta)\log\bar{\eta}}_{\tilde{k}^x} + \underbrace{\log E_{ct} P_{ct}^{\eta-1}}_{\tilde{\varphi}_{ct}^{x}} + \underbrace{(1-\eta)\log c_{it}(S_{it})}_{\tilde{\varphi}_{it}^{x}} + \underbrace{(\eta-1)\left(\log \zeta_{ict} - \log \tau_{ict}\right)}_{\tilde{\varphi}_{ict}^{x}}. \tag{8}$$

Similarly to equation (7), equation (8) states that the log of the value of exports of firm i to country c at time t depends on a constant term ($\tilde{k}^x$), a country-time specific component common to all firms ($\tilde{\varphi}_{ct}^{x}$), a firm-year component common across destinations ($\tilde{\varphi}_{it}^{x}$), and a firm-country-year component reflecting firms' demand shifters relative to variable costs ($\tilde{\varphi}_{ict}^{x}$).

Differently from equation (7), fixed costs do not enter the intensive margin of exports.

Import Probability

Unlike export choices, sourcing decisions are not separately additive across origins in equation (3), so the set S_{it} cannot be characterized in closed form (Antràs *et al.*, 2017; Blaum *et al.*, 2018). However, cost minimization requires that firm i imports from country c at time t if an only if the cost of sourcing from a set of countries that includes c is not greater than the cost of sourcing from a set of countries that excludes it, i.e., $z_{it}^{-1}\left(B_{it}(S_{it}\backslash\{c\}) - B_{it}(S_{it})\right) \geq w_{ct}F_{ict}^{m}$. We can express the probability that this inequality holds as:

$$\Pr\left(-\underbrace{\log w_{ct}}_{\varphi_{ct}^{m}} - \underbrace{\log z_{it}}_{\varphi_{it}^{m}} + \underbrace{\log\left(B_{it}(S_{it}\backslash\{c\}) - B_{it}(S_{it})\right)}_{\varphi_{ict}^{m}} \geq \underbrace{\log F_{ict}^{m}}_{f_{ict}^{m}}\right). \tag{9}$$

Equation (9) states that the probability that firm i imports from country c at time t depends on a country-time specific component common to all firms (φ_{ct}^{m}), a firm-year component common across origins (φ_{it}^{m}),[25] and two firm-country-year components. The first reflects a firm's reduction in marginal costs when adding country c to its optimal sourcing set (φ_{ict}^{m}), whereas the second captures the fixed cost faced by firm i when sourcing from country c at time t (f_{ict}^{m}). Because there are no fixed costs when sourcing domestically, all firms source material inputs from the home country.

Import Values

Conditional on sourcing from a country, applying Shephard's lemma to the cost function in equation (4) delivers material input demand equal to $m_{ict} \equiv b_{ict}x_{ict} = M_{it}B_{it}^{\sigma-1}\xi_{ict}^{\sigma-1}b_{ict}^{1-\sigma}$, where M_{it} is firm i's total material input expenditure at time t.[26] Taking logs delivers the following equation for the intensive margin of imports:

$$\log m_{ict} = \underbrace{\log M_{it} + (\sigma-1)\log B_{it}}_{\tilde{\varphi}_{it}^{m}} + \underbrace{(\sigma-1)(\log \xi_{ict} - \log b_{ict})}_{\tilde{\varphi}_{ict}^{m}}. \tag{10}$$

Similarly to equation (9), equation (10) states that the log of the value of imports of firm i from country c at time t depends on a firm-year component common across origins ($\tilde{\varphi}_{it}^{m}$) and a firm-country-year component reflecting firms' country-specific input shifters relative

[25] Since we solve the sourcing problem for a given level of output, an increase in z_{it} reduces the probability of importing material inputs from abroad in equation (9). This differs from Antràs *et al.* (2017), who let production quantity directly depend on the set of sourcing origins.

[26] Similarly, optimal labor is $w_tL_{it} = M_{it}B_{it}^{\sigma-1}\xi_{iLt}^{\sigma-1}w_t^{1-\sigma}$.

to variable costs ($\tilde{\varphi}^m_{ict}$). As in equation (8), fixed costs do not enter the intensive margin of imports.

4.4 The Role of MNC Ownership

We introduce multinational ownership in the model by allowing values of the following firm-country-year variables to potentially differ when firm i is owned by an MNC in t:

$$\{\zeta_{ict}, z_{it}, \xi_{iLt}, \xi_{ict}, \tau_{ict}, b_{ict}, F^m_{ict}, F^x_{ict}, S_{it}, C_{it}\}. \tag{11}$$

We do not model MNC acquisitions explicitly and, instead, address selection into MNC ownership empirically in Section 5.2. From now on, we use the subscript $i(p)$ to indicate variables pertaining to firm i when owned by parent p. Consistently with our data, we also introduce two indicator variables. The first is $MNC_{i(p)t}$, which is equal to 1 if firm i is owned by parent p at time t and 0 otherwise. The second is *In* MNC_{cp}, which is equal to 1 if parent p has at least one affiliate in country c and 0 otherwise.

Firm-level MNC Ownership Effects

We let MNC ownership affect firm-year variables in equations (7) and (9) as:

$$\varphi^j_{i(p)t} = \overline{\psi}^j_{i(p)t} + h_j(MNC_{i(p)t}) + \epsilon^j_{i(p)t} \quad \text{for } j \in \{x, m\}. \tag{12}$$

In words, firm-year variables governing the extensive margin of export and import choices depend on an average component ($\overline{\psi}^j_{i(p)t}$), an error term ($\epsilon^j_{i(p)t}$), and a function of MNC ownership status, which we denote by $h_j(MNC_{i(p)t})$. We adopt an analogous definition for $\tilde{\varphi}^x_{i(p)t}$ and $\tilde{\varphi}^m_{i(p)t}$ when considering the intensive margins of exports and imports in equations (8) and (10), respectively.

Equation (12) allows MNC ownership to flexibly affect several characteristics of affiliates, including their productivity, product quality, and appeal to buyers. Therefore, it encompasses the traditional firm-level effects of MNC ownership highlighted by the existing literature.

MNC Network Effects

In contrast to the existing literature, we also let MNC ownership affect firm-country-year variables, where country c is either a potential source of inputs or a potential export destination, as:

$$\varphi^j_{i(p)ct} - f^j_{ict} = \psi^j_{ct} + \psi^j_{i(p)t} + \psi^j_{i(p)c} + g_j(MNC_{i(p)t}, In\ MNC_{cp}) + \epsilon^j_{i(p)ct} \text{ for } j \in \{x, m\}, \quad (13)$$

$$\tilde{\varphi}^j_{i(p)ct} = \tilde{\psi}^j_{ct} + \tilde{\psi}^j_{i(p)t} + \tilde{\psi}^j_{i(p)c} + \tilde{g}_j(MNC_{i(p)t}, In\ MNC_{cp}) + \tilde{\epsilon}^j_{i(p)ct} \text{ for } j \in \{x, m\}. \quad (14)$$

In words, firm-country-year variables governing the extensive margin of export and import choices in equation (13) depend on an average term, which we decompose into all its possible bilateral determinants (ψ^j_{ct}, $\psi^j_{i(p)t}$, and $\psi^j_{i(p)c}$), an error term ($\epsilon^j_{i(p)ct}$), and a function of MNC ownership and the global presence of MNC parents, which we denote by $g_j(MNC_{i(p)t}, In\ MNC_{cp})$. A similar definition applies to the firm-country-year components governing the intensive margin of export and import choices in equation (14).

The terms $g_j(MNC_{i(p)t}, In\ MNC_{cp})$ and $\tilde{g}_j(MNC_{i(p)t}, In\ MNC_{cp})$ are the main focus of our paper. They capture the idea that MNC ownership can potentially affect affiliates' variable and entry trade costs, product quality, and appeal in different ways across countries depending on the global footprint of their parents. All else equal, if $g_j(\cdot)$ and $\tilde{g}_j(\cdot)$ are increasing in their arguments, MNC ownership boosts trade at the intensive and extensive margin in countries belonging to the parental network.

4.5 Estimation

Equations (7) to (10), together with equations (12), (13), and (14), flexibly describe how belonging to an MNC network may affect affiliates' export and import choices at the extensive and intensive margins. To bring these equations to our data, we need to impose further parametric assumptions on $g_j(\cdot)$ and $\tilde{g}_j(\cdot)$. In particular, we let:

$$g_j(\cdot) = \beta^j_1 MNC_{i(p)t} + \beta^j_2 In\ MNC_{cp} + \beta^j_3(MNC_{i(p)t} \times In\ MNC_{cp}) \quad \text{for } j \in \{x, m\}, \quad (15)$$

$$\tilde{g}_j(\cdot) = \tilde{\beta}^j_1 MNC_{i(p)t} + \tilde{\beta}^j_2 In\ MNC_{cp} + \tilde{\beta}^j_3(MNC_{i(p)t} \times In\ MNC_{cp}) \quad \text{for } j \in \{x, m\}. \quad (16)$$

Combining the equations above delivers estimating equations for each of the four margins of trade we consider. The estimating equation for the extensive margin of exports is:

$$\Pr(i \text{ exports to } c \text{ in } t) = \beta^x_3(MNC_{i(p)t} \times In\ MNC_{cp}) + k^x + \lambda^x_{ct} + \lambda^x_{it} + \lambda^x_{ic} + \varepsilon^x_{i(p)ct}. \quad (17)$$

The estimating equation for the intensive margin of exports is:

$$\log r_{i(p)ct} = \tilde{\beta}^x_3(MNC_{i(p)t} \times In\ MNC_{cp}) + \tilde{k}^x + \tilde{\lambda}^x_{ct} + \tilde{\lambda}^x_{it} + \tilde{\lambda}^x_{ic} + \tilde{\varepsilon}^x_{i(p)ct}. \quad (18)$$

The estimating equation for the extensive margin of imports reads:

$$\Pr(i \text{ imports from } c \text{ in } t) = \beta_3^m (MNC_{i(p)t} \times \mathit{In}\ MNC_{cp}) + \lambda_{ct}^m + \lambda_{it}^m + \lambda_{ic}^m + \varepsilon_{i(p)ct}^m. \quad (19)$$

Finally, the estimating equation for the intensive margin of imports is:

$$\log m_{i(p)ct} = \tilde{\beta}_3^m (MNC_{i(p)t} \times \mathit{In}\ MNC_{cp}) + \tilde{\lambda}_{ct}^m + \tilde{\lambda}_{it}^m + \tilde{\lambda}_{ic}^m + \tilde{\varepsilon}_{i(p)ct}^m. \quad (20)$$

We approximate the probability functions in equations (17) and (19) using a linear probability model.[27] In Section B-1 of the Theoretical Appendix, we show how to derive our estimating equations and provide a structural interpretation of the featured fixed effects.

4.6 Interpretation and Identification

When considering the extensive margin of trade in equations (17) and (19), we assume that firms can potentially trade with all the countries in our dataset in every year. The estimation sample is thus a balanced panel at the firm-country-year level. We restrict our attention to actual trade flows when looking at the intensive margin of exports and imports in equations (18) and (20). In both cases, the control group includes not-yet-acquired firms and already-acquired firms trading with a country $k \neq c$ in year t. Identification hinges on the assumption that firm i would have not increased trade participation with country c in the MNC network relative to the control group in the absence of the acquisition.

Our identification strategy requires parallel trends after netting out all the possible pairwise fixed effects admitted by our three-dimensional panel. Crucially, the inclusion of firm-year fixed effects allows us to control for the standard mechanisms through which MNC ownership can increase trade participation, e.g., productivity growth or a reduction in financial constraints. The inclusion of country-year fixed effects accounts for factors that may lead all firms to change their trade patterns with a particular country over time, e.g., the entry into force of a trade agreement between the EU and that country. Finally, including firm-country fixed effects accounts for any reasons firms have systematic differences in trade activities with some countries, e.g., distance or common language.

Acquisitions must create value for the multinational, e.g., due to increased trade participation in countries belonging to the MNC network or synergies across affiliates. Our identification strategy can accommodate different motives for FDI (horizontal, vertical, or export-platform) and is consistent with changes in trade participation occurring both within

[27] In robustness checks, we show that the estimation results are robust to using a logit model with high-dimensional fixed effects.

and outside the multinational boundaries. The key identification assumption is that, conditional on the three-way fixed effects, firm i would have not increased its trade with countries belonging to p's network if it had not been acquired.

Bilateral selection effects are the main threat to our identification strategy. Our baseline estimates would be upwards-biased if parent p acquired firm i because it expected that, irrespective of the acquisition, it would start trading with (or increase its trade with) some specific countries, including those belonging to p's network. In Section 5.2, we exploit plausibly exogenous changes in the multinational network of Belgian affiliates to address this concern.

5 Network Effects of Multinational Ownership

Anecdotal evidence in our data suggests that network effects may help explain why trade participation increases after MNC acquisition. For example, a Belgian firm in our sample was acquired in 1999 by a direct parent located in Japan. Before 2000, this firm was not exporting at all. From 2000, it started exporting not only to Japan, but also to other countries in which its parent had affiliates, including the United States. In what follows, we establish that this pattern is systematic on both the export and import side: acquired firms are more likely to start trading with countries that belong to their parents' network or are exogenously added to it. We also provide systematic evidence that these network effects extend beyond the boundaries of the multinational.

5.1 Countries Belonging to the Parental Network

Guided by the model in Section 4, we identify the network effects of multinational ownership by estimating firm-level gravity regressions on the set of new affiliates, i.e., Belgian firms that switched from domestic to foreign ownership during our sample period.

Extensive Margin

To examine the effects on the extensive margin of trade, we bring equations (17) and (19) to the data and estimate:

$$Entry^j_{i(p)ct} = \beta_j(MNC_{i(p)t} \times In\ MNC_{cp}) + \lambda^j_{it} + \lambda^j_{ic} + \lambda^j_{ct} + \varepsilon^j_{i(p)ct}, \quad j \in \{x, m\}. \tag{21}$$

$Entry^j_{i(p)ct}$ is a dummy variable equal to 1 from the first year t in which firm i (owned by parent p) exports to, or imports from, country c. Recall from the previous section that

$MNC_{i(p)t}$ is a dummy variable equal to 1 after firm i is acquired by p, while $In\ MNC_{cp}$ is a dummy variable equal to 1 if country c belongs to the set of countries in which the multinational parent has at least one affiliate firm. Fixed effects capture other mechanisms relating MNC affiliation and trade. Our model implies that the β_j coefficient in equation (21) should be positive and significant, if multinational ownership has network effects on the probability that affiliates enter new markets.

Table 3

Network Effects of MNC Ownership

	(1) Export Entry	(2) Import Entry
$MNC_{i(p)t} \times In\ MNC_{cp}$	0.029***	0.016***
	(0.007)	(0.006)
Firm-Country FE	Yes	Yes
Firm-Year FE	Yes	Yes
Country-Year FE	Yes	Yes
Observations	236,256	236,256
Estimator	OLS	OLS

The table reports the results of estimating equation (21). In column 1, the dependent variable is $Export\ Entry_{i(p)ct}$, a dummy variable equal to 1 from the first year t in which firm i (owned by parent p) exports to country c. In column 2, the dependent variable is $Import\ Entry_{i(p)ct}$, a dummy variable equal to 1 from the first year t in which firm i (owned by parent p) imports from country c. $MNC_{i(p)t}$ is a dummy variable equal to 1 after firm i is acquired by p. $In\ MNC_{cp}$ is a dummy variable equal to 1 if country c belongs to the set of countries in which the multinational parent has a presence. Heteroscedasticity robust standard errors in parenthesis. Significance levels: *** 0.01, ** 0.05, * 0.1.

Table 3 reports the results for export entry (column 1) and import entry (column 2). The coefficient of the interaction term $MNC_{i(p)t} \times In\ MNC_{cp}$ is positive and significant at the 1% level in both columns, providing evidence of MNC network effects on the extensive margin of trade: after being acquired, firm i is more likely to start exporting to and importing from, countries that belong to its parent p's network. In terms of magnitude, the coefficient in column 1 (2) indicates that the probability of export (import) entry increases by 2.9 (1.6) percentage points. This corresponds to a 17% (16%) increase in the unconditional probability of export (import) entry, which is equal to 17% (9%).

We have carried out a series of additional estimations to verify the robustness of the results in Table 3. First, instead of focusing on the network of the direct parent (DP) of each Belgian affiliate, we consider the network of its global ultimate owner (GUO). The results reported in Table A-11 show that our main results continue to hold when using this larger network. Second, we have employed an alternative estimator. Table A-12 shows that the results of Table 3 are robust to using a logit model instead of a linear probability model. Finally, Table A-13 shows that the results continue to hold if we exclude countries classified as tax havens by Dharmapala and Hines (2009).

Intensive Margin

We bring equations (18) and (20) to the data to examine whether multinational ownership affects the intensive margin of trade. We focus on the set of countries each affiliate i was already trading with before being acquired.[28] We use as the dependent variable log $Export\ Value_{i(p)ct}$ (or log $Import\ Value_{i(p)ct}$), the value of firm i's exports to (or imports from) country c. The results reported in Table A-14 show that new affiliates do not significantly increase their export and import values in countries they were already trading with before being acquired by the multinational, in that the interaction between the dummy variables $MNC_{i(p)t}$ and $\times In\ MNC_{cp}$ is never significant. In the rest of our analysis, we thus focus on the extensive margin of trade.

5.2 Exogenous Network Changes

As discussed in Section 4.6, bilateral selection effects are the main threat to our identification strategy. The estimates in Table 3 would be upwards-biased if firm i were acquired because the parent knew that it would have started trading with (or increased its trade) with countries belonging to the MNC network, independent of the acquisition.

To address this concern, we follow an identification strategy similar to Atalay *et al.* (2019), exploiting plausibly exogenous changes in the multinational network of Belgian affiliates. As in the previous section, we consider the set of firms that were acquired by a foreign multinational during our sample period and always had the same direct parent (DP). Using information from Orbis M&A, we identify the subset of these firms that changed global ultimate owner (GUO) during the period and exploit these ownership changes to identify network effects.[29]

In line with Atalay *et al.* (2019), we focus on affiliates that are peripheral to their GUOs' main line of business. That is, we exclude cases in which the sector code of the

[28] A country c is classified as "old" for firm i if this was exporting to or importing from c in at least one of the five years before being acquired. This definition does not suffer from left censoring: the NBB trade dataset starts in 1993; even for firms acquired in 1998, we can thus observe exports and imports in the previous five years (see also Conconi *et al.*, 2016).

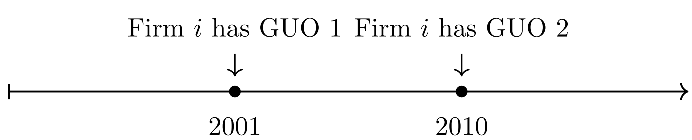
[29] We focus on ownership changes occurring between between 2007, which is the earliest year in which network data is available from Historical Orbis, and 2011, so that we can observe affiliates' trade patterns for at least three years after the change in GUO).

GUOs, whenever available, is the same as the sector of the Belgian affiliate. To further strengthen identification, we focus on cases in which neither of the GUOs is also the affiliate's direct parent. The M&A activities we consider involve large companies, with many affiliates dispersed globally. The key assumption is that these activities are not driven by the trade patterns of one peripheral affiliate that these companies only indirectly control.

Figure 3 provides an illustrative example of a firm i that changed GUO. This firm became foreign owned in 2001, when it was acquired by DP_i, which remained its direct parent until the end of the sample. DP_i was originally controlled by a Swedish company (GUO 1), but in 2010 it was acquired by another Swedish company (GUO 2). As a result of this ownership change, several countries were added to firm i GUO's network (e.g., the United States, China, South Korea, India, Vietnam, Colombia). As mentioned above, the key identifying assumption is that the changes in GUO are not driven by the trading patterns of Belgian affiliates. In the example of Figure 3, the assumption is that GUO 2 (which had 1,039 subsidiaries in 2010) did not acquire GUO 1 (which had 42 subsidiaries, including i's DP) to trade with particular countries through Belgian firm i.

Figure 3

An Example



To identify switches in GUO, we define the following ownership variables: $\textit{Old MNC}_{i,t}$ is dummy variable equal to 1 in the years in which firm i has GUO 1; $\textit{New MNC}_{i,t}$ is a dummy equal to 1 in the years in which firm i has GUO 2.

Since Orbis M&A starts in 2007, we construct GUO 1's network in the year in which it acquired firm i or in 2007, whichever is later. To identify countries belonging to this network, we define the dummy variable $\textit{In Old MNC}_{ic}$, which equals 1 if GUO 1 has subsidiaries in c. The network of GUO 2 is constructed using information from the year in which this became i's GUO. To identify countries belonging to this network, we define the dummy variable $\textit{In New MNC}_{ic}$, which equals 1 if GUO 2 has subsidiaries in c.

By comparing the networks of the two GUOs, we construct the following dummy variables: $\textit{Only in Old MNC}_{ic}$, which is equal to 1 if country c belongs to GUO 1's network but does not belong to GUO 2's network; and $\textit{Only in New MNC}_{ic}$, which is equal to 1 if country c belongs to GUO 2's network but does not belong to GUO 1's network.

To identify network effects driven by exogenous network changes, we focus on the set of countries that do not belong the original GUO's network and estimate:

$$Entry^j_{i(p)ct} = \beta_j(New\ MNC_{it} \times Only\ In\ New\ MNC_{ic}) + \lambda^j_{it} + \lambda^j_{ic} + \lambda^j_{ct} + \varepsilon^j_{i(p)ct}, \quad j \in \{x, m\}. \tag{22}$$

The dependent variable is defined as in equation (21). The coefficient β_j thus captures the probability that firm i starts trading with countries that are added to its network after changing GUO, relative to countries that belong to neither the old or the new network.

Table 4

Network Effects of MNC Ownership (Exogenous Network Changes)

	(1) Export Entry	(2) Import Entry
$New\ MNC_{it} \times Only\ In\ New\ MNC_{ic}$	0.020**	0.069***
	(0.008)	(0.009)
Firm-Country FE	Yes	Yes
Firm-Year FE	Yes	Yes
Country-Year FE	Yes	Yes
Observations	48,550	48,550
Estimator	OLS	OLS

The table reports the results of estimating equation (22). In column 1, the dependent variable is $Export\ Entry_{ict}$, a dummy variable equal to 1 from the first year t in which firm i exports to country c. In column 2, the dependent variable is $Import\ Entry_{ict}$, a dummy variable equal to 1 from the first year t in which firm i imports from country c. $New\ MNC_{i,t}$ is a dummy variable equal to 1 in the years in which firm i has GUO 2. $Only\ In\ New\ MNC_{ic}$ is a dummy variable equal to 1 if country c belongs to GUO 2's network of GUO2 but does not belong to the network of GUO 1. We focus on cases in which the sector of GUO 1 and GUO 2 are different from those of the Belgian affiliate and neither GUO has direct control over it. Heteroscedasticity robust standard errors in parenthesis. Significance levels: *** 0.01, ** 0.05, * 0.1.

Table 4 reports the results of estimating equation (22). The coefficient of interest is positive and significant at the 1% level for both export and import entry. Thus, when its DP has a new GUO, Belgian affiliates are more likely to start trading with countries that have been added to their network (e.g., the United States, China, South Korea, India, Vietnam, and Colombia in the example of Figure 3). The estimates indicate that the probability that an affiliate starts exporting to (importing from) a country in its new parental network increases by 2.4 (6.1) percentage points.[30]

The findings of Table 4 confirm that are baseline estimates in Table 3 are robust to

[30]This corresponds to a 26% (100%) increase in the unconditional probability of export (import) entry, which is equal to 9% (5%).

addressing concerns about the endogeneity of the affiliates' networks.

5.3 Network Effects Beyond Firm Boundaries

The results in the previous subsections show that being acquired by an MNC increases the probability that a firm starts exporting to (and importing from) countries in which the parent has a presence. In principle, these network effects could be driven by intra-MNC supply-chain linkages, i.e., Belgian affiliates exporting their products to (importing their inputs from) more downstream (upstream) affiliates of the same parent. Unfortunately, the NBB does not collect transaction-level trade data, which would allow us to observe intra-MNC flows. However, as discussed below, four sets of empirical findings suggest that the effects of MNC ownership on affiliates' trade participation extend beyond the boundaries of the multinational.

5.3.1 Extended Network Effects

As shown below, MNC ownership increases the probability that affiliates enter only in countries that belong to their parent's network, but also in countries that are close to—but do not belong to—this network. By definition, these "extended network effects" cannot be driven by intra-MNC trade, since they involve countries in which the the multinational parent does not have an affiliate.[31]

The literature on extended gravity (e.g., Albornoz, *et al.*; 2012; Morales *et al.*, 2019; Alfaro-Ureña *et al.*, 2023) shows that firms are more likely to start exporting to markets that are close to prior destinations, i.e., that share a common border or membership in a regional trade agreement. In line with these studies, we examine whether multinational ownership has extended network effects. If such effects are at work, a new Belgian affiliate may be more likely to enter not only countries that belong to the network of their parent (e.g., Argentina), but also nearby countries (e.g., Chile), even if the parent has no presence there. To verify this, we define the variable $\textit{Close to MNC}_{cp}$, which is equal to 1 if country c is close to — but does not belong to — the network of countries in which p has subsidiaries. We define two versions of this variable: the first is a dummy variable equal to 1 if c has common border with a country in the parental network but does not belong to the network;[32] the

[31]These results echo Carballo *et al.* (2022)'s finding that new independent Uruguayan suppliers of MNCs are more likely to start exporting to countries in which the multinational operates, selling to both affiliates of the same multinational and also to independent firms.

[32]Formally, we define the dummy variable $\textit{Contiguous}_{ck}$ as equal to 1 if countries c and k share a common border. In this case, $\textit{Close to MNC}_{cp}$ is equal to 1 if $\textit{In MNC}_{cp} = 0$, but there is at least one country k such that $\textit{Close}_{ck} = 1$, and $\textit{In MNC}_{kp} = 1$.

second is a dummy equal to 1 if c is in a regional trade agreement (RTA) with a country in the parental network but does not belong to the network.[33]

To test for extended network effects, we include an interaction between the variables $MNC_{i(p)t}$ and $Close\ to\ MNC_{ct}$ in equations (17) and (19) that lead to the following estimating equation:

$$\begin{aligned} Entry^{j}_{i(p)ct} = & \quad \beta_j (MNC_{i(p)t} \times In\ MNC_{cp}) \\ + & \quad \gamma_j (MNC_{i(p)t} \times Close\ to\ MNC_{cp}) \\ + & \quad \lambda^j_{it} + \lambda^j_{ic} + \lambda^j_{ct} + \varepsilon^j_{i(p)ct}, \quad j \in \{x, m\}. \end{aligned} \tag{23}$$

The coefficients β_j and γ_j, respectively, capture any network and extended network effects of multinational ownership.

Table 5 reports the results of estimating equation (23). These provide evidence of extended network effects of multinational ownership: the coefficient of the interaction term $MNC_{i(p)t} \times Close\ to\ MNC_{cp}$ is always positive and significant, indicating that new affiliates are more likely to start exporting to and importing from countries that are close to but do not belong to their parental network.

In terms of magnitude, the estimates of Table 5 indicate that affiliates increase their probability of exporting to (importing from) countries sharing a border with those in their parental network by about 2.4 (2.6) percentage points, corresponding to a 14% (26%) increase relative to the unconditional probability of exporting to (importing from) these countries. Similarly, the average increase in the probability of exporting to (importing from) countries that are not in their parental network but with whom Belgium has ever signed an RTA is 1.1 (17) percentage point, corresponding to a 14% (6%) increase relative to the unconditional probability of exporting to (importing from) these countries. As expected, network effects are stronger than extended network effects: in three of the four specifications (columns 1, 2, and 4), the coefficient of $MNC_{(i(p)t} \times In\ MNC_{cp}$ is significantly larger than the coefficient of $MNC_{(p)it} \times Close\ to\ MNC_{cp}$ (in the remaining specification, the coefficients are not statistically different from each other).

[33]Formally, we define the variable RTA_{ck} as equal to 1 if countries c and k are members of the same RTA. In this case, $Close\ to\ MNC\ Network_{cp}$ is equal to 1 if $In\ MNC_{cp} = 0$, but there is at least one country k such that $RTA_{ck} = 1$, and $In\ MNC_{kp} = 1$.

Table 5

Extended Network Effects of MNC Ownership

	(1)	(2)	(3)	(4)
	Export Entry		Import Entry	
	Border	RTA	Border	RTA
$MNC_{(i(p)t}$ $\times$*In* MNC_{cp}	0.039***	0.040***	0.022***	0.028***
	(0.007)	(0.007)	(0.007)	(0.007)
$MNC_{(p)it}$ $\times$*Close to* MNC_{cp}	0.024***	0.011***	0.026***	0.017***
	(0.005)	(0.003)	(0.004)	(0.002)
Firm-Country FE	Yes	Yes	Yes	Yes
Firm-Year FE	Yes	Yes	Yes	Yes
Country-Year FE	Yes	Yes	Yes	Yes
Observations	194,847	194,847	194,847	194,847
Estimator	OLS	OLS	OLS	OLS

The table reports the results of estimating equation (23). In columns 1 and 2, the dependent variable is $Export\ Entry_{i(p)ct}$, a dummy variable equal to 1 from the first year t in which firm i (owned by parent p) exports to country c. log $Exports_{i(p)ct}$, the value of exports of firm i (owned by parent p) to country c in year t. In columns 3 and 4, the dependent variable is $Import\ Entry_{i(p)ct}$, a dummy variable equal to 1 from the first year t in which firm i (owned by parent p) imports from country c. Heteroscedasticity robust standard errors in parenthesis. In column 1 and 3 (column 2 and 4), the variable *Close to* MNC_{cp} is equal to 1 if country c shares a common border (is a member of an RTA) with a country that belongs to p's network, but is not itself in the network. Heteroscedasticity robust standard errors in parenthesis. Significance levels: *** 0.01, ** 0.05, * 0.1.

Table 5 provides *prima facie* evidence that MNC network effects are not merely driven by intra-firm trade. While the network effects may partly be driven by intra-firm trade, extended network effects operate outside the boundaries of the multinational, since they involve countries in which the parent has no affiliates.[34]

5.3.2 Heterogeneous Network Effects by Distance

If the network effects of MNC ownership are driven by trade between vertically-related affiliates, we would expect them to decrease with distance, as new Belgian affiliates should be less likely to start trading with geographically and culturally more distant affiliates of the same multinational. By contrast, if MNC ownership leads to a reduction in country-specific trade frictions, due to, for example, the cost of learning about market-specific regulations,

[34]We have verified that the results of Table 5 are robust to dropping countries that belong to the GUO's network when defining countries that are close to (but do not belong to) the DP's network.

we would expect the MNC network effect to be stronger in countries that are geographically or culturally more distant from Belgium. As an example of why, imagine that MNC ownership removes all fixed costs of trade with countries in which the parent has a presence. This will have a disproportionate impact on the relative profitability of trading with more distant countries once affiliated because fixed costs to these countries were initially higher for domestic firms due to gravity.

We can test these hypotheses in the data by adding interaction terms in equations (17) and (19) and estimating to the following reformulation of equation (21):

$$
\begin{aligned}
Entry^{j}_{i(p)ct} = \quad & \beta_j (MNC_{i(p)t} \times In\ MNC_{cp}) \\
+ \quad & \gamma_j (MNC_{i(p)t} \times In\ MNC_{cp} \times \log Distance_c) \\
+ \quad & \delta_j (MNC_{i(p)t} \times \log Distance_c) \\
+ \quad & \lambda^{j}_{it} + \lambda^{j}_{ic} + \lambda^{j}_{ct} + \varepsilon^{j}_{i(p)ct}, \quad j \in \{x, m\}.
\end{aligned} \tag{24}
$$

The sign of the γ_j coefficient helps us distinguish between the two candidate hypotheses.

We use two measures of distance between Belgium and country c. The first measure comes from the CEPII dataset (Mayer and Zignago, 2011) and is the geographical distance (in kilometres) between the capitals of the two countries. The second measure comes from Melitz and Toubal (2014) and is one minus the share of the population in country c that speaks one of the official languages of Belgium; it is thus a measure of the cultural distance between the two countries.

The results from estimating equation (24) are reported in Table 6. Notice that the number of observations is lower than in Table 3, due to the fact that the distance measures are not available for all countries. The β_j coefficients are always positive and significant at the 1% level, confirming that MNC ownership increases the probability of export and import entry in country in which the parent has a presence. The triple interaction coefficients γ_j are also always positive and highly significant at the 1% percent level, indicating that the network effects are larger in geographically and culturally more distant countries, in which Belgian affiliates faced stronger trade frictions prior to the acquisition. This finding confirms that the network effects are not merely driven by intra-firm trade and suggests that MNC ownership alleviates trade frictions related to gravity.

Table 6
Network Effects of MNC Ownership, The Role of Distance

	(1)	(2)	(3)	(4)
	Export Entry		Import Entry	
	Geogr. distance	Cultural distance	Geogr. distance	Cultural distance
$MNC_{i(p)t} \times In\ MNC_{cp}$	0.044***	0.039***	0.034***	0.027***
	(0.008)	(0.008)	(0.008)	(0.007)
$MNC_{i(p)t} \times In\ MNC_{cp} \times \log Distance_c$	0.019***	0.017***	0.028***	0.027***
	(0.004)	(0.006)	(0.004)	(0.005)
$MNC_{i(p)t} \times \log Distance_c$	-0.010***	-0.006***	-0.015***	-0.008***
	(0.002)	(0.001)	(0.002)	(0.001)
Firm-Country FE	Yes	Yes	Yes	Yes
Firm-Year FE	Yes	Yes	Yes	Yes
Country-Year FE	Yes	Yes	Yes	Yes
Observations	194,847	194,847	194,847	194,847
Estimator	OLS	OLS	OLS	OLS

The table reports the results of estimating equation (24). In columns 1 and 2, the dependent variable is $Export\ Entry_{i(p)ct}$, a dummy variable equal to 1 from the first year t in which firm i (owned by parent p) exports to country c. In columns 3 and 4, the dependent variable is $Import\ Entry_{i(p)ct}$, a dummy variable equal to 1 from the first year t in which firm i (owned by parent p) imports from country c. In columns 1 and 3, the variable $Distance_c$ measures the geographical distance (in kilometres) between the capital of Belgium and the capital of country c; in columns 2 and 4, it is one minus the share of the population in country c that speaks one of the official languages of Belgium. Heteroscedasticity robust standard errors in parenthesis. Significance levels: *** 0.01, ** 0.05, * 0.1.

5.3.3 Persistence of Network Effects

Another way to verify whether the effects of MNC ownership affiliates' trade participation extend beyond the firm boundaries is to examine their persistence. For this purpose, we again exploit the exogenous changes in GUOs' networks discussed in Section 5.2.

We focus on divestitures, i.e., cases in which GUO 1 sells i's DP to GUO 2, which can result in some countries being dropped from i's GUO network. As an example, in 2005, a Belgian firm i was acquired by a DP controlled by GUO 1. In 2011, i's GUO 1 sold DP to GUO 2. As a result of this divestiture, several countries exited firm i's GUO network (Japan, Indonesia, and Tunisia).

We first consider countries in the old GUO's network (i.e., *In Old MNC*$_{cp}$ = 1) and compare those dropped from i's network with those still in the network by estimating:

$$Trade^j_{ict} = \beta_j(New\ MNC_{i,t} \times Only\ in\ Old\ MNC_{ic}) + \lambda^j_{it} + \lambda^j_{ic} + \lambda^j_{ct} + \varepsilon^j_{ict}, \quad j \in \{x, m\}. \quad (25)$$

$Trade^j_{ict}$ is dummy equal to 1 if firm i exports to or imports from country c in year t. If network effects are persistent and not confined to current MNC boundaries, β_j should not be significant. This is indeed what the results of Table 7 shows: the coefficient of the interaction term $New\ MNC_{i,t} \times Only\ in\ Old\ MNC_{ic}$ indicates that affiliates are not significantly less likely to trade with countries dropped from their network compared to countries still in their network.

Table 7

Persistence of Network Effects of MNC Ownership
(Dropped vs Retained Network Countries)

	Exports	Imports
	(1)	(2)
$New\ MNC_{it} \times Only\ In\ Old\ MNC_{ic}$	-0.050	-0.022
	(0.038)	(0.035)
Firm-Country FE	Yes	Yes
Firm-Year FE	Yes	Yes
Country-Year FE	Yes	Yes
Observations	5,460	5,460
Estimator	OLS	OLS

The table reports the results of estimating equation (25). In column 1, the dependent variable is $Export_{ict}$, a dummy variable equal to 1 from if firm i exports to country c in year t. In column 2, the dependent variable is $Import_{ict}$, a dummy variable equal to 1 from if firm i imports from country c in year t. $New\ MNC_{it}$ is a dummy variable equal to 1 in the years in which firm i has GUO 2. $Only\ in\ Old\ MNC_{ic}$ is dummy variable equal to 1 if country c belongs to the network of GUO 1, but does not belong to the network of GUO 2. The sample includes all countries that belong to GUO 1's network (i.e., $In\ Old\ MNC\ Network_{ic} = 1$). Heteroscedasticity robust standard errors in parenthesis. Significance levels: *** 0.01, ** 0.05, * 0.1.

We next compare the probability that affiliates enter countries dropped from their network versus never in their network after changing GUO. If network effects take time to manifest, we would expect affiliates to be more likely to start exporting to and importing from countries that are no longer in their network relative to countries never in their network. For this purpose, we exclude from the sample countries added to the network from the sample (i.e., $In\ New\ MNC\ Network_{ic} = 1$) and estimate:

$$Entry^j_{ict} = \beta_j(New\ MNC_{i,t} \times Only\ in\ Old\ MNC_{ic}) + \lambda^j_{it} + \lambda^j_{ic} + \lambda^j_{ct} + \varepsilon^j_{ict}, \quad j \in \{x, m\}. \quad (26)$$

The results reported in Table 8 show that even after changing GUO, affiliates are more likely to start trading with countries that used to be in their multinational network relative to countries never in the their network. These results confirm that MNC network effects are persistent and are not confined to intra-firm trade.

Table 8
Persistence of Network Effects of MNC Ownership
(Countries Dropped vs Never in the Network)

	Export Entry	Import Entry
	(1)	(2)
$\textit{New MNC}_{it} \times \textit{Only In Old MNC}_{ic}$	0.039**	0.036**
	(0.019)	(0.006)
Firm-Country FE	Yes	Yes
Firm-Year FE	Yes	Yes
Country-Year FE	Yes	Yes
Observations	14,383	14,383
Estimator	OLS	OLS

The table reports the results of estimating equation (26). In column 1, the dependent variable is $\textit{Export Entry}_{ict}$, a dummy variable equal to 1 if firm from the first year t in which firm i exports to country c. In column 2, the dependent variable is $\textit{Import Entry}_{ict}$, a dummy variable equal to 1 from the first year t in which firm i imports from country c. $\textit{New MNC}_{it}$ is a dummy variable equal to 1 in the years in which firm i has GUO 2. $\textit{Only in Old MNC Network}_{ic}$ is dummy variable equal to 1 if country c belongs to the network of GUO 1, but does not belong to the network of GUO 2. The sample excludes countries added to i's network after the change in GUO (i.e., $\textit{Only in New MNC Network}_{ic} = 1$). Heteroscedasticity robust standard errors in parenthesis. Significance levels: *** 0.01, ** 0.05, * 0.1.

5.3.4 Distance from Other Affiliates Along Value Chains

If the network effects were driven by supply chain linkages within MNCs, we would expect them to be stronger when the activities of affiliates are vertically-related. To investigate this, we use the methodology of Alfaro *et al.* (2019) to construct the variable $\textit{Upstreamness}_{ij}$, which measures the distance along supply chains between Belgian affiliate i's and affiliate j of parent p located in country c.

Since the upstreamness measure can only be defined for countries in the parental network, we restrict the analysis to these countries (i.e., $\textit{In MNC}_{cp} = 1$). We include an interaction between the variables $\textit{MNC}_{i(p)t}$ and $\textit{Upstreamness}_{ij}$ in equations (17) and (19) that lead to the following estimating equation:

$$\textit{Entry}^{j}_{i(p)c(j)t} = \beta_j(\textit{MNC}_{i(p)t} \times \textit{Upstreamness}_{ij}) + \lambda^{j}_{it} + \lambda^{j}_{ic} + \lambda^{j}_{ct} + \varepsilon^{j}_{i(p)c(j)t}, \quad j \in \{x, m\}. \quad (27)$$

Depending on the specification, the dependent variable is a dummy variable equal to 1 from the first year t in which Belgian affiliate i (with multinational parent p) exports to or imports from c, the country in which affiliate j (of parent p) is located. When looking at export (import) entry, the variable $Upstreamness_{ij}$ is constructed using the Belgian affiliate as the supplier (user) and affiliate j in country c as the user (supplier). Given that parent p can have multiple affiliates in country c, we cluster standard errors at the country level.

Table 9

Network Effects of MNC Ownership, The Role of Distance Along Supply Chains

	Export Entry	Import Entry
	(1)	(2)
$MNC_{i(p)t} \times Upstreamness_{ij}$	0.004	0.001
	(0.007)	(0.003)
Firm-Country FE	Yes	Yes
Firm-Year FE	Yes	Yes
Country-Year FE	Yes	Yes
Observations	14,295	14,054
Estimator	OLS	OLS

The table reports the results of estimating equation (27). In column 1, the dependent variable is $Export\ Entry_{i(p)c(j)t}$, a dummy variable equal to 1 from the first year t in which Belgian affiliate i (with parent p) exports to c (the country in which affiliate j is located). In column 2, the dependent variable is $Import\ Entry_{i(p)c(j)t}$, a dummy variable equal to 1 from the first year t in which Belgian affiliate i (with parent p) imports from c (the country in which affiliate j is located). In column 2, the dependent variable is $Import\ Entry_{ict}$, a dummy variable equal to 1 from the first year t in which firm i imports from country c. $MNC_{i(p)t}$ is a dummy variable equal to 1 after firm i is acquired by p. $Upstreamness_{ij}$ measures the distance along supply chains between Belgian affiliate i's and affiliate j. In column 1 (column 2) it is constructed using the Belgian affiliate as the supplier (user) and affiliate j in country c as the user (supplier). The sample is restricted to countries belonging to the parental network (i.e., $In\ MNC_{cp} = 1$). Standard errors clustered by country in parenthesis. Significance levels: *** 0.01, ** 0.05, * 0.1.

Table 9 reports the results of estimating equation (27). The β_j coefficient is not significant, indicating that whether the acquired Belgian affiliate i starts trading with countries in the network of its parent does not depend on its position along supply chains relative to other affiliates of the same parent. That is, whether or not the network presence is upstream or downstream of the Belgian affiliate does not affect the magnitude of the network effect, counter to the idea that the network effects are due to direct sales and purchases by commonly-owned affiliates within a global supply chain.

6 The Importance of MNC Network Effects

In this section, we discuss the relative size of MNC network effects versus traditional firm-level mechanisms through which MNC ownership can affect trade participation. In addition, we use the structure of the model to perform a back-of-the-envelope calculation of the impact of MNC network effects on affiliates' total sales and labor demand. Additional details can be found in Appendix B-2.

6.1 Variance Decomposition

To assess the relative importance of network effects versus traditional firm-level mechanisms through which MNC ownership can affect trade participation, we decompose the total variance of $Entry_{i(p)ct}$ in equation (21) and compute the share that can be attributed to $MNC_{i(p)t} \times In\ MNC_{cp}$ and the different fixed effects. We do so by using the Shapley decomposition (Huettner and Sunder, 2012), which allows us to identify the marginal contribution of each regressor if it were to be removed from the function.[35] The details of the implementation of the Shapley decomposition can be found in Appendix Section B-2.1.

The results reported in Table B-1 show that firm-country fixed effects explain around 90% of the variation in export and import entry, confirming the central role of gravity. The results also indicate that MNC network effects are quantitatively more important than firm-year effects in explaining new affiliate entry patterns: MNC network effects explain 3.91% and 5.76% of the total variation in the probability that a firm starts exporting to and importing from a country, respectively. By contrast, firm-year fixed effects explain 3.22% and 1.50% of the total variation, respectively. Country-year fixed effects account for the remaining part.

6.2 Implications for Firm Growth

So far, we have examined the role of MNC network effects in explaining firm-level trade participation. By combining our theoretical model and empirical estimates, we can assess their relevance for the overall growth of MNC affiliates.

We proceed in two steps. First, we use the structure of the model to compute the fraction of sales and employment attributable to MNC network effects in each post-acquisition year. Second, we multiply this share by the overall increase in sales and employment due to MNC

[35] Compared to other methods such as ANOVA, the Shapley decomposition has two desirable properties. First, it is an exact decomposition that allows us to compute the marginal contribution of each regressor even when they are correlated. Second, it is insensitive to the order in which the regressors are removed from the estimating equation. See Sharapov *et al.* (2020) for a review of the advantages of the Shapley decomposition over other methods.

acquisitions from Table 2. This way, we obtain an estimate of the annual change in affiliates' sales and employment when they begin trading with new countries within their parent's network. The model in Section 4 assumes that firms decide on sales after selecting the optimal mix of production inputs. We can thus infer changes in affiliates' sales by looking at their export choices and changes in labor demand by examining their import decisions. See Section B-2.2 of the Theoretical Appendix for additional details.

Using the model and our data, we find that approximately 13% of yearly post-acquisition sales are attributable to MNC network effects, on average. Since MNC acquisitions increase firm-level sales by about 32.3% (as indicated in Table 2), we infer that exporting to new countries belonging to the parental network generates an average post-acquisition increase in sales of (13% × 32.3% =) 4.1%. Similarly, approximately 14.1% of the post-acquisition number of employees is attributable to MNC network effects. Since MNC acquisitions increase firm-level employment by about 19.8%, we conclude that importing from new countries within to the parental network generates an average post-acquisition increase in employment of (13.7% × 14.1% =) 2.7%.

For comparison, the median annual growth rate of sales and employment among domestic Belgian firms during our sample period are 1.9% and 0%, respectively. Therefore, through MNC network effects, acquired firms experience an annual growth rate that is more than twice as large as the median growth observed in the data.

7 Conclusions

Firms affiliated with multinationals account for a disproportionately large share of international trade. Previous studies explain this dominance as the result of mechanisms that affect the affiliate at the time of acquisition: for examples, MNC ownership may boost affiliates' trade participation by increasing their productivity through transfers of technology or managerial know-how or by alleviating their credit constraints. In this paper, we identify a novel mechanism that operates at the affiliate-country level: firms acquired by multinationals face lower trade frictions in and around the network of countries in which their parent has other affiliates.

We first provide some stylized facts on the overall effects of multinational ownership. Using rich administrative data from the National Bank of Belgium, we show that after being acquired by an MNC, firms are more likely to export and import, to export to and import from more countries, and have higher total values of exports and imports. Non-trade outcomes are also affected, with acquired firms becoming larger and more productive. These results are robust to accounting for selection effects through re-weighting methods that allow us to create a group of untreated firms that is indistinguishable—in terms of the different moments (mean, variance, and skewness) of the distribution of a large set of observables—from the group of treated firms.

We next develop a model in which firms choose from which countries to source their inputs to minimize production costs and where to sell their final goods to maximize profits. MNC ownership can affect export and import decisions of new affiliates at the extensive and intensive margins, through firm-specific channels (e.g., increased productivity through technology transfers) and firmcountry specific channels (e.g., reduction of trade barriers in countries in which the parent already has a presence). The model delivers structural firm-level gravity equations that can be estimated to identify the network effects of multinational ownership.

We bring the model's predictions to the data by combining rich administrative data from the NBB with data on multinational networks constructed from various Bureau van Dijk datasets. We find evidence of network effects from MNC ownership at the extensive margin: new affiliates are more likely to start exporting to, and importing from, countries in which their parent has a presence. The results are robust to a broad set of alternative specifications and estimation approaches. Crucially, they also continue to hold when we exploit plausibly exogenous changes in multinational networks arising from M&A activities that change the organizational structure of the multinational group. We instead find no significant network effects on the intensive margin: new affiliates do not increase the value of their exports to (and imports from) countries they were already trading with prior to the acquisition. These findings suggest that multinational ownership alleviates country-specific trade frictions that operate at the extensive margin of trade (e.g., fixed costs associated with learning regulations in foreign markets).

Four sets of additional results indicate that the effects are not confined to the boundaries of the multinational. First, acquired firms are more likely to start trading not only with countries in which other affiliates are located, but also with countries that are close—but do not belong—to their parents' network. By definition, these effects cannot be driven by intra-MNC trade, since they involve countries in which the multinational parent has no subsidiaries. Second, we show that the network effects increase with the geographical or cultural distance between the foreign country and the country of the acquired firms (Belgium), suggesting that multinational ownership alleviates trade frictions that are related to gravity. If the effects were solely driven by global supply chains within the multinational, we would expect them to *decrease* with distance: new Belgian affiliates should be *less* likely to start exporting to and importing from other affiliates of their parent when these are further away from Belgium. Third, we find that MNC network effects are persistent, i.e., affiliates continue trading with countries that used to belong to their MNC network. Finally, we show that the network effects do not depend on the relative position of affiliates along supply chains: the probability that an acquired firm starts exporting to (importing from) a country that belongs to its parental network does not depend on how upstream (downstream) its activities are relative to those of its parent's affiliates in that country.

When we decompose the total variance of trade participation into its components, we find that MNC network effects are quantitatively more important than traditional effects of foreign ownership, explaining a larger share of the total variation in the probability that a firm starts exporting to and importing from a country. Combining the structure of our theoretical model with our estimates, we also show that network effects account for a large share of affiliates' growth (in terms of sales and employment).

Overall, our analysis shows that multinational ownership reduces entry frictions in and around the network of countries in which the parent has a presence, making it easier for affiliates to expand both their set of customers and suppliers. In turn, these network effects contribute to the growth of acquired firms, boosting their sales and employment.

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Appendices

Empirical Appendix

A-1 Descriptive Statistics

A-1.1 Acquired and Non-Acquired Firms

Table A-1

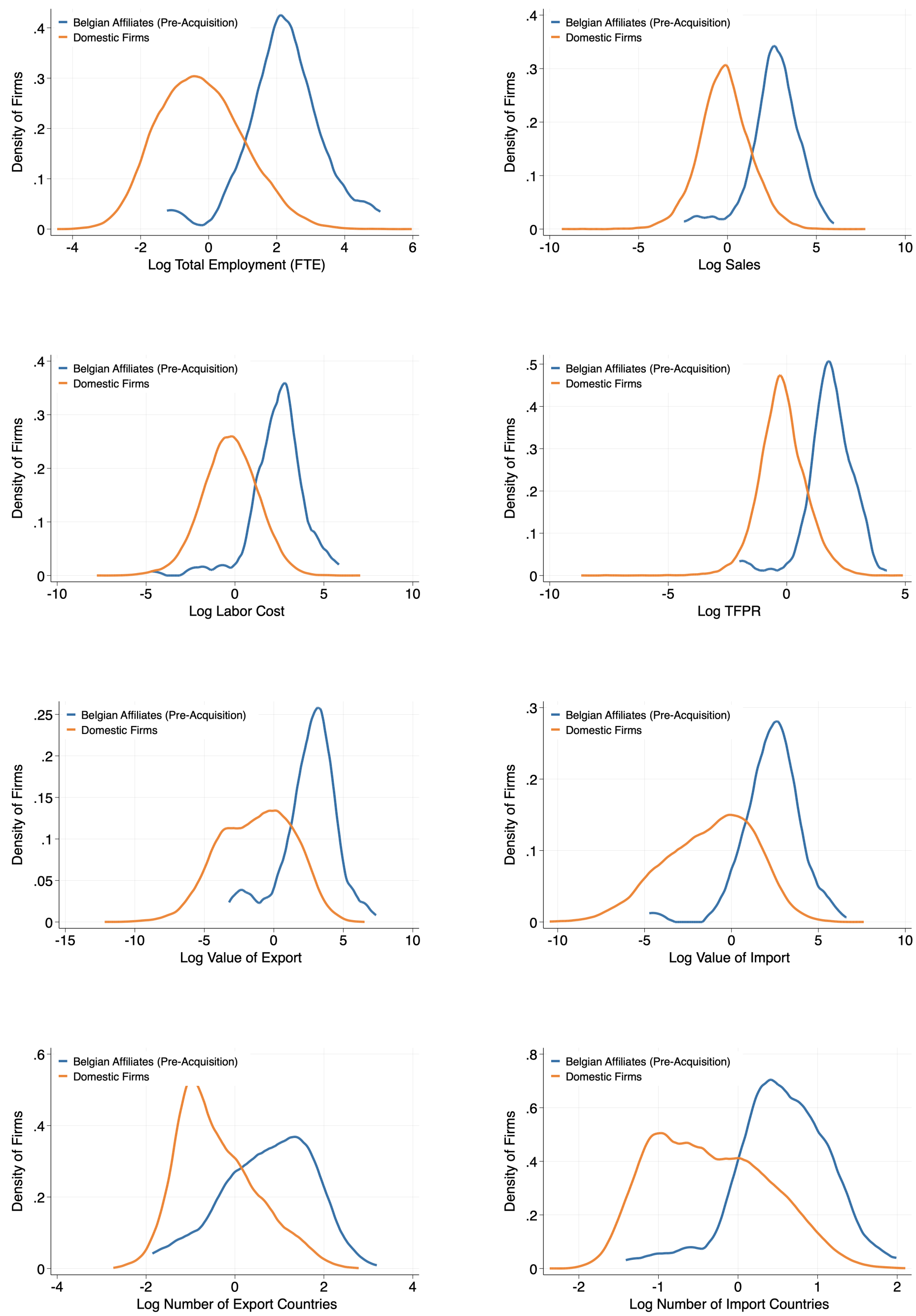
Distributions of Covariates of Treated (Acquired) and Untreated (Non-Acquired) Firms

Covariates	Mean Treat	Mean Control	Var. Treat	Var. Control	Skew. Treat	Skew. Control
Lag Log Fixed Assets	16.20	13.65	1.60	2.56	–0.03	–0.38
Lag Log Employees	4.93	3.19	1.08	1.37	–0.23	–0.38
Lag Log Sales	17.44	15.51	1.32	1.45	–0.09	0.11
Lag Log No. Export Countries	2.64	1.88	0.95	1.12	–0.35	–0.06
Lag Log No. Import Countries	2.32	1.69	0.30	0.58	–0.36	–0.64
Lag Log Exports	13.85	12.00	2.19	3.86	–0.88	–1.11
Lag Log Imports	13.46	11.56	1.75	3.64	0.08	–1.10
Growth Rate Sales	0.08	0.00	0.15	0.10	0.68	–3.11
Growth Rate Exports	–0.09	–0.03	1.45	1.15	–3.25	–0.09
Growth Rate Imports	0.02	–0.04	0.49	1.09	–1.02	–0.30
Growth Rate No. Export Countries	0.01	0.00	0.15	0.19	0.82	–0.13
Growth Rate No. Import Countries	0.03	–0.00	0.07	0.18	0.41	–0.17
Log Distance	7.78	7.41	0.55	0.85	–1.16	–0.55
Lag Log GDP Per Capita (PPP)	20.84	21.05	0.19	0.36	–0.13	–0.02
Longitude	15.22	13.69	160.77	306.94	–0.22	0.14
Latitude	39.90	42.56	72.95	65.63	–0.86	–1.35

The table reports the mean, variance, and skewness of firms' characteristics for the treated and control groups, after applying the entropy balance re-weighting algorithm of Hainmueller (2012). The weights assigned to treated and non-treated firms are constructed to equate the mean, variance, and skewness of all covariates. All the lagged variables refer to the year before the acquisition for firms in the treatment group and the year before the one in which they are controls for those in the control group. The same applies to variables in growth rates. Log Distance, Lag Log GDP per capita (PPP), Longitude, and Latitude refer to the characteristics of the countries with whom firms trade (export or import) in the year before the acquisition (if they are acquired) or in the year before the one in which they are controls (if they are not acquired).

Figure A-1

Acquired and Non-Acquired Firms



The figure shows empirical probability density functions of various outcomes (in logarithms and after demeaning by industry-time). The orange lines refer to domestic-owned firms, whereas the blue lines to foreign-owned firms before the acquisition.

A-1.2 New Foreign Affiliates and their Multinational Network

Table A-2

Number of New Foreign Affiliates by Sector

Sector	
Agriculture, Mining and Quarrying (A1 - B9)	2
Automobile, Transport (C29 - C30)	8
Coke, Chemicals, Pharmaceuticals, Rubbers (C19 - C22)	40
Computer, Machinery, Equipment (C26 - C28)	13
Food, Beverages, Tobacco (C10 - C12)	20
Furniture and Other (C31- C33)	5
Mineral, Metal, Steel (C23 - C25)	19
Wood, Paper, Media (C16 - C18)	8

The table shows the number of new foreign affiliates by sector (1998-2014). Incumbent foreign-owned surviving firms are excluded.

Table A-3

Distribution of Foreign Equity

Mean	1st Pctile	25th Pctile	Median	75th Pctile	99th Pctile
89.118%	23.000%	88.294%	99.975%	100.000%	100.000%

Distribution of average equity of new foreign affiliates (across the years in which they are foreign owned). For affiliates with more than one DP, we average across years and parents.

Table A-4

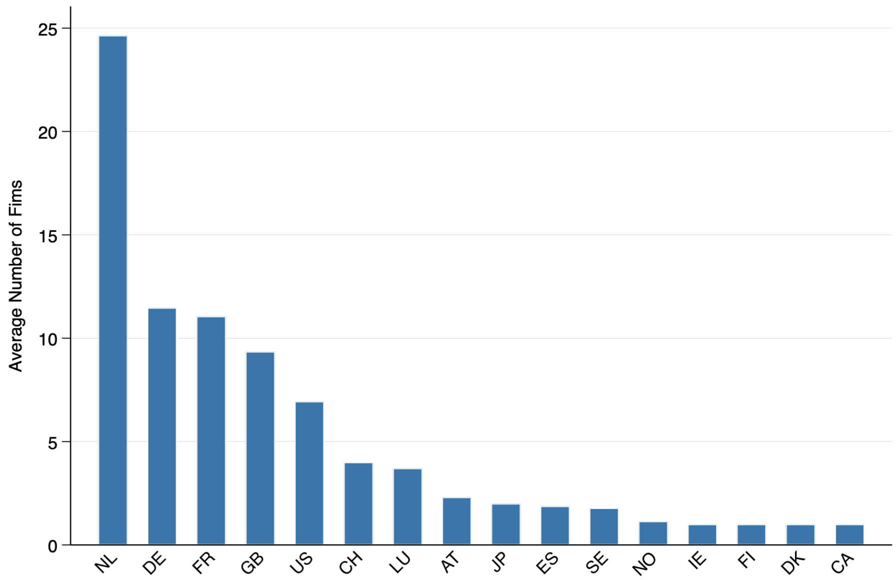
Parental Network of New Affiliates, Summary Statistics

Network of Direct Parents				
Mean	Median	Min	Max	Std. Dev.
9.44	3.00	1.00	75.00	14.33
Network of GUOs				
Mean	Median	Min	Max	Std. Dev.
24.65	18.00	1.00	103.00	23.41

The table reports summary statistics of the size of the multinational network of the (direct and global) parents of Belgian affiliates, i.e., the number of countries in which the parents have affiliates.

Figure A-2

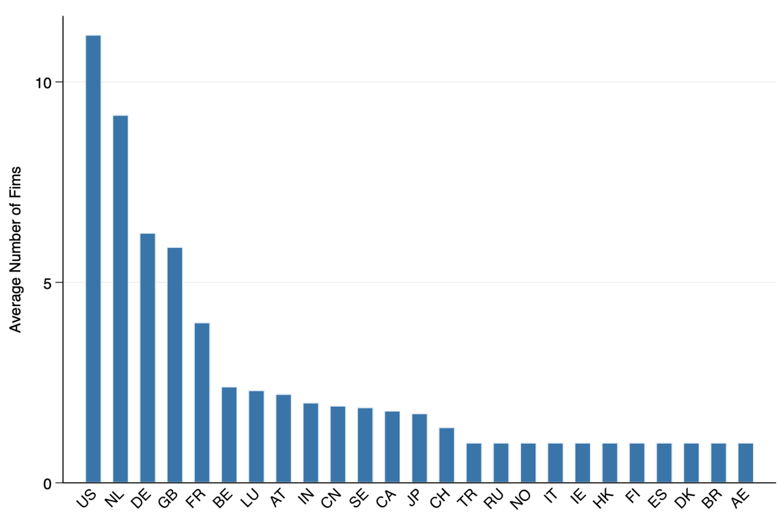
Number of Belgian Affiliates by Country of the DP



The figure shows the average number of Belgian affiliates by country of origin of the direct parent during 1998-2014.

Figure A-3

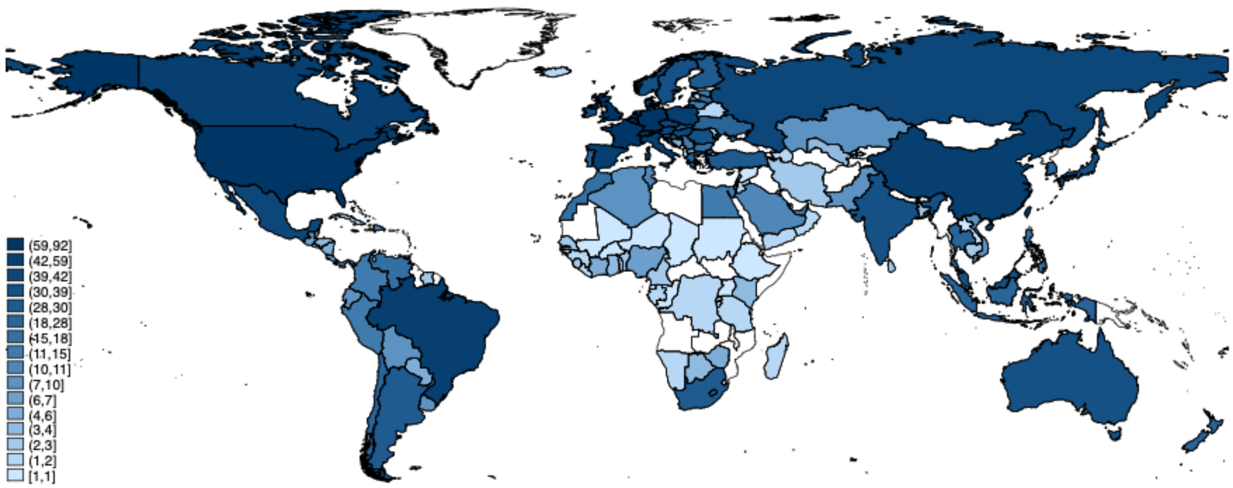
Average Number of Belgian Affiliates by Country of the GUO



The figure shows the number of Belgian affiliates by country of origin of the global ultimate owner.

Figure A-4

Global Presence of GUOs of Belgian Affiliates



The figure shows the countries in which the global ultimate owners of Belgian affiliates have a presence.

A-2 MNC Ownership and Overall Trade Participation

A-2.1 Event Study

We estimate the following equation:

$$y_{it} = \sum_{s=-k_l}^{k_u} \theta_s MNC_{it}^{s} + \delta_i + \delta_t + \varepsilon_{it}. \tag{28}$$

y_{it} is the trade outcome variable of interest of firm i at time t, i.e., its export/import status, the number of countries to which the firm exports, of from which it imports, and the total value of its exports/imports.[36] MNC_{it}^{s} is a dummy variable identifying periods before and after the acquisition of firm i by a foreign multinational. k_l and k_u denote the first and last period for which MNC_{it}^{s} can be defined. δ_i and δ_t are respectively firm and year fixed effects. The coefficients θ_s measure the dynamic treatment effect, and we normalize $\theta_{-1} = 0$. Therefore, the estimated coefficients are relative to the year before the acquisition.[37]

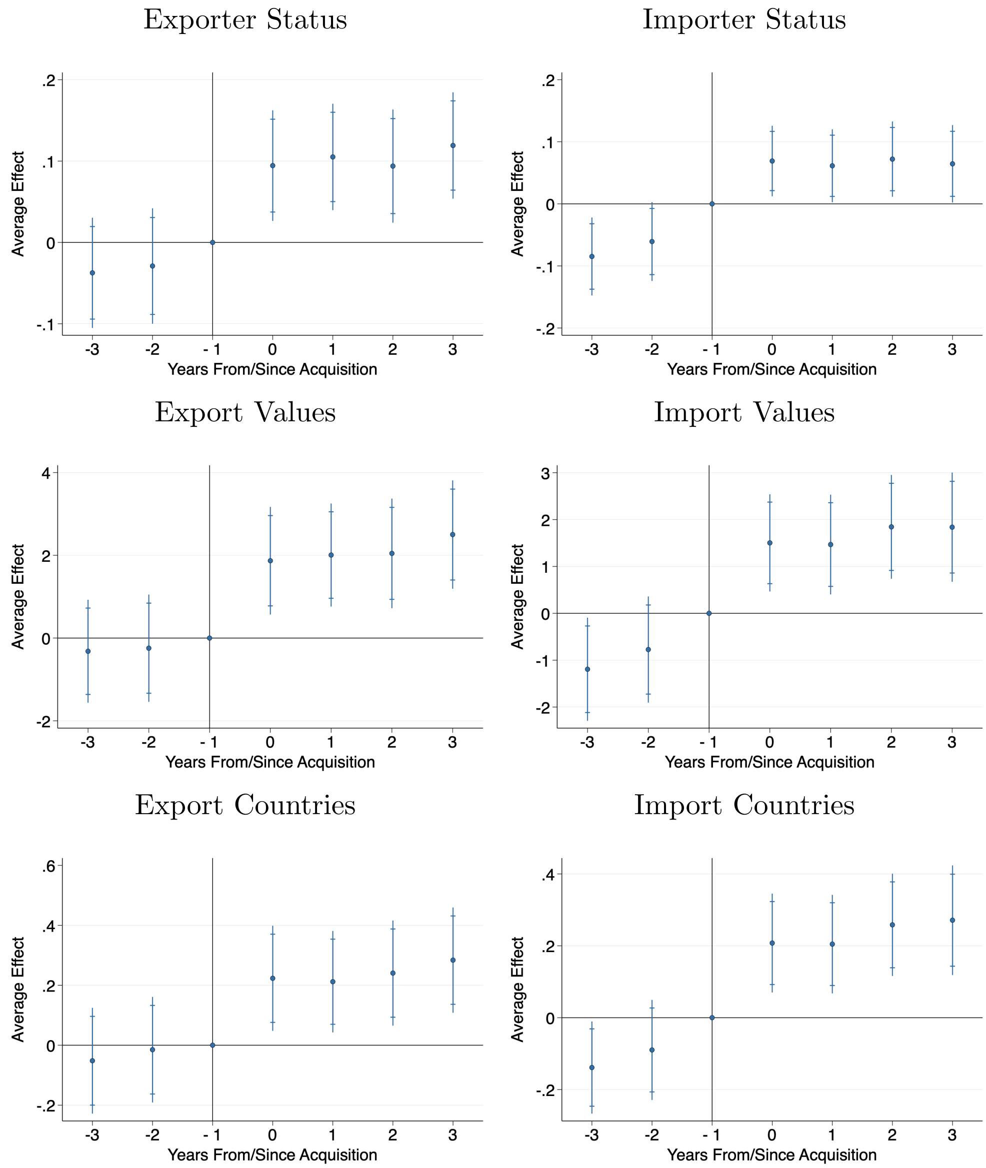
The recent literature surveyed by de Chaisemartin and D'Haultfœuille (2023) emphasizes that estimating event studies with a two-way fixed-effects (TWFE) estimator may fail to recover the treatment effect when the roll-out is staggered and treatment effects are time-varying. We deal with this concern by using the method proposed by Sun and Abraham (2021), which entails estimating cohort-specific dynamic treatment effects and aggregating them using the size of each cohort as a weight. We estimate equation (28) using all firms in the sample. The θ_s coefficients are identified under the assumption that never acquired and not-yet-acquired firms are a credible counterfactual for acquired ones, conditional on the fixed effects.

The results are reported in Figure A-5. Compared to never- and not-yet-treated firms, acquired firms increase the probability of any exporting (importing) by around 10 percentage points (7 percentage points). Additionally, they increase average export (import) values by approximately 6 (3.5) times and the number of export (import) markets by around 22% (25%).

[36] When looking at the number of countries a firm trades with or the total of its exports and imports, the dependent variable is $\log(1 + y_{it})$. This allows us to include observations in which $y_{it} = 0$, accounting for the fact that acquired and non-acquired firms do not always trade. The results are robust to using the inverse hyperbolic sine transformation of these variables. Unlike the log transformation, the inverse hyperbolic sine is defined at zero (Burbidge *et al.*, 1988; MacKinnon and Magee, 1990). The PPML estimator often used in the gravity literature to account for zeros (e.g., Santos Silva and Tenreyro, 2006) cannot be used to consistently estimate event-study specifications with staggered treatment roll-out and potentially time-varying treatment effects.

[37] In line with Alfaro-Ureña *et al.* (2022), in our baseline specifications, we use heteroskedasticity-robust standard errors. The results continue to hold if we cluster standard errors by firm.

Figure A-5
Event Studies



The figure reports the results of estimating (28) using different outcome variables. There are 280,101 observations. 90% and 95% confidence intervals are based on heteroskedasticity-robust standard errors.

A key concern with the event studies is that selection effects—observed or unobserved time-varying firm-level shocks that are correlated with the acquisition and the trade variables—are biasing the results. This concern is particularly relevant for the import variables, for which Figure A-5 shows significant pre-trends. In Section 3, we show that the results are robust to using re-weighting methods to account for selection effects.

A-2.2 Re-weighting

Table A-5

Distributions of Covariates of Treated and Untreated Firms,
After Re-Weighting (Entropy Balancing)

Covariates	Mean Treat	Mean Control	Var. Treat	Var. Control	Skew. Treat	Skew. Control
Lag Log Fixed Assets	16.20	16.20	1.60	1.60	–0.03	–0.03
Lag Log Employees	4.93	4.93	1.08	1.08	–0.23	–0.23
Lag Log Sales	17.44	17.44	1.32	1.32	–0.09	–0.09
Lag Log No. Export Countries	2.64	2.64	0.95	0.95	–0.35	–0.35
Lag Log No. Import Countries	2.32	2.32	0.30	0.30	–0.36	–0.36
Lag Log Exports	13.85	13.85	2.19	2.19	–0.88	–0.88
Lag Log Imports	13.46	13.46	1.75	1.75	0.08	0.08
Growth Rate Sales	0.08	0.08	0.15	0.15	0.68	0.68
Growth Rate Exports	–0.09	–0.09	1.45	1.45	–3.25	–3.25
Growth Rate Imports	0.02	0.02	0.49	0.49	–1.02	–1.02
Growth Rate No. Export Countries	0.01	0.01	0.15	0.15	0.82	0.82
Growth Rate No. Import Countries	0.03	0.03	0.07	0.07	0.41	0.41
Log Distance	7.78	7.78	0.55	0.55	–1.16	–1.16
Lag Log GDP Per Capita (PPP)	20.84	20.84	0.19	0.19	–0.13	–0.13
Longitude	15.22	15.22	160.77	160.77	–0.22	–0.22
Latitude	39.90	39.90	72.95	72.95	–0.86	–0.86

The table reports the mean, variance, and skewness of firms' characteristics for the treated and control groups, after applying the entropy balance re-weighting algorithm of Hainmueller (2012). The weights assigned to treated and non-treated firms are constructed to equate the mean, variance, and skewness of all covariates. All the lagged variables refer to the year before the acquisition for firms in the treatment group and the year before the one in which they are controls for those in the control group. The same applies to variables in growth rates. Log Distance, Lag Log GDP per capita (PPP), Longitude, and Latitude refer to the characteristics of the countries with whom firms trade (export or import) in the year before the acquisition (if they are acquired) or in the year before the one in which they are controls (if they are not acquired).

Table A-6

Distributions of Non-Targeted Covariates of Treated and Untreated Firms, After Re-Weighting (Entropy Balancing)

Covariates	Mean Treat	Mean Control	Var Treat	Var. Control	Skew. Treat	Skew. Control
Lag Log No. Import Products	1.48	1.36	0.81	0.72	–0.17	–0.16
Lag Log No. Export Products	0.76	0.77	0.68	0.83	–0.25	0.14
Lag Log No. Import Products (DE)	2.79	2.76	1.20	1.22	–0.00	–0.26
Lag Log No. Import Products (FR)	2.12	2.32	1.32	1.16	–0.06	–0.21
Lag Log No. Import Products (GB)	1.74	1.46	1.11	1.05	0.02	0.44
Lag Log No. Import Products (NL)	2.95	3.00	1.46	1.31	–0.56	–0.22
Lag Log No. Import Products (US)	1.75	1.48	1.47	1.72	0.21	0.52
Lag Log No. Import Products (JP)	0.82	1.20	0.92	2.07	1.24	1.30
Lag Log No. Export Products (DE)	1.38	1.46	1.22	1.35	0.54	0.59
Lag Log No. Export Products (FR)	1.46	1.65	1.49	1.46	0.34	0.44
Lag Log No. Export Products (GB)	1.21	1.24	1.12	1.17	0.57	0.70
Lag Log No. Export Products (NL)	1.70	1.70	1.67	1.44	0.43	0.53
Lag Log No. Export Products (US)	1.18	1.22	0.83	1.26	0.38	0.95
Lag Log No. Export Products (JP)	0.71	0.95	0.48	1.10	0.51	1.00
Lag Log Imports (DE)	14.44	14.35	3.88	4.14	–0.38	–0.60
Lag Log Imports (FR)	13.42	13.87	6.13	4.68	–0.88	–0.75
Lag Log Imports (GB)	12.67	12.30	4.20	6.68	–0.27	–0.32
Lag Log Imports (NL)	14.05	14.31	5.14	4.75	–0.23	–0.59
Lag Log Imports (US)	12.21	11.93	7.19	10.13	–0.09	–0.12
Lag Log Imports (JP)	11.50	11.79	8.09	12.67	–0.39	0.16
Lag Log Exports (DE)	14.04	14.33	8.90	6.15	–1.13	–0.91
Lag Log Exports (FR)	14.42	14.96	7.59	4.66	–1.83	–1.02
Lag Log Exports (GB)	13.43	13.92	8.07	6.45	–1.16	–0.95
Lag Log Exports (NL)	14.65	14.67	6.39	5.09	–0.95	–1.03
Lag Log Exports (US)	12.41	13.05	8.88	8.52	–0.43	–0.06
Lag Log Exports (JP)	11.78	12.15	4.10	7.77	–0.23	–0.02

The table shows the mean, variance, and skewness of non-targeted firms' characteristics for the treated and control group after using the entropy balance re-weighting algorithm of Hainmueller (2012).

Table A-7

Distributions of Covariates of Treated and Untreated Firms,
After Re-Weighting (Inverse Probability Re-Weighting)

Covariates	Mean Treat	Mean Control	Var. Treat	Var. Control	Skew. Treat	Skew. Control
Lag Log Fixed Assets	16.20	16.26	1.60	2.32	–0.03	0.56
Lag Log Employees	4.93	4.95	1.08	1.27	–0.23	0.29
Lag Log Sales	17.44	17.45	1.32	2.08	–0.09	–1.01
Lag Log No. Export Countries	2.64	2.67	0.95	1.10	–0.35	–0.37
Lag Log No. Import Countries	2.32	2.34	0.30	0.37	–0.36	–0.56
Lag Log Exports	13.85	13.83	2.19	2.08	–0.88	–0.89
Lag Log Imports	13.46	13.45	1.75	1.80	0.08	–0.04
Growth Rate Sales	0.08	0.10	0.15	0.29	0.68	7.75
Growth Rate Exports	–0.09	–0.08	1.45	0.82	–3.25	–3.17
Growth Rate Imports	0.02	0.01	0.49	0.45	–1.02	–1.24
Growth Rate No. Export Countries	0.01	0.02	0.15	0.15	0.82	0.64
Growth Rate No. Import Countries	0.03	0.03	0.07	0.07	0.41	0.41
Log Distance	7.78	7.78	0.55	0.46	–1.16	–0.98
Lag Log GDP Per Capita (PPP)	20.84	20.85	0.19	0.26	–0.13	–0.78
Longitude	15.22	15.26	160.77	164.61	–0.22	0.05
Latitude	39.90	39.85	72.95	69.86	–0.86	–0.54

The table reports the mean, variance, and skewness of firms' characteristics for the treated and control groups, after applying the inverse probability re-weighting algorithm of Guadalupe *et al.* (2012). The weights assigned to treated and non-treated firms are constructed to equate the mean, variance, and skewness of all covariates. All the lagged variables refer to the year before the acquisition for firms in the treatment group and the year before the one in which they are controls for those in the control group. The same applies to variables in growth rates. Log Distance, Lag Log GDP per capita (PPP), Longitude, and Latitude refer to the characteristics of the countries with whom firms trade (export or import) in the year before the acquisition (if they are acquired) or in the year before the one in which they are controls (if they are not acquired).

Table A-8

MNC Ownership and Trade Participation (No Re-Weighting)

	(1)	(2)	(3)
	Exporter Dummy	Export Values	Export Countries
MNC_{it}	0.127***	2.259***	0.263***
	(0.010)	(0.206)	(0.034)
	(4)	(5)	(6)
	Importer Dummy	Import Values	Import Countries
MNC_{it}	0.095***	1.904***	0.319***
	(0.009)	(0.190)	(0.026)
Firm FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Estimator	OLS	OLS	OLS
Re-weighting	No	No	No
Observations	93,171	93,171	93,171

The table reports the results of estimating equation (1) without re-weighting the observations for treated and non-treated firms. Heteroscedasticity robust standard errors in parenthesis. Significance levels: *** 0.01, ** 0.05, * 0.1.

Table A-9

MNC Ownership and Trade Participation (Inverse Probability Re-Weighting)

	(1)	(2)	(3)
	Exporter Dummy	Export Values	Export Countries
MNC_{it}	0.043***	0.722***	0.099**
	(0.013)	(0.268)	(0.046)
	(4)	(5)	(6)
	Importer Dummy	Import Values	Import Countries
MNC_{it}	0.034***	0.743***	0.112***
	(0.010)	(0.229)	(0.034)
Firm FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Estimator	OLS	OLS	OLS
Re-weighting	Yes	Yes	Yes
Observations	93,171	93,171	93,171

The table reports the results of estimating equation (1). We compute the weights as a function of all the observables in Table A-5 using the Inverse Probability Re-Weighting (IPW) estimator. Heteroscedasticity robust standard errors in parenthesis. Significance levels: *** 0.01, ** 0.05, * 0.1.

Table A-10

MNC Ownership and Other Firm-Level Outcomes (No Re-Weighting)

	(1)	(2)	(3)	(4)
	Employment	Sales	Value Added	Productivity
MNC_{it}	0.244***	0.473***	0.354***	0.198***
	(0.037)	(0.059)	(0.041)	(0.047)
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Estimator	OLS	OLS	OLS	OLS
Re-weighting	Yes	Yes	Yes	Yes
Observations	71,979	75,645	73,964	71,347

The table reports the results of estimating equation (1) without re-weighting the observations for treated and non-treated firms. The dependent variable is the log of $Employment_{f,t}$, $Sales_{f,t}$, $Value\ Added_{f,t}$, and $Productivity_{f,t}$. Heteroscedasticity robust standard errors in parenthesis. Significance levels: *** 0.01, ** 0.05, * 0.1.

A-3 Network Effects of MNC Ownership

A-3.1 Additional Results and Robustness Checks

Table A-11

Network Effects of MNC Ownership (Network of the GUO)

	(1) Export Entry	(2) Import Entry
$MNC_{i(p)t} \times In\ MNC_{cp}$	0.033***	0.027***
	(0.004)	(0.004)
Firm-Country FE	Yes	Yes
Firm-Year FE	Yes	Yes
Country-Year FE	Yes	Yes
Observations	202,924	202,924
Estimator	OLS	OLS

The table reports the results of estimating equation (21). In column 1, the dependent variable is $Export\ Entry_{i(p)ct}$, a dummy variable equal to 1 from the first year t in which firm i (with GUO p) exports to country c. In column 2, the dependent variable is $Import\ Entry_{i(p)ct}$, a dummy variable equal to 1 from the first year t in which firm i (with GUO p) imports from country c. Heteroscedasticity robust standard errors in parenthesis. Significance levels: *** 0.01, ** 0.05, * 0.1.

Table A-12

Network Effects of MNC Ownership (Logit Model)

	(1) Export Entry	(2) Import Entry
$MNC_{i(p)t} \times In\ MNC_{cp}$	0.066***	0.058**
	(0.022)	(0.023)
Firm-Country FE	Yes	Yes
Firm-Year FE	Yes	Yes
Country-Year FE	Yes	Yes
Observations	236,256	236,256
Estimator	Logit	Logit

The table reports the results of estimating equation (21). In column 1, the dependent variable is $Export\ Entry_{i(p)ct}$, a dummy variable equal to 1 from the first year t in which firm i (owned by parent p) exports to country c. In column 2, the dependent variable is $Import\ Entry_{i(p)ct}$, a dummy variable equal to 1 from the first year t in which firm i (owned by parent p) imports from country c. Heteroscedasticity robust standard errors in parenthesis. Significance levels: *** 0.01, ** 0.05, * 0.1.

Table A-13

Network Effects of MNC Ownership (Excluding Tax Havens)

	(1)	(2)
	Export Entry	Import Entry
$MNC_{i(p)t} \times In\ MNC_{cp}$	0.027***	0.013**
	(0.007)	(0.007)
Firm-Country FE	Yes	Yes
Firm-Year FE	Yes	Yes
Country-Year FE	Yes	Yes
Observations	194,304	194,304
Estimator	OLS	OLS

The table reports the results of estimating equation (21). In column 1, the dependent variable is $\textit{Export Entry}_{i(p)ct}$, a dummy variable equal to 1 from the first year t in which firm i (owned by parent p) exports to country c. In column 2, the dependent variable is $\textit{Import Entry}_{i(p)ct}$, a dummy variable equal to 1 from the first year t in which firm i (owned by parent p) imports from country c. The sample excludes countries classified as tax haven countries by Dharmapala and Hines (2009). Heteroscedasticity robust standard errors in parenthesis. Significance levels: *** 0.01, ** 0.05, * 0.1.

Table A-14

Network Effects of MNC Ownership: Intensive Margin

	(1)	(2)
	Export Entry	Import Entry
$MNC_{i(p)t} \times In\ MNC_{cp}$	0.040	-0.157
	(0.090)	(0.098)
Firm-Country FE	Yes	Yes
Firm-Year FE	Yes	Yes
Country-Year FE	Yes	Yes
Observations	15,942	10,448
Estimator	OLS	OLS

The table reports the results of estimating equation (21). In column 1, the dependent variable is $\log \textit{Exports}_{i(p)ct}$, the value of exports of firm i (owned by parent p) to country c in year t. In column 2, the dependent variable is $\log \textit{Imports}_{i(p)ct}$, the value of imports of firm i (owned by parent p) from country c in year t. The sample is restricted to countries firm i was already trading with before being acquired. Heteroscedasticity robust standard errors in parenthesis. Significance levels: *** 0.01, ** 0.05, * 0.1.

Appendices

Theoretical Appendix

B-1 Estimating Equations and Fixed Effects

In this appendix, we derive the firm-level gravity equations and the expressions for the fixed effects from our theoretical model. We obtain an expression for the probability of exporting by substituting equation (15) into equation (13) and plugging the resulting expression together with equation (12) into equation (7). We approximate the probability function using a linear model:

$$\Pr(i \text{ exports to } c \text{ in } t) = \beta_3^x(MNC_{i(p)t} \times In\ MNC_{cp}) + k^x + \lambda_{ct}^x + \lambda_{it}^x + \lambda_{ic}^x + \varepsilon_{i(p)ct}^x. \quad (29)$$

Where:

- $\lambda_{ct}^x = \varphi_{ct}^x + \psi_{ct}^x$,
- $\lambda_{it}^x = \overline{\psi}_{i(p)t}^x + \psi_{i(p)t}^x + h_x(MNC_{i(p)t}) + \beta_1^x MNC_{i(p)t}$,
- $\lambda_{ic}^x = \psi_{i(p)c}^x + \beta_2^x In\ MNC_{cp}$,
- $\varepsilon_{i(p)ct}^x = \epsilon_{i(p)ct}^x + \epsilon_{i(p)t}^x$.

λ_{ct}^x accounts for any reason why all firms may trade more with a country over time, such as the introduction of trade agreements. λ_{it}^x controls for firm-specific time-varying forces driving trade, including post-acquisition productivity changes brought about after MNC acquisition. Finally, λ_{ic}^x accounts for any time-invariant explanation of firm-level exports, such as gravity.

Substituting equation (16) into equation (14) and plugging the resulting expression together with equation (12) into equation (8) delivers the following estimating equation for the intensive margin of exports:

$$\log r_{i(p)ct} = \tilde{\beta}_3^x(MNC_{i(p)t} \times In\ MNC_{cp}) + \tilde{k}^x + \tilde{\lambda}_{ct}^x + \tilde{\lambda}_{it}^x + \tilde{\lambda}_{ic}^x + \tilde{\varepsilon}_{i(p)ct}^x. \quad (30)$$

Where:

- $\tilde{\lambda}_{ct}^x = \tilde{\varphi}_{ct}^x + \tilde{\psi}_{ct}^x$,
- $\tilde{\lambda}_{it}^x = \overline{\tilde{\psi}}_{i(p)t}^x + \tilde{\psi}_{i(p)t}^x + \tilde{h}_x(MNC_{i(p)t}) + \tilde{\beta}_1^x MNC_{i(p)t}$,

- $\tilde{\lambda}^x_{ic} = \tilde{\psi}^x_{i(p)c} + \tilde{\beta}^x_2 In\ MNC_{cp}$,
- $\tilde{\varepsilon}^x_{i(p)ct} = \tilde{\epsilon}^x_{i(p)ct} + \tilde{\epsilon}^x_{i(p)t}$.

The interpretation of the fixed effects mirrors that for the extensive margin of exports.

We derive estimating equations for the import decisions using a symmetric argument. The estimating equation for the intensive margin of imports is:

$$\Pr(i \text{ imports from } c \text{ in } t) = \beta^m_3(MNC_{i(p)t} \times In\ MNC_{cp}) + \lambda^m_{ct} + \lambda^m_{it} + \lambda^m_{ic} + \varepsilon^m_{i(p)ct}. \quad (31)$$

Where:

- $\lambda^m_{ct} = \varphi^m_{ct} + \psi^m_{ct}$,
- $\lambda^m_{it} = \overline{\psi}^m_{i(p)t} + \psi^x_{i(p)t} + h_m(MNC_{i(p)t}) + \beta^m_1 MNC_{i(p)t}$,
- $\lambda^m_{ic} = \psi^m_{i(p)c} + \beta^m_2 In\ MNC_{cp}$,
- $\varepsilon^m_{i(p)ct} = \epsilon^m_{i(p)ct} + \epsilon^m_{i(p)t}$.

The estimating equation for the intensive margin of imports is:

$$\log m_{i(p)ct} = \tilde{\beta}^m_3(MNC_{i(p)t} \times In\ MNC_{cp}) + \tilde{\lambda}^m_{ct} + \tilde{\lambda}^m_{it} + \tilde{\lambda}^m_{ic} + \tilde{\varepsilon}^m_{i(p)ct}. \quad (32)$$

Where:

- $\tilde{\lambda}^m_{ct} = \tilde{\psi}^m_{ct}$,
- $\tilde{\lambda}^m_{it} = \overline{\tilde{\psi}}^m_{i(p)t} + \tilde{\psi}^m_{i(p)t} + \tilde{h}_m(MNC_{i(p)t}) + \tilde{\beta}^m_1 MNC_{i(p)t}$,
- $\tilde{\lambda}^m_{ic} = \tilde{\psi}^m_{i(p)c} + \tilde{\beta}^m_2 In\ MNC_{cp}$,
- $\tilde{\varepsilon}^m_{i(p)ct} = \tilde{\epsilon}^m_{i(p)ct} + \tilde{\epsilon}^m_{i(p)t}$.

The interpretation of the fixed effects when looking at import choices mirrors the proposed interpretation for export choices.

B-2 Measuring the Size of MNC Network effects

In this appendix, we provide additional details about the variance decomposition and back-of-the-envelope calculations we present in Section 6.

B-2.1 Decomposing Variation in Export and Import Entry

We employ the Shapley decomposition to decompose the variance of $Entry_{ict}$ in equation (21) into its components, identifying the contribution of MNC network effects and each fixed effect. Intuitively, this method allows us to identify the contribution of each covariate in explaining the variance of a regression outcome of interest in two steps. In the first, it iteratively calculates all the possible ways of decomposing the outcome of interest by eliminating each covariate at once. In the second, it takes the average of the contributions of the covariate.

Because the original method does not accommodate high-dimensional fixed effects as in equation (21), we modify it and proceed in two steps:

1. We regress $Entry_{ict}$ on FE_{ic}, FE_{ct}, and FE_{it} and store the predicted fixed effects (denoted by $\widehat{FE}_{ic}$, $\widehat{FE}_{ct}$, and $\widehat{FE}_{it}$);

2. We regress $Entry_{ict}$ on $MNC_{i(p)t} \times In\ MNC_{cp}$, $\widehat{FE}_{ic}$, $\widehat{FE}_{ct}$, and $\widehat{FE}_{it}$ and apply the Shapley decomposition treating each estimated set of fixed effects as a distinct variable.

We employ this procedure to decompose the probability of export and import entry. The results reported in Table B-1 show that gravity, captured by firm-country fixed effects, explains the largest share of the variance (around 90%). MNC network effects explain a larger share of the remaining variation than firm-year and country-year fixed effects.

Table B-1

Shapley Decomposition of the Probability of Trade Entry

	Firm-Country Fixed Effect	Country-Year Fixed Effect	Firm-Year Fixed Effect	$MNC_{it} \times$ $in\ MNC_{cp}$
Export	90.71%	2.16%	3.22%	3.91%
Import	89.08%	3.66%	1.50%	5.76%

Each column shows the percentage contribution of a factor to explaining the variance of the outcome variable (the probability of export or import entry).

B-2.2 Back-of-the-Envelope Calculations for Firm Growth

We use the structure of our model to infer how exporting to or importing from new countries that belong to the parental network affects affiliates' sales and employment. Our assumption in Section 4 is that firms first make sourcing decisions and then make sales choices. Therefore, we use changes in the set of source countries to infer changes in employment and changes in the set of export countries to measure changes in sales.

Methodology for Sales

By definition, firm-level total sales in year t can be expressed as:

$$p_{it}y_{it} = \sum_{c \in C_{it}} p_{ict}q_{ict}$$

. We define the following indicator function:

$$\mathbf{1}^{x}_{ict} = \mathbf{1}\{MNC_{it} = 1 \ \& \ EntryX_{ict} = 1 \ \& \ MNCdate_i \leq EntryXdate_{ic} \ \& \ In\ MNC_{cp} = 1\},$$

where:

- $MNC_{it} = 1$ if firm i is owned by an MNC at time t;
- $EntryX_{ict} = 1$ since the first year firm i exports to country c;
- $MNCdate_i$ is the year in which firm i is acquired by an MNC;
- $EntryXdate_{ic}$ is the year in which firm i starts exporting to c;
- $In\ MNC_{cp} = 1$ if country c belongs to the network of parent p.

In words, $\mathbf{1}^{x}_{ict} = 1$ if firm i is owned by an MNC at time t and started exporting to country c belonging to the parental network after the acquisition year.

Then, we express firm i's total sales in year t post MNC acquisiton as:

$$Y^{'}_{it} = \frac{1}{|S_{it}|} \sum_{c \in S_{it}} \left(p_{ict}q_{ict} \times MNC_{it} \right).$$

Firm i's sales in year t attributable to the addition of new countries belonging to the MNC network after MNC acquisition are instead:

$$Y^{''}_{it} = \frac{1}{|S_{it}|} \sum_{c \in S_{it}} \left(p_{ict}q_{ict} \times \mathbf{1}^{x}_{ict} \right).$$

By definition, Y''_{it} is a subset of Y'_{it}, and Y''_{it}/Y'_{it} is the share of sales attributable to MNC network effects in year t. Its average across affiliates and time in our data is 13%. Multiplying this share by the total change in sales due to MNC acquisitions in Table 2 allows us to infer the average annual change in sales due to MNC network effects.

Methodology for Employment

Applying Shephards' Lemma to equation (4) implies that firm i's material input demand from country $c \in S_{it}$ at time t is:

$$b_{ict}x_{ict} = M_{it}B_{it}^{\sigma-1}\xi_{ict}^{\sigma-1}b_{ict}^{1-\sigma}.$$

Similarly, firm i's labor demand at time t is:

$$w_tL_{it} = M_{it}B_{it}^{\sigma-1}\xi_{iLt}^{\sigma-1}w_t^{1-\sigma}.$$

Taking the ratio of these two equations delivers the following expression for firm i's material input expenditure share on country $c \in S_{it}$ at time t:

$$s_{ict} \equiv \frac{b_{ict}x_{ict}}{\sum_{c\in S_{it}} b_{ict}x_{ict} + w_tL_{it}} = \frac{\xi_{ict}^{\sigma-1}b_{ict}^{1-\sigma}}{\sum_{c\in S_{it}} \xi_{ict}^{\sigma-1}b_{ict}^{1-\sigma} + \xi_{iLt}^{\sigma-1}w_t^{1-\sigma}}.$$

Firm i's labor expenditure share at time t is:

$$s_{iLt} \equiv \frac{w_tL_{it}}{\sum_{c\in S_{it}} b_{ict}x_{ict} + w_tL_{it}} = \frac{\xi_{iLt}^{\sigma-1}w_t^{1-\sigma}}{\sum_{c\in S_{it}} \xi_{ict}^{\sigma-1}b_{ict}^{1-\sigma} + \xi_{iLt}^{\sigma-1}w_t^{1-\sigma}}.$$

Therefore, we can express firm i's labor demand at time t as:

$$w_tL_{it} = \frac{s_{iLt}}{s_{ict}}b_{ict}x_{ict} \qquad \Longleftrightarrow \qquad w_tL_{it} = \frac{1}{|S_{it}|}\sum_{c\in S_{it}} \frac{s_{iLt}}{s_{ict}}b_{ict}x_{ict}.$$

We define the following indicator function:

$$\mathbf{1}_{ict}^{m} = \mathbf{1}\{MNC_{it} = 1 \ \& \ EntryI_{ict} = 1 \ \& \ MNCdate_i \leq EntryIdate_{ic} \ \& \ In\ MNC_{cp} = 1\}.$$

Where:

- $MNC_{it} = 1$ if firm i is owned by an MNC at time t;
- $EntryI_{ict} = 1$ since the first year firm i sources from country c;

- $MNCdate_i$ is the year in which firm i is acquired by an MNC;
- $EntryIdate_{ic}$ is the year in which firm i starts sourcing from c;
- $In\ MNC_{cp} = 1$ if country c belongs to the network of parent p.

In words, $\mathbf{1}^m_{ict} = 1$ if firm i is owned by an MNC at time t and started sourcing from country c belonging to the parental network after the acquisition year.

Then, we express firm i's labor demand in year t post MNC acquisition as:

$$L^{(1)}_{it} = \frac{1}{|S_{it}|} \sum_{c \in S_{it}} \left(\frac{s_{iLt}}{s_{ict}} b_{ict} x_{ict} \times MNC_{it} \right).$$

Firm i's labor demand in year t attributable to the addition of new countries belonging to the MNC network after MNC acquisition is instead:

$$L^{(2)}_{it} = \frac{1}{|S_{it}|} \sum_{c \in S_{it}} \left(\frac{s_{iLt}}{s_{ict}} b_{ict} x_{ict} \times \mathbf{1}^m_{ict} \right).$$

By definition, $L^{(2)}_{it}$ is a subset of $L^{(1)}_{it}$, and $L^{(2)}_{it}/L^{(1)}_{it}$ is the share of labor demand attributable to MNC network effects in year t. Its average across affiliates and time in our data is 14%. Multiplying this share by the total change in employment due to MNC acquisitions in Table 2 allows us to infer the average annual change in employment due to MNC network effects.