Working Paper Research

September 2024 No 456

Multinational networks and trade participation

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National Bank OF BELGIUM
Eurosystem

Publisher

Pierre Wunsch, Governor of the National Bank of Belgium

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The Working Papers are available on the website of the Bank: http://www.nbb.be

ISSN: 1375-680X (print)
ISSN: 1784-2476 (online)

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 provide 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. We find that acquired firms are more likely to start trading with countries that belong to—or that are exogenously added to—their parental network. Network effects extend beyond MNC boundaries and dominate traditional firm-level channels in explaining affiliates' entry in new markets. Our analysis suggests that the growth rate of acquired firms is more than twice as large as that of the median domestic firm due to MNC network effects.

Keywords: Multinational Firms, International Business, Firm Behavior: Empirical Analysis.

JEL Codes: F23,D22.

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We wish to thank Pol Antràs, David Atkin, Joaquín Blaum, Kirill Borusyak, Banu Demir, Peter Egger, Lionel Fontagné, Teresa Fort, Gordon Hanson, Paul Horsler, Beata Javorcik, Wolfgang Keller, Rocco Macchiavello, Isabela Manelici, Ignacio Marra, Thierry Mayer, Eduardo Morales, Michael Peters, Veronica Rappoport, Steve Redding, Andrés Rodríguez-Clare, Meredith Startz, Dan Trefler, and Jose Vasquez, as well as participants at the IES workshop at Princeton, the NBER Summer Institute on International Trade and Investment, the ERWIT, EOS, GEP, RIEF, and CESifo conferences, the workshop on International Trade and Multilateralism, the Trade and Development workshop, the CITP conference, the conference on Trade and Value Chains at the Bank of Italy, and seminars at the LSE, Brandeis, Bielefeld, Durham, UCD, IADB, CEPII, Cambridge, Kings, and Oxford for their comments. We are grateful to Camin McCluskey, Afrola Plaku, and Tommaso Sonno for their help with the data. This project started while Glenn Magerman was at the National Bank of Belgium. Paola Conconi gratefully acknowledges financial support from the European Research Council (Advanced ERC Grant Agreement No. 834253). Glenn Magerman gratefully acknowledges funding from the Fonds de la Recherche Scientifique (FRS-FNRS Grant No. H.P046.20).The views expressed in this paper are those of the authors and do not necessarily reflect the views of the National Bank of Belgium, the Eurosystem, or any other institution with which the authors are affiliated.

Non-technical summary

Multinational corporations (MNCs) dominate international trade, accounting for almost two thirds of the value of global trade flows. What is the role of MNC ownership on acquired firms' outcomes? Earlier work has identified several channels that affect firm-level outcomes, including productivity increases, technology transfers, etc. In this paper, we put forward a novel mechanism that contributes to this dominance.

Upon acquisition by an MNC, a firm gains access to the MNC's global network of affiliates, significantly reducing trade barriers with countries within that network. 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 export and import values, and trade with more countries. Moreover, non-trade outcomes are also affected: acquired firms increase sales, hire more workers, and become more productive. These network effects are not limited to trading between affiliated firms but extend to nearby countries, indicating that MNCs help alleviate trade frictions even in broader regions around their network. Moreover, the MNC network effects are stronger when the target countries are geographically or culturally distant from Belgium. The findings suggest that MNC ownership helps firms navigate complex international trade environments by reducing fixed costs, such as those associated with entering new markets or complying with local regulations.

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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 make up only 1% of the population of firms, but are responsible for 60% of total exports and 65% of imports.

In this paper, we put forward a novel mechanism that contributes to this dominance. We show that multinational ownership reduces country-specific trade frictions, making it easier for acquired firms to export to and import from countries in which their parent has other affiliates.[1] We label this mechanism "MNC network effects", and isolate it from firm-specific channels emphasized in the existing literature, such as productivity increases due to technological or managerial transfers.[2] We find that MNC network effects explain more of the variance in new affiliates' entry in foreign markets than standard firm-level effects and account for a large share of their growth after being acquired. We also provide systematic evidence that the effects of MNC ownership are not confined to the boundaries of the multinational.

We start by evaluating the effects of MNC ownership on firms' 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 export and import values, and trade with more countries. Moreover, non-trade outcomes are also affected: acquired firms increase sales, hire more workers, and become more productive. These effects are identified by comparing acquired firms with never-acquired and not-yet-acquired firms and account for selection effects through a re-weighting methodology that allows us to create a group of untreated firms that is indistinguishable from the group of treated firms in terms of several moments of the distribution (mean, variance, and skewness) of a large set of observables.

Our main contribution is to theoretically and empirically isolate a novel network-specific mechanism behind the effects of MNC ownership. We provide a theoretical model in which firms choose which countries to source their inputs from to minimize costs and where to sell their output to maximize profits. MNC ownership can affect export and import decisions of new affiliates both at the extensive and intensive margins, through firm-specific channels

[1] A large gravity literature reviewed by Disdier and Head (2008) and Head and Mayer (2014) shows that bilateral frictions (e.g., physical distance, cultural differences, tariffs and non-tariff barriers) hamper trade.

[2] 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).

(e.g., increased productivity through technological or managerial transfers) and firm-country specific channels (e.g., alleviation 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 MNC network effects.

We bring the model to the data by combining firm-level information from the NBB with the Orbis and Historical Orbis datasets from Moody's 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. Our baseline estimates are identified by exploiting within-firm variation in MNC ownership status and cross-firm variation in the geographical structure of multinational networks. The firm-level gravity regressions provide evidence of "MNC network effects" at the extensive margin: post acquisition, Belgian affiliates are more likely to start trading with countries in which their parent has other affiliates; controlling for gravity and firm-level effects of MNC ownership, the probability that a new affiliate starts exporting to (importing from) a country in its parental network increases by 24% (26%). Instead, we do not find 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.

We also exploit changes in affiliates' MNC networks driven by plausibly exogenous mergers and acquisitions (M&As). For this purpose, we use data from Orbis M&A to identify Belgian affiliates that change global ultimate owner (GUO) during our sample period, and require that they are not directly controlled by their (old or new) GUO and do not to operate in their (old or new) GUO's primary or secondary line of business.[3] The identifying assumption is that the trade choices of these Belgian firms are orthogonal to the reasons for the M&As between their GUOs. We find that affiliates are more likely to start exporting to and importing from countries that are added to their MNC networks following these global ownership changes.

Our analysis suggests that, through their networks of affiliates, MNCs alleviate country-specific trade frictions that deter firms from entering new export and import markets. Four sets of findings provide additional insights into the nature of the frictions alleviated by multinational ownership and indicate that the effects are not confined to trade between affiliates of the same parent.[4] First, MNC network effects increase with geographical and cultural distance, suggesting that multinational ownership alleviates trade frictions related to grav-

[3]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.

[4]Carballo *et al.* (2022) also show that MNCs generate network effects outside their boundaries: using data from Uruguay, they find that new independent suppliers of MNCs are more likely to start exporting to countries in which the respective multinational is headquartered or has an affiliate.

ity. If MNC network effects were solely driven by intra-firm trade, we would instead expect them to 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. Second, 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 to—but do not belong to—their parents' network. By definition, these "extended MNC network effects" operate outside the boundaries of the multinational because they involve countries in which the parent has no affiliate presence. These effects can be due to geographical or cultural closeness to the MNC affiliate, or similarity in market conditions and access, in analogy to the extended gravity effects shown in Morales *et al.* (2019, 2023). Third, the effects of multinational ownership are persistent: firms continue to trade with countries that exit their parental network following exogenous ownership changes, suggesting that MNC networks reduce fixed costs that are sunk upon entry and that these effects are not confined to trade with other affiliates of the same parent. Finally, if 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. Using the bilateral upstreamness measures of Alfaro *et al.* (2019), we show that the probability that an acquired firm starts exporting to (and importing from) a country that belongs to its parental network is orthogonal to 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, we find that our novel MNC network channel explains a larger share of new affiliates' export and import entry probability than traditional firm-level explanations. Combining the structure of our model with the empirical 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. Our analysis suggests that the growth rate of acquired firms is more than twice as large as that of the median domestic firm due to MNC network effects: acquired firms' sales (employment) grew by 4.1% (2.7%) per year due to MNC network effects, whereas non-acquired firms' median annual sales (employment) growth is 1.9% (0.0%).

Our analysis suggests that firms face sizable trade frictions, which deter their entry into new export and import markets. Reducing such frictions is a widespread goal of trade promotion agencies established by the governments of many countries.[5] Our results show that, through their networks, MNCs can alleviate entry barriers in foreign markets, making it possible for their affiliates to expand the set of countries in which they have customers

[5]For example, the Belgian Foreign Trade Agency organizes economic missions and disseminates information and documentation about foreign markets. See `https://www.abh-ace.be/en/about-bfta`. Some studies show that export promotion policies can be effective at boosting trade (e.g., Martincus and Carballo, 2008; Lederman *et al.*, 2010).

and suppliers.

Our paper is related to three main streams of literature. A first stream studies the effects of multinational ownership. Much of this literature focuses on the productivity of acquired firms (e.g., Aitken and Harrison, 1999; Arnold and Javorcik, 2009) or on multinationals' productivity spillovers (e.g., Haskel *et al.*, 2007; Keller and Yeaple, 2009; Javorcik, 2004; Alfaro-Ureña *et al.*, 2022). A few studies show that multinational ownership can alleviate financial constraints faced by acquired firms (e.g., Harrison *et al.*, 2004; Manova *et al.*, 2015).[6] The closest paper 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 the more general effects of multinational ownership on the trade participation of new affiliates: they are more likely to start exporting to and importing from countries in which their parent already operates and other countries connected to them, not only within their distribution networks.

We also contribute to the literature on networks in trade. Several studies model frictions in networks (e.g., Jackson and Rogers, 2007; Chaney, 2014), while others show that social and ethnic networks reduce information frictions between buyers and sellers (e.g., Rauch, 1999; Rauch and Trindade, 2002).[7] Some of our results relate to the extended gravity literature, showing that lowering 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). Using cross-sectional data on U.S. MNCs, Antràs *et al.* (2024) find that multinational parents are more likely to trade with countries that are proximate to their affiliates, consistent with MNC-level fixed costs of trade. Ours is the first paper to identify network and extended network effects of MNC ownership on affiliates' activities.

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.[8] For example, Ashenfelter and 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

[6] Our paper also relates to the literature on the location decisions of MNCs (e.g., Tintelnot, 2017; Head and Mayer, 2019; Garetto *et al.*, 2019; and Oberfield *et al.*, 2024).

[7] A few 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). There is also an emerging literature on the role of buyer-seller relationships (e.g., Bernard and Moxnes, 2018; Bernard *et al.*, 2022).

[8] One exception is the paper by Blonigen and Pierce (2016), who use confidential data from the U.S. Census Bureau to study the impact of domestic M&As on productivity and market power.

effects of multinational acquisitions in beer and spirits. None of these papers examine how multinational acquisitions affect affiliates' trade participation.

The rest of the paper is structured as follows. Section 2 presents the data used. Section 3 shows that MNC ownership boosts affiliates' overall trade participation. Section 4 develops a model in which MNC ownership affects export and import choices through firm-specific and network-specific channels. Section 5 evaluates the model's predictions about MNC network effects. Section 6 offers some evidence about the types of frictions that MNCs alleviate. Section 7 discusses the importance of MNC network effects. Section 8 concludes.

2 Data

In this section, we describe the data sources and methodology used to identify Belgian firms acquired by MNCs and construct multinational networks. Section A-1 of the Empirical Appendix provides more details on the data construction and summary statistics.

2.1 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 firms' number of full-time equivalent employees, labor cost, sales, value-added, input expenditure, and fixed assets. All flow variables are annualized to map to 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 the Belgian affiliates of foreign multinationals: for each Belgian firm with a foreign parent, the survey reports the parent's location, name, year of acquisition, and equity share. We 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 dataset provides information on firm-level exports and 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 firms whose annual trade flows (overall receipts or shipments) exceed a certain threshold.[9] For each firm in Belgium, we observe the value of its exports to each

[9]Thresholds are set by individual member states so that reported trade covers at least 97% of total

destination country and its imports from each source country.

We obtain information on the main economic activity of the firm from the Crossroads Bank for Enterprises, reporting 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.[10]

We collect information about the corporate structure of each Belgian affiliate's multinational parents using three datasets from Moody's, which can be linked using the firm identifiers: Orbis, Historical Orbis, and Orbis M&A. We use the first dataset to collect information on the direct parent of each Belgian affiliate and to identify its global ultimate owner, the second to identify the countries where the multinational parents have other affiliates, and the third to identify changes in the GUOs of Belgian affiliates. We also use the Belgian Input-Output tables for the year 2010 at the level of 124 NACE sectors to measure the vertical distance along supply chains between affiliates of the same multinational.

Finally, 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). We use this dataset to obtain information about characteristics of each country (e.g., GDP per capita, population size, geographical coordinates) and distance between countries (in kilometers). Information on the cultural distance between countries comes from Melitz and Toubal (2014).

2.2 New Foreign Affiliates and their Multinational Network

We apply several criteria to select the Belgian firms to include in our analysis. First, we exclude very small firms, which do not report at least one full-time equivalent employee in at least one year. Second, we focus 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), for which we can observe exports and imports throughout our sample period.[11] Third, we consider domestic firms and affiliates of foreign multinationals, excluding

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/.

[10] We impose two criteria to avoid losing observations due to missing values. First, we interpolate missing values in the annual accounts. We do so only if the length of the missing spell is not longer than three consecutive years. Second, some firms always appear in the annual accounts but are in the Foreign Trade dataset only for 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. As we cannot distinguish between these two cases, we treat all such missing trade values as zeros.

[11] We exclude firms operating in tradable service sectors due to changes in the NBB data collection procedures: the NBB provides a quasi-exhaustive picture of firm-level trade in services up to 2005. Unfortunately,

Belgian multinationals, i.e., firms that engage in outward FDI.[12]

The sample includes Belgian firms that are affiliates of foreign multinationals for at least part of the sample period.[13] To examine the effects of MNC ownership, we exploit the fact that some of these firms switch from domestic to foreign ownership during our sample period. To identify these "switchers", we apply three additional selection criteria. First, we exclude firms already foreign owned in 1997, for which we cannot determine the acquisition date. Second, 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 acquisitions. Last, we exclude firms that switch between domestic and MNC ownership multiple times, as their trade participation can be affected by the reversal of MNC ownership status.[14] While the number of firms that switch from domestic to foreign owned is relatively small (115), the sample used to identify MNC network effects is much larger, since the firm-level gravity regressions are estimated at the firm-country-year level, across all the countries in which an MNC could potentially have a presence.

To construct the multinational network of new foreign affiliates, we proceed in two steps. First, we search for the firm identifier of the direct parent (DP) of each Belgian affiliate in the Orbis database. DPs typically own the vast majority of their affiliates' equity share (the mean ownership share is 89.12% and the median is 99.98%). Second, we retrieve the corporate structure of each parent from Historical Orbis (HO) and all the countries in which the DP has a presence.[15] We also construct the network of the global ultimate owner (GUO). For each Belgian affiliate, we use the subsidiary files in HO to find the GUO of its DP, and collect all the countries in which the GUO has subsidiaries.[16]

Figure 1 illustrates geographical variation in MNC networks, focusing on two Belgian affiliates, denoted by A and B. The DPs of both affiliates are located in the Netherlands. However, their networks differ not only in size (63 countries for the DP of affiliate A, 26 for

afterwards the collection system has become survey-based (see Ariu *et al.*, 2020).

[12]The predictions of our theoretical model apply to affiliates of both foreign and Belgian MNCs. However, the NBB data does not allow us to identify firms acquired by Belgian multinationals.

[13]After excluding firms that do not report at least one full-time equivalent employee in at least one year, there are 2,578 foreign affiliates. The number is reduced to 633 once we restrict the sample to affiliates operating in tradable sectors. After also excluding firms engaged in outward FDI, the sample includes 312 Belgian affiliates of foreign MNCs.

[14]After excluding firms under foreign control at the start of the sample, there are 182 affiliates of foreign MNCs. Removing those born through greenfield FDI leaves us with 174 affiliates, 115 of which switched from domestic to foreign ownership once during our sample period.

[15]The information on ownership is available in each year from 2007. Since HO information is only available as of 2007, we code this variable for the year in which a firm is acquired or in 2007, whichever is later.

[16]This is given by the 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.

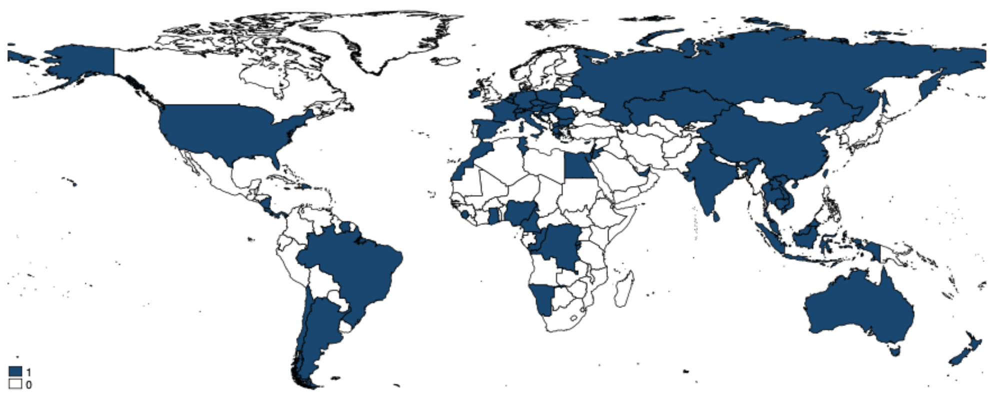
the DP of affiliate B), but also in the geographical structure: there are countries in which only the parent of affiliate A has a presence (e.g., Australia, Chile, and India); and others in which only the parent of affiliate B has a presence (e.g., Mexico, Canada, and Japan).

Anecdotal evidence suggests that the trade expansion of new foreign affiliates may be skewed towards countries that belong to their parental network. For example, a Belgian firm in our sample was acquired in 1999 by a DP located in Japan. Before the acquisition, this firm was not exporting at all. From 2000, it started exporting to Japan and other countries belonging to its parent's network (e.g., the United States). The results presented in Section 5 show that the geographical structure of the parental network systematically affects the probability of affiliates' export and import entry into new foreign markets.

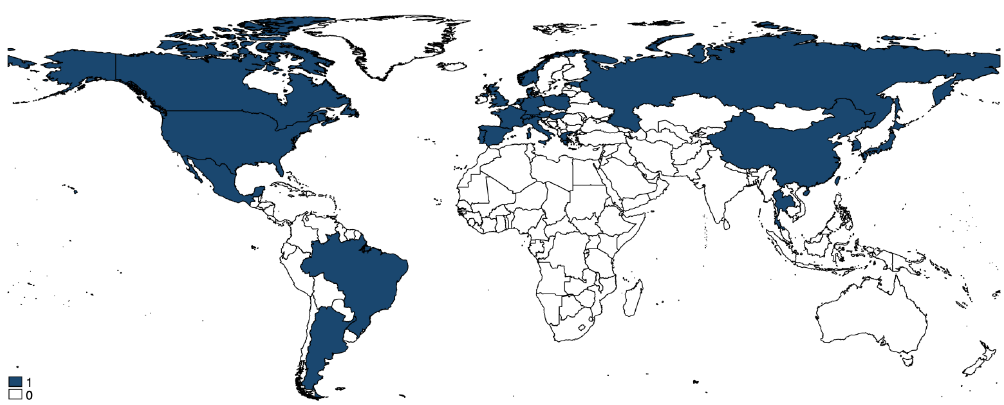
Figure 1

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.

3 MNC Ownership and Overall Trade Participation

In this section, we present evidence that MNC ownership increases the overall trade activity of affiliates in Belgium. We also show that ownership switches also boost non-trade activities. These findings are consistent with previous studies focusing on other countries, e.g., Indonesia (Arnold and Javorcik, 2009), Spain (Guadalupe *et al.*, 2012), and Turkey (Bircan, 2019).

3.1 Empirical Strategy and Results

We estimate the following equation on the sample of both acquired and non-acquired firms:

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

y_{it} is the 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.[17] The variables δ_i and δ_t are firm and year fixed effects, respectively, and u_{it} is an error term.

Acquired firms are systematically different from non-acquired firms: even before acquisition, future affiliates outperform always-domestic firms in many dimensions (see the descriptive statistics and the event studies in the Empirical Appendix Sections A-1 and A-2, respectively). If better performing firms are selected into MNC ownership, estimating equation (1) via OLS would thus deliver an upward-biased estimate of the coefficient of interest θ.

To account for selection effects, we employ Hainmueller (2012)'s entropy balance reweighting algorithm.[18] For each year, we consider firms acquired in that year as treated observations and never-acquired firms as control units. We pool treated and control units across all years and use the algorithm to assign a weight between 0 and 1 to each firm. Table A-5 shows that the algorithm guarantees that treated firms are indistinguishable from untreated firms in terms of multiple moments of the distribution of several characteristics used to construct the weights: fixed assets, number of employees (full-time equivalents), total sales, number of export and import countries, export and import values (both in levels and in growth rates), and various characteristics of the countries they trade with (i.e., distance

[17] When considering some of the outcomes (export/import values, the number of export/import countries), the dependent variable is expressed as $\log(1 + y_{it})$, to account for both extensive and intensive margin effects. The results are robust to using the inverse hyperbolic sine transformation which, unlike the log transformation, is defined at zero (Burbidge et al., 1988; MacKinnon and Magee, 1990).

[18] The key advantage of this method is that unlike other 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. See Egger and Tarlea (2020) for an example of the same re-weighting strategy.

from Belgium, GDP per capita in PPP, longitude, and latitude).[19]

Table A-6 shows that, after applying entropy balance re-weighting, the group of treated firms is also similar to the group of untreated firms in terms of the first three moments of the distribution of non-targeted characteristics (i.e., variables not used to create the weights, including the number of exported and imported products, and other trade-related variables at the bilateral level), alleviating concerns of remaining selection on unobservables.

The results of estimating equation (1) on the re-weighted sample are reported in Table 1. The coefficient on MNC_{it} is positive and significant at the 1% level across all specifications, indicating that MNC ownership increases new affiliates' trade participation. 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 11% (12%).[20]

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
Re-weighting	Yes	Yes	Yes
Observations	93,171	93,171	93,171
Estimator	OLS	OLS	OLS

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. Significance levels: *** 0.01, ** 0.05, * 0.1.

It is interesting to compare the results of Table 1 with the corresponding results in Table

[19]The algorithm assigns a weight of 1 to treated firms, and a weight between 0 and 1 to non-treated firms (with their sum constrained to be equal to 1). The initial sample includes 22,626 firms. 5,391 of them (24%) receive a positive weight, due to missing values in some characteristics. The average weight among non-treated firms in our sample is 0.017, and the standard deviation is 0.077.

[20]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 that approach. As expected, this method accurately matches groups in terms of their average characteristics but not in terms of higher moments of their distribution.

A-8, in which we estimate equation (1) without re-weighting the sample. The coefficients in that table are more than twice as large, emphasizing the importance of accounting for selection effects: for example, re-weighting decreases the coefficient of the exporter dummy from 0.127 to 0.046. For the number of export values, the coefficient decreases from 2.259 to 0.788, and for export countries 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 again employ the entropy balance re-weighting algorithm to study the effects of MNC ownership 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 increase value added and productivity.[21] In particular, post acquisition, employment and value added increase by 20%, sales by 32%, and productivity by 17% on average.[22]

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

	(1) Employment	(2) Sales	(3) Value Added	(4) 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
Re-weighting	Yes	Yes	Yes	Yes
Observations	71,979	75,645	73,964	71,347
Estimator	OLS	OLS	OLS	OLS

The table reports the results of estimating equation (1). The dependent variables are the log of $Employment_{it}$, $Sales_{it}$, $Value\ Added_{it}$, and $Productivity_{it}$. 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.

In Section 7, we combine the estimates of Table 2 with the structure of our theoretical model to compute the fraction of sales and employment growth attributable to MNC network effects.

[21] We estimate productivity as TFP recovered from a gross output Cobb-Douglas production function at 2-digit NACE sectors, using a control function approach with material inputs as proxy variable, implemented using the procedure in Wooldridge (2009).

[22] Table A-10 reports the corresponding results without re-weighting the sample. As expected, estimated coefficients are larger, again emphasizing the importance of accounting for selection effects.

4 A Model of Multinational Ownership and Trade

The previous section shows that MNC ownership increases new affiliates' overall trade participation. This section provides 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 regulations or market conditions. The model allows us to separate network-specific mechanisms 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. In addition, our approach does not require us to take a stand on the reasons for multinationals' acquisitions.[23]

4.1 Environment

The world economy consists of a set of countries, denoted by c, each populated by firms, denoted by i. There is an infinite sequence of periods, denoted by t.

Demand

Demand Q_{ct} in country c at time t is given by a constant elasticity of substitution (CES) aggregator of the form:

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

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

[23] In our empirical analysis, we address concerns about of the endogeneity of these acquisitions by exploiting plausibly exogenous changes in global ownership structures.

Production Technology

Firms produce output q_{it} with CES technology:

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

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 (endogenous) set of countries firm i sources material inputs from at time t. We denote the elasticity of substitution between inputs of production by σ. z_{it} is firm i's Hicks-neutral productivity at time t, whereas ξ_{iLt} and ξ_{ict} are firm-level 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:

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

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 the marginal cost of selling to country c at time t is $c_{ict} = \tau_{ict} c_{it}(S_{it})$.

Firm Choices

Firms are price takers in their input markets and monopolistically competitive in output markets. In each period, firm i chooses labor (L_{it}), a set of source countries (S_{it}), a vector of material inputs ($\mathbf{x_{ict}}$), a set of export destinations (C_{it}), and a vector of prices ($\mathbf{p_{ict}}$) to maximize profits, separable by destination:

$$\pi_{it} = \max_{\substack{L_{it}, S_{it}, \mathbf{x_{ict}}, \\ C_{it}, \mathbf{p_{ict}}}} \sum_{c \in C_{it}} \underbrace{(p_{ict} - \tau_{ict} c_{it}(S_{it})) q_{ict}}_{\equiv \pi_{ict}} - \sum_{c \in C_{it}} w_t F^x_{ict} - \sum_{c \in S_{it}} w_{ct} F^m_{ict}. \tag{5}$$

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 from now on. 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. We assume that there are no fixed costs when sourcing inputs domestically.[24]

Each period, we assume that firms first choose domestic and foreign inputs to minimize production costs. Conditional on their input choice, they then decide where to sell their final goods to maximize profits. We solve the firm's problem using backward induction.

4.2 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 $q_{ict} = E_{ct}P_{ct}^{\eta-1}p_{ict}^{-\eta}\zeta_{ict}^{\eta-1}$ where E_{ct} is total expenditure in c at t. Profit maximization from equation (5) delivers the 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:

$$\Pr\left(\underbrace{\log(\bar{\eta}-1)\bar{\eta}^{-\eta}}_{k^x} + \underbrace{\log E_{ct}P_{ct}^{\eta-1}}_{\varphi_{ct}^x} + \underbrace{(1-\eta)\log c_{it}(S_{it})}_{\varphi_{it}^x} + \underbrace{(\eta-1)\left(\log\zeta_{ict} - \log\tau_{ict}\right)}_{\varphi_{ict}^x} \geq \underbrace{\log F_{ict}^x}_{f_{ict}^x}\right). \tag{6}$$

Equation (6) 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 and 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

[24] In the model, we do not distinguish between export and import sunk and per-period fixed costs. We provide empirical evidence that input and export fixed costs are at least partially sunk in Section 6.

for the intensive margin of exports:[25]

$$\log r_{ict} = \underbrace{(1-\eta)\log\bar{\eta}}_{\tilde{k}^x} + \underbrace{\log E_{ct}P_{ct}^{\eta-1}}_{\tilde{\varphi}_{ct}^x} + \underbrace{(1-\eta)\log c_{it}(S_{it})}_{\tilde{\varphi}_{it}^x} + \underbrace{(\eta-1)\left(\log\zeta_{ict} - \log\tau_{ict}\right)}_{\tilde{\varphi}_{ict}^x}. \quad (7)$$

Similar to equation (6), equation (7) 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 and variable costs ($\tilde{\varphi}_{ict}^x$). In contrast to equation (6), 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 and 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., $\frac{B_{it}(S_{it}\setminus\{c\})}{z_{it}} + w_{ct}F_{ict}^m \leq \frac{B_{it}(S_{it})}{z_{it}}$. We can express the probability that this inequality holds as:

$$\Pr\left(-\underbrace{\log w_{ct}}_{\varphi_{ct}^m} - \underbrace{\log z_{it}}_{\varphi_{it}^m} + \underbrace{\log\left(B_{it}(S_{it}\setminus\{c\}) - B_{it}(S_{it})\right)}_{\varphi_{ict}^m} \geq \underbrace{\log F_{ict}^m}_{f_{ict}^m}\right). \quad (8)$$

Equation (8) 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), and two firm-country-year components.[26] The first reflects a firm's reduction in its input price index 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.

[25] The tildes used for the components of equation (7) reflect the fact that, when examining the intensive margin, these terms can only be estimated using the subset of countries to which a firm already exports prior to year t. By contrast, when estimating the extensive margin in (6), we can use all country-year observations.

[26] 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 (8). This differs from Antràs *et al.* (2017), who let production quantity directly depend on the set of sourcing origins.

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.[27] Taking logs delivers the following equation for the intensive margin of imports:

$$\log m_{ict} = \underbrace{\log M_{it} + (\sigma-1)\log B_{it}}_{\tilde{\varphi}_{it}^{m}} + \underbrace{(\sigma-1)(\log \xi_{ict} - \log b_{ict})}_{\tilde{\varphi}_{ict}^{m}}. \tag{9}$$

Similar to equation (8), equation (9) 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 to variable costs ($\tilde{\varphi}_{ict}^{m}$). As in equation (7), fixed costs do not enter the intensive margin of imports.

4.3 The Role of MNC Ownership

Post acquisition, MNC ownership can affect firm outcomes over time (e.g., affiliates may become more productive), as well as firm-country outcomes over time (e.g., affiliates may face lower frictions to trade with particular markets in which their multinational parent already has a presence). The model provides multiple channels through which these components can affect trade outcomes. In particular, the following objects can be affected by MNC ownership:

$$\{z_{it}, \xi_{iLt}, S_{it}, C_{it}, F_{ict}^{m}, F_{ict}^{x}, \zeta_{ict}, \xi_{ict}, \tau_{ict}, b_{ict}\}. \tag{10}$$

The first component (z_{it}) represents the traditional firm-level effect of MNC ownership on firm outcomes: post acquisition, firms can become more productive, e.g., due to transfers of technology and managerial practices. In turn, these productivity gains can boost overall trade participation inducing firms to enter more markets and sell more in each entered market (Melitz, 2003). Acquisition might also affect labor productivity through such transfers via ξ_{iLt}. MNC ownership can also affect the set of source and destination countries, S_{it} and C_{it}.

Our main goal is to evaluate the contribution of firm-country-specific effects of MNC ownership. For example, the multinational acquiring firm i may have knowledge of the local regulations and red tape in the countries in which it already operates. Post-acquisition, i may thus face lower fixed costs of exporting to and importing from those network countries

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

(F^m_{ict}, F^x_{ict}), which would increase its probability of entry. All other *ict* terms in (10) can also affect trade participation (at the extensive and intensive margin). For example, MNC ownership can: shift demand for a firm's output (ζ_{ict}), e.g., through brand recognition; shift a firm's input demand (ξ_{ict}), e.g., through better quality monitoring or customization of inputs; lower variable trade costs (τ_{ict}), e.g., through the parent's distribution network; lower input prices (b_{ict}), e.g., by improving access to higher quality/lower price suppliers.

In what follows, we show how MNC ownership can affect both firm and firm-country variables in a flexible way, while still delivering straightforward estimation equations. From now on, we use the subscript $i(p)$ to indicate variables pertaining to firm i when owned by parent p. We also make use of the following indicator variables: $MNC_{i(p)t}$, which is equal to 1 if firm i is owned by parent p at time t and 0 otherwise; and $In\ MNC_{cp}$, which is equal to 1 if country c belongs to the network of parent p and 0 otherwise.

Firm-Level MNC Effects

We let MNC ownership affect firm-year variables at the extensive margin (equations (6) and (8)) as:

$$\varphi^j_{i(p)t} = \overline{\psi}^j_{i(p)t} + h_j(MNC_{i(p)t}) + \epsilon^j_{i(p)t} \quad \text{for } j \in \{x, m\}. \tag{11}$$

In words, firm-year variables governing the extensive margin of export and import choices depend on an average component ($\overline{\psi}^j_{i(p)t}$), a function of MNC ownership status, which we denote by $h_j(MNC_{i(p)t})$, and an error term ($\epsilon^j_{i(p)t}$). 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 (7) and (9), respectively.

Equation (11) 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 c is either a potential source of inputs or a potential export destination, as:

$$\varphi^j_{i(p)ct} - f^j_{ict} = \psi^j_{ct} + \psi^j_{i(p)t} + \psi^j_{i(p)c} + g_j(MNC_{i(p)t}, In\ MNC_{cp}) + \epsilon^j_{i(p)ct} \text{ for } j \in \{x, m\}, \tag{12}$$

$$\tilde{\varphi}^j_{i(p)ct} = \tilde{\psi}^j_{ct} + \tilde{\psi}^j_{i(p)t} + \tilde{\psi}^j_{i(p)c} + \tilde{g}_j(MNC_{i(p)t}, In\ MNC_{cp}) + \tilde{\epsilon}^j_{i(p)ct} \text{ for } j \in \{x, m\}. \tag{13}$$

In words, firm-country-year variables governing the extensive margin of export and import choices in equation (12) depend on averages ψ^j_{ct}, $\psi^j_{i(p)t}$, and $\psi^j_{i(p)c}$, a function of MNC ownership and the global presence of MNC parents, which we denote by $g_j(MNC_{i(p)t}, In\ MNC_{cp})$, and an error term ($\epsilon^j_{i(p)ct}$). A similar definition applies to the firm-country-year components governing the intensive margin of export and import choices, denoted by a tilde, in equation (13).

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 MNC networks 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.

4.4 Estimation

Equations (6) to (9) together with equations (11) to (13) flexibly describe how belonging to an MNC network may affect affiliates' export and import choices at the extensive and intensive margins. To bring these to the data, we impose further parametric assumptions on $g_j(\cdot)$ and $\tilde{g}_j(\cdot)$. In particular, we let:[28]

$$g_j(\cdot) = \beta^j_1 MNC_{i(p)t} + \beta^j_2 In\ MNC_{cp} + \beta^j_3 (MNC_{i(p)t} \times In\ MNC_{cp}) \quad \text{for } j \in \{x, m\}, \tag{14}$$
$$\tilde{g}_j(\cdot) = \tilde{\beta}^j_1 MNC_{i(p)t} + \tilde{\beta}^j_2 In\ MNC_{cp} + \tilde{\beta}^j_3 (MNC_{i(p)t} \times In\ MNC_{cp}) \quad \text{for } j \in \{x, m\}. \tag{15}$$

The model delivers four gravity equations (one for each of the four margins of trade) with three-way fixed effects. In particular:

$$\Pr(i \text{ exports to } c \text{ in } t) = \beta^x_3 (MNC_{i(p)t} \times In\ MNC_{cp}) + k^x + \lambda^x_{ct} + \lambda^x_{it} + \lambda^x_{ic} + \varepsilon^x_{i(p)ct}. \tag{16}$$

$$\log r_{i(p)ct} = \tilde{\beta}^x_3 (MNC_{i(p)t} \times In\ MNC_{cp}) + \tilde{k}^x + \tilde{\lambda}^x_{ct} + \tilde{\lambda}^x_{it} + \tilde{\lambda}^x_{ic} + \tilde{\varepsilon}^x_{i(p)ct}. \tag{17}$$

$$\Pr(i \text{ imports from } c \text{ in } t) = \beta^m_3 (MNC_{i(p)t} \times In\ MNC_{cp}) + \lambda^m_{ct} + \lambda^m_{it} + \lambda^m_{ic} + \varepsilon^m_{i(p)ct}. \tag{18}$$

[28] This linear approximation with an interaction term allows us to estimate a linear model with three-way fixed effects and to interpret the regression coefficients as shifters. Conceptually, higher-order approximations are also possible.

$$\log m_{i(p)ct} = \tilde{\beta}_3^m (MNC_{i(p)t} \times In\ MNC_{cp}) + \tilde{\lambda}_{ct}^m + \tilde{\lambda}_{it}^m + \tilde{\lambda}_{ic}^m + \tilde{\varepsilon}_{i(p)ct}^m. \quad (19)$$

We approximate the probability functions in equations (16) and (18) using a linear probability model.[29] In Section B-1 of the Theoretical Appendix, we show how to derive our estimating equations and provide a structural interpretation of the fixed effects.

When considering the extensive margin of trade in equations (16) and (18), 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 (17) and (19). 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.

4.5 Identification

Our identification strategy can accommodate different motives for multinationals' acquisitions (e.g., portfolio diversification, horizontal, vertical, or export-platform FDI). Conditional on the three-way fixed effects, the identification assumption is that, had firm i not been acquired, it would have not increased its trade with countries belonging to p's network. The inclusion of firm-year fixed effects accounts 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.

The main remaining threat to identification is the possibility that, even without being acquired, an affiliate would have increased trade with countries in its parent's network. In this case, the specific set of network countries would be endogenous and our baseline estimates in Section 5.1 would be biased. In Section 5.2, we address this concern by exploiting plausibly exogenous changes in the multinational network of affiliates.

5 Network Effects of Multinational Ownership

In this section, we show that multinational affiliates are more likely to start exporting to and importing from countries that belong to their parents' network or are added to the network

[29] In robustness checks, we show that the results of the firm-level gravity regressions are robust to using a high-dimensional fixed effects logit model.

as a result of plausably exogenous global ownership changes.

5.1 Network Variation Across Affiliates

Guided by the model in Section 4, we identify multinational ownership's network effects by estimating firm-level gravity regressions on the set of new affiliates, i.e., Belgian firms that switched from domestic to foreign ownership during the sample period. From now on, we focus on affiliates that have a single direct parent during the period in which they are foreign-owned, for which we can construct their parent's networks. There are 60 such firms. While this number is relatively small, the sample used to identify MNC network effects is much larger, since the firm-level gravity regressions are estimated at the firm-country-year level across all the countries where an MNC could potentially have a presence.

Extensive Margin

To examine the effects on the extensive margin of trade, we bring equations (16) and (18) to the data. The dependent variable is $Entry^{j}_{i(p)ct}$, an indicator variable equal to 1 from the first year t in which firm i (owned by parent p) exports to, or imports from, country c.

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. The coefficient in column 1 indicates that the probability of export entry increases by 2.9 percentage points. This corresponds to a 24% increase in the probability of export entry before the acquisition, which is equal to 12%. Similarly, the coefficient in column 2 indicates that the probability of import entry increases by 1.6 percentage points. This corresponds to a 26% increase in the probability of import entry before the acquisition, which is equal to 6%.

Table 3

Network Effects of MNC Ownership

	(1)	(2)
	Export Entry	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 equations (16) and (18). In column 1 (2), the dependent variable is $Export\ Entry_{i(p)ct}$ ($Import\ Entry_{i(p)ct}$), a dummy variable equal to 1 from the first year t in which firm i (owned by parent p) exports to (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.

We estimate a series of additional specifications to verify the robustness of these results. 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.[30] Finally, Table A-13 shows that the results continue to hold if we exclude countries that Dharmapala and Hines (2009) classify as tax havens.

Intensive Margin

To bring equations (17) and (19) to the data, we focus on the set of countries each affiliate i was already trading with before being acquired and examine whether the value of its exports and imports increases in countries in which its parent has other affiliates.[31] The results reported in Table 4 show that the interactions between the dummy variables $MNC_{i(p)t}$ and

[30] We estimate a high-dimensional fixed effects logit model using the R package `fixest` (Bergé, 2018).

[31] A country c is classified as an "old" export destination (import source) for firm i if it was exporting to (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).

$\times$*In* MNC_{cp} are not significant, implying that MNC ownership does not affect affiliates' intensive margin of trade through network effects. In the rest of our analysis, we thus focus on the extensive margin of trade.

Table 4

Network Effects of MNC Ownership: Intensive Margin

	(1)	(2)
	Export Values	Import Values
$MNC_{i(p)t} \times In\ MNC_{cp}$	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 equations (17) and (19). In column 1, the dependent variable is $\log Exports_{i(p)ct}$, the (log of) value of exports of firm i (owned by parent p) to country c in year t. In column 2, the dependent variable is $\log Imports_{i(p)ct}$, the (log of) 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.

5.2 Exogenous Network Changes Within Affiliates

Bilateral selection effects are the main threat to our identification strategy. The estimates in Table 3 would be upward-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 Belgian affiliates' multinational networks. 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.[32]

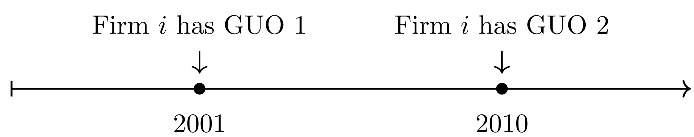
[32] We focus on ownership changes occurring between 2007, which is the earliest year in which network data is available from Historical Orbis, and 2011, so that we can observe affiliates' trade patterns for at least three years after the change in GUO.

In line with Atalay *et al.* (2019), we focus on affiliates that are peripheral to their GUOs' main lines of business, i.e., we exclude cases in which the primary or secondary sector code of the GUOs, whenever available, is the same as the sector of the Belgian affiliate (at the NACE4 level). To further strengthen identification, we focus on cases in which neither of the GUOs is 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 2 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 (the United States, China, South Korea, India, Vietnam, Colombia). In this example, the identifying 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 2

An Example



To identify network effects driven by exogenous network changes, we estimate:

$$Entry^j_{i(p)ct} = \beta_j(New\ MNC_{it} \times Only\ In\ New\ MNC_{ic}) + \lambda^j_{it} + \lambda^j_{ic} + \lambda^j_{ct} + \varepsilon^j_{i(p)ct}, \quad j \in \{x, m\}. \tag{20}$$

$New\ MNC_{it}$ is a dummy equal to 1 in the years in which firm i has GUO 2, whereas $Only\ in\ New\ MNC_{ic}$ is equal to 1 if country c belongs to GUO 2's network but does not belong to GUO 1's network. Countries that only belong to the network of the initial GUO are excluded from the estimation sample. Therefore, the coefficient β_j captures the probability that firm i starts exporting to ($j = x$) or importing from ($j = m$) countries that are added to its network after changing GUO, relative to countries that belong to neither the old nor the new network.

Table 5 reports the results of estimating equation (20). 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, a Belgian affiliate is more likely to start trading with countries that have been added to its network (e.g., in the example shown in Figure 2, with the United

States, China, South Korea, India, Vietnam, and Colombia). The estimates indicate that the probability that an affiliate starts exporting to (importing from) a country in its new parental network increases by 2.0 (6.9) percentage points. This corresponds to a 43% (156%) increase in the probability of export (import) entry before the acquisition, which is equal to 4.6% (4.4%). The findings in Table 5 confirm that our baseline estimates in Table 3 are robust to addressing concerns about the endogeneity of the affiliates' networks.

Table 5

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 (20). In column 1 (2), the dependent variable is $Export\ Entry_{ict}$ ($Import\ Entry_{ict}$), a dummy variable equal to 1 from the first year t in which firm i exports to (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. The sample excludes all countries that only belong to the initial GUO's network. Heteroscedasticity robust standard errors in parenthesis. Significance levels: *** 0.01, ** 0.05, * 0.1.

6 Network Effects Beyond Firm Boundaries

The results presented in the previous section suggest that, through their networks of affiliates, multinationals alleviate country-specific trade frictions that deter entry into new export and import markets. Crucially, MNC networks effects shape both export and import participation, but only at the extensive margin: new affiliates are more likely to start trading with countries in which their parent has a presence, but the intensity of their pre-existing trade relations is unaffected. These findings suggest that firms face fixed costs when exporting to (and importing from) foreign markets (F^x_{ict} and F^m_{ict} in our model).

In principle, the effects may operate only within the boundary of the firm, i.e., acquired Belgian firms may only start exporting to and importing from other affiliates of the same parent. In this section, we present four sets of additional findings that provide insights about the nature of the trade frictions alleviated by multinational ownership. The results presented below show that MNC network effects extend beyond the boundaries of the multinational.

6.1 Heterogeneous Network Effects by Distance

Trade frictions tend to be amplified by gravity, i.e., have larger negative effects on bilateral trade between more geographically and culturally distant countries. For example, exporting to (and importing from) a foreign market may require obtaining information about the local regulatory environment, which may be harder for more distant markets. A Belgian firm may find it easier to obtain information about France—a country which shares a common border, an official language, and many regulations with Belgium—compared to a more geographically and culturally distant country like Japan.

MNC ownership might alleviate such frictions. For example, a parent may provide information to its affiliates about the regulatory environment in countries in which it operates. We would then expect MNC network effects to be stronger in more distant countries. To illustrate the logic, consider a firm i that faces fixed entry costs F^x_{ict} and F^m_{ict}, which increase in the distance of country c. Imagine that, following its acquisition by multinational parent p, entry costs in countries in which the parent already has a presence are lower. MNC ownership would then increase the probability that i starts trading with more distant network countries, in which the fixed entry costs were higher prior to the acquisition. By contrast, if the network effects of MNC ownership were solely driven by trade between affiliates, we would expect them to decrease with distance: new Belgian affiliates should be less likely to start trading with geographically and culturally more distant affiliates of the same multinational.

To examine the role of distance, we add the interaction term $MNC_{i(p)t} \times In\ MNC_{cp} \times Distance_c$ in equations (16) and (18) and estimate

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

We use two measures of distance between Belgium and country c. The first measure is the log of the geographical distance (in kilometres) between the capitals of the two countries. The second measure is one minus the share of the population in country c that speaks one of the official languages of Belgium (French and Dutch), and is a measure of the cultural distance between the two countries.

The results of estimating equation (21) are reported in Table 6.[33] 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 a country in which the parent has a presence. The triple interaction coefficients γ_j are also always positive and highly significant, indicating that MNC network effects are larger in more geographically and culturally distant countries.

These findings are in line with the hypothesis that multinational ownership alleviates gravity-related trade frictions that deter entry into foreign markets and suggest that MNC network effects are not just driven by new affiliates selling their products to (or purchasing inputs from) other affiliates of the same parent.

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)
$MNC_{i(p)t} \times In\ MNC_{cp} \times Distance_c$	0.019***	0.017***	0.028***	0.027***
	(0.004)	(0.006)	(0.004)	(0.005)
$MNC_{i(p)t} \times Distance_c$	-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 (21). 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 log of 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.

[33] Note that the number of observations in Table 6 is smaller than in Table 3 because the distance measures are not available for all countries.

6.2 Extended Network Effects

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, e.g., share a common border or belong to the same regional trade agreement (RTA). In what follows, we examine whether MNC ownership has "extended network effects", i.e., increases the probability that new affiliates enter countries that are close to—but do not belong to—their parental network. For example, after being acquired by a parent that has affiliates in Argentina, a Belgian firm may be more likely to enter not only Argentina, but also a neighbouring country like Chile, even if the parent has no affiliates 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; the second is a dummy equal to 1 if c is in a RTA with a country in the parental network but does not belong to the network.

To test for extended network effects, we include an interaction between the variables $MNC_{i(p)t}$ and $\textit{Close to MNC}_{ct}$ in equations (16) and (18):

$$\begin{aligned} Entry^{j}_{i(p)ct} = \quad & \beta_j(MNC_{i(p)t} \times \textit{In MNC}_{cp}) \\ + \quad & \gamma_j(MNC_{i(p)t} \times \textit{Close to MNC}_{cp}) \\ + \quad & \lambda^j_{it} + \lambda^j_{ic} + \lambda^j_{ct} + \varepsilon^j_{i(p)ct}, \quad j \in \{x, m\}. \end{aligned} \tag{22}$$

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

The results in Table 7 provide evidence of extended network effects of multinational ownership: the coefficient of the interaction term $MNC_{i(p)t} \times \textit{Close to MNC}_{cp}$ 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. The estimates imply 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 17% (37%) increase relative to the probability of exporting to (importing from) these countries before the acquisition. 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 (1.7) percentage points, corresponding to a 8% (24%) increase relative to the probability of exporting to (importing from) these countries before the acquisition. 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).[34]

Table 7

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 (22). 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.

The results of Table 7 provide direct evidence that the effects of MNC ownership are not confined to the boundaries of the multinational. By definition, these "extended network effects" cannot be driven by intra-MNC trade, since they involve countries in which the multinational parent does not have an affiliate.[35]

[34] We have verified that the results of Table 7 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.

[35] These results echo Antràs *et al.*, (2024)'s results that US MNEs trade more with countries in which they

6.3 Persistence of Network Effects

Another way to verify whether the effects of MNC ownership extend beyond the multinational boundaries is to examine their persistence. In this section, we show that MNC network effects are persistent and thus not confined to trade with other affiliates of the same parent: firms continue to trade with countries that are dropped from their parental network as a result of plausibly exogenous ownership changes. The results also shed light on the nature of the fixed costs that firms face in export and import markets, suggesting that they are, at least partially, sunk upon entry.

Similarly to Section 5.2, we exploit exogenous changes in GUOs' networks. In this case, 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. For example: in 2005, a Belgian firm i was acquired by a DP controlled by GUO 1. In 2011, i's GUO 1 sold the DP to GUO 2. As a result of this divestiture, several countries exited firm i's GUO network (Japan, Indonesia, and Tunisia).

We first compare trade participation between countries dropped from the old parent's network after the M&A transaction and those that belong to the networks of both the old and new parent. If network effects are persistent and not confined to current MNC boundaries, we would not expect affiliates to be less likely to export to and import from countries dropped from their network compared to countries that are still in their network. We focus on countries that belong to the old GUO's network and estimate:

$$Trade^{j}_{ict} = \beta_j(New\ MNC_{it} \times Only\ in\ Old\ MNC_{ic}) + \lambda^{j}_{it} + \lambda^{j}_{ic} + \lambda^{j}_{ct} + \varepsilon^{j}_{ict}, \quad j \in \{x, m\}. \quad (23)$$

$Trade^{j}_{ict}$ is dummy equal to 1 if firm i exports to, or imports from, country c in year t. $New\ MNC_{it}$ is defined as in equation (20), whereas $Only\ in\ Old\ MNC_{ic}$ is equal to 1 if country c belongs to GUO 1's network but does not belong to GUO 2's network.

Table 8 reports the results of estimating equation (23). 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 that are still in their network.

have affiliates and other countries in the same region as their affiliates. While they describe these patterns using cross-sectional data, we use time-series variation to identify extended network effects.

Table 8

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

	(1)	(2)
	Exports	Imports
$New\ MNC_{it} \times Only\ In\ Old\ MNC_{ic}$	-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 (23). In column 1, the dependent variable is $Exports_{ict}$, a dummy variable equal to 1 if firm i exports to country c in year t. In column 2, the dependent variable is $Imports_{ict}$, a dummy variable equal to 1 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 a 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 all countries that only belong to the new GUO's network. Heteroscedasticity robust standard errors in parentheses. Significance levels: *** 0.01, ** 0.05, * 0.1.

We next compare the probability that affiliates enter countries dropped from their network versus those that were 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. We exclude countries added to the network from the sample and estimate:

$$Entry^j_{ict} = \beta_j(New\ MNC_{i,t} \times Only\ in\ Old\ MNC_{ic}) + \lambda^j_{it} + \lambda^j_{ic} + \lambda^j_{ct} + \varepsilon^j_{ict}, \quad j \in \{x, m\}. \quad (24)$$

The results reported in Table 9 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 that were never in their network. These results confirm that MNC network effects are persistent and are not confined to intra-firm trade.

Table 9
Persistence of Network Effects of MNC Ownership
(Countries Dropped vs Never In the Network)

	Export Entry	Import Entry
	(1)	(2)
New MNC_{it} × *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 (24). In column 1, the dependent variable is *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 *Import* $Entry_{ict}$, a dummy variable equal to 1 from the first year t in which firm i imports from country c. *New* MNC_{it} is a dummy variable equal to 1 in the years in which firm i has GUO 2. *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. Heteroscedasticity robust standard errors in parenthesis. Significance levels: *** 0.01, ** 0.05, * 0.1.

6.4 Distance from Other Affiliates Along Value Chains

If MNC network effects were solely driven by trade between affiliates of the same parent, we would expect them to be stronger if the activities of these affiliates are vertically-related. To investigate this, we use the methodology developed by Alfaro *et al.* (2019) to measure the distance along supply chains between Belgian affiliate i and an affiliate i' (located in country c) of the same parent. The variable $Upstreamness_{ii'(c)}$ is constructed combining information on the main NACE codes of affiliates i and i' with data on input-output linkages.[36]

To study whether MNC network effects depend on distance between affiliates, we restrict the analysis to the set of countries in which the parent has affiliates (i.e., those for which *In* $MNC_{cp} = 1$) and include an interaction between $MNC_{i(p)t}$ and $Upstreamness_{ii'(c)}$ in

[36]We use input-output data from Belgium. When looking at export (import) entry, the variable $Upstreamness_{ii'(c)}$ is constructed using the Belgian affiliate as the supplier (user) and affiliate i' in country c as the user (supplier). For each Belgian affiliate i, this measure can only be defined for countries in which its parent p has other affiliates i'.

equations (16) and (18):

$$Entry^{j}_{i(p)c(i')t} = \beta_j(MNC_{i(p)t} \times Upstreamness_{ii'(c)}) + \lambda^{j}_{it} + \lambda^{j}_{ic} + \lambda^{j}_{ct} + \varepsilon^{j}_{i(p)c(i')t}, \quad j \in \{x, m\}. \quad (25)$$

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 country c, in which affiliate i' of the same parent is located. Given that parent p can have multiple affiliates in country c, we cluster standard errors at the country level.

Table 10 reports the results of estimating equation (25). The β_j coefficient is not significant, indicating that whether the acquired Belgian affiliate i starts trading with countries in its parent's network does not depend on its position along the supply chain 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 effects, counter to the idea that these effects are driven by transactions between commonly-owned affiliates within a global supply chain.

Table 10

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 (25). 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). $MNC_{i(p)t}$ 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., those for which $Upstreamness_{ij}$ can be defined. Standard errors clustered by country in parenthesis. Significance levels: *** 0.01, ** 0.05, * 0.1.

7 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 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.

7.1 Variance Decomposition

To assess the relative importance of network effects versus traditional firm-level mechanisms through which MNC ownership can affect trade participation, we use the baseline results of Table 3 and decompose the total variance of $Entry_{i(p)ct}$ to compute the shares that can be attributed to $MNC_{i(p)t} \times In\ MNC_{cp}$ and to 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.[37] The details of the implementation of the Shapley decomposition can be found in Appendix Section B-2.1.

Table 11

Shapley Decomposition of the Probability of Trade Entry

	Firm-Country Fixed Effect	Country-Year Fixed Effect	Firm-Year Fixed Effect	MNC Network Effects
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).

The results reported in Table 11 show that firm-country fixed effects explain around 90% of the variation in export and import entry, confirming the central role of gravity. Notice, however, 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

[37]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.

total variation, respectively.

7.2 Implications for Firm Growth

So far, we have examined the role of MNC network effects in explaining firm-level trade participation. To close the paper, we assess their relevance for MNC affiliates' overall growth, and proceed in two steps. First, we use 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 acquisition 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.

Table 12

Implications of MNC Network Effects for Firm Growth

Category	Post-Acquisition Increase	Post-Acquisition Share due to MNC Network Effects	Post-Acquisition Increase due to MNC Network Effects
Sales	32.3%	13.0%	4.1%
Employment	19.8%	14.1%	2.7%

The table reports the share of the post-acquisition increase in firm sales and labor demand attributable to MNC network effects.

Table 12 shows the results. We find that 13% of yearly post-acquisition sales can be attributed to MNC network effects. Since MNC acquisitions increase firm-level sales by about 32.3% (as documented 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% $\times$ 32.3% =) 4.1%. Our analysis suggests that the growth rate of acquired firms is more than twice as large as that of the median domestic firm due to MNC network effects. 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 the parental network generates an average post-acquisition increase in employment of (19.8% $\times$ 14.1% =) 2.7%. In comparison, the median annual sales growth rate among domestic Belgian firms during our sample period was 1.9% and there was no growth in median employment.

8 Conclusions

Firms affiliated with multinationals account for a disproportionately large share of international trade. Standard explanations for this dominance rely on mechanisms that operate at the firm level (e.g., new MNC affiliates become more productive, through transfers of technology or managerial know-how from the parent). In this paper, we identify a novel mechanism that operates at the firm-country level: firms acquired by an MNC face lower trade frictions in and around the network of countries in which their parent has other affiliates.

We first show that MNC ownership affects overall trade participation: after accounting for selection effects, firms acquired by an MNC are more likely to export and import, have higher export and import values, and increase the number of countries they trade with. Non-trade outcomes are also affected, with acquired firms becoming larger and more productive.

To understand the mechanisms behind these effects, we provide a model in which MNC ownership can affect the export and import decisions of new affiliates through firm-specific channels and firm-country specific channels. The model delivers structural firm-level gravity equations which can be estimated to identify the network effects of multinational ownership.

We find evidence of MNC network effects 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 continue to hold when we exploit M&A activities that change the organizational structure of the multinational group to generate plausibly exogenous changes in multinational networks. We provide evidence that MNC network effects are not confined to trade between affiliates of the same parent, but extent beyond the boundaries of the multinational. We also show that network-level effects are quantitatively more important than the traditional firm-level effects of MNC ownership, explaining a larger share of the total variation in the probability that foreign affiliates enter new foreign markets. Finally, combining the structure of our theoretical model with our data, we find that network effects account for a large share of affiliates' growth in terms of sales and employment: through these effects, the growth rate of acquired firms is more than twice as large as that of the median domestic firm.

Our analysis suggests that multinational ownership alleviates country-specific trade frictions which deter entry into new export and import markets. We find that MNC network effects are stronger in more geographically or culturally distant countries, in which affiliates face higher trade frictions before the acquisition. It would also be interesting to explore differences across products. In particular, if differentiated products are characterized by higher trade frictions, we would expect MNC network effects to be stronger for affiliates that export products that are not sold on an organized exchange (based on the classification by Rauch, 1999) and import more differentiated inputs (measured by combining the Rauch classification with input–output tables, as in Nunn, 2007). Another interesting avenue of future research is to provide direct evidence of the mechanisms through which multinational parents can alleviate such frictions for their affiliates (e.g., by helping them to navigate the regulatory environments in the foreign markets in which they operate) and examine potential effects on suppliers and customers of MNCs. This would help to shed light on whether government agencies can play a similar role to multinational firms, and help in designing policies to alleviate the country-specific trade frictions faced by domestic firms.

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Appendices

Empirical Appendix

A-1 Descriptive Statistics

A-1.1 Acquired and Non-Acquired Firms

We find 22,938 Belgian firms that satisfy the sample selection criteria described in Section 2. Of these, 22,626 are always domestic and 312 are foreign affiliates for at least part of the sample period. Of the latter group, 115 firms were acquired via brownfield FDI some time after 1997 and did not switch between domestic and foreign ownership multiple times.

Table A-1

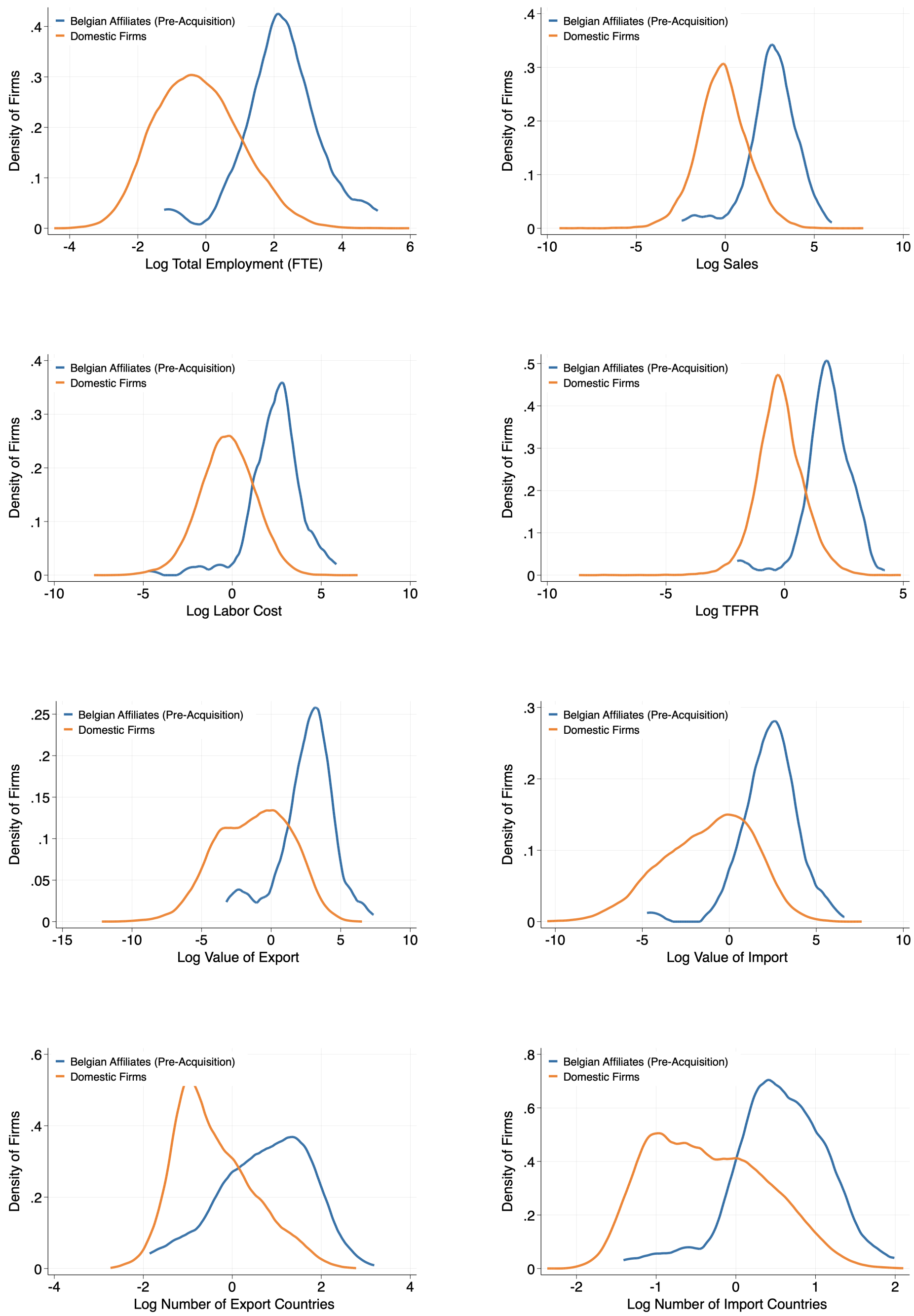
Distributions of Covariates of Treated (Acquired) and Untreated (Non-Acquired) Firms

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. 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-1 provides descriptive statistics for the new foreign affiliates and shows that there are systematic differences between these firms and non-acquired firms in terms of the mean, variance, and skewness of a large set of observables. Figure A-1 shows that future multinational affiliates outperform always-domestic firms in many dimensions prior to acquisition.

Figure A-1
Acquired and Non-Acquired Firms



The figure shows the probability density functions of different variables (in logarithms, after demeaning by industry-time) for domestic firms (blue lines) and foreign-owned firms before their acquisition (orange lines).

A-1.2 New Foreign Affiliates and their Multinational Network

Table A-2 reports the number of new foreign affiliates by sector for the 115 firms that survive the selection criteria in Section 2.2. The most common NACE sectors are those between C19 and C22, which are the manufacture of coke, chemicals, pharmaceuticals, and rubber.

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

Table A-3 illustrates the distribution of average equity share across the years that foreign parents own their Belgian affiliates. Direct parents DP 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.[38] Our sample of 115 new foreign affiliates is associated with 188 distinct DPs.

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%

The table shows the 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 provides descriptive statistics about the size of multinational networks. DPs have a presence in 8 countries on average, and the largest multinational network includes 65 countries. GUO networks are larger by construction (with an average of 23 and a maximum of 103 countries).

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

Table A-4

Summary Statistics for Multinational Parent Networks

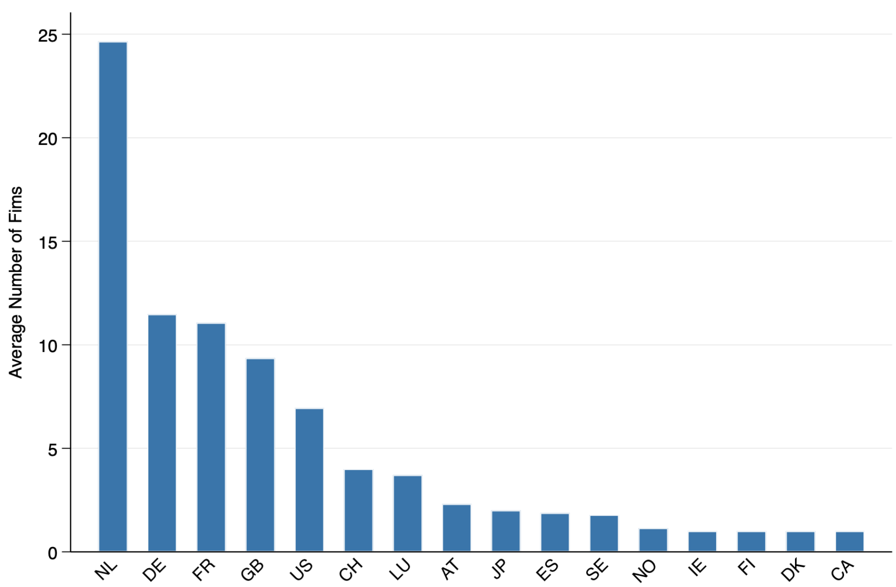
Mean	Median	Min	Max	Std. Dev.
Direct Parent Networks				
Mean	Median	Min	Max	Std. Dev.
8.10	3.00	1.00	65.00	11.39
Global Ultimate Owner Networks				
Mean	Median	Min	Max	Std. Dev.
23.22	14.50	1.00	103.00	25.03

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 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. Figure A-3 shows that the GUOs of most Belgian affiliates are headquartered in countries geographically close to Belgium or are in the United States.

Figure A-2

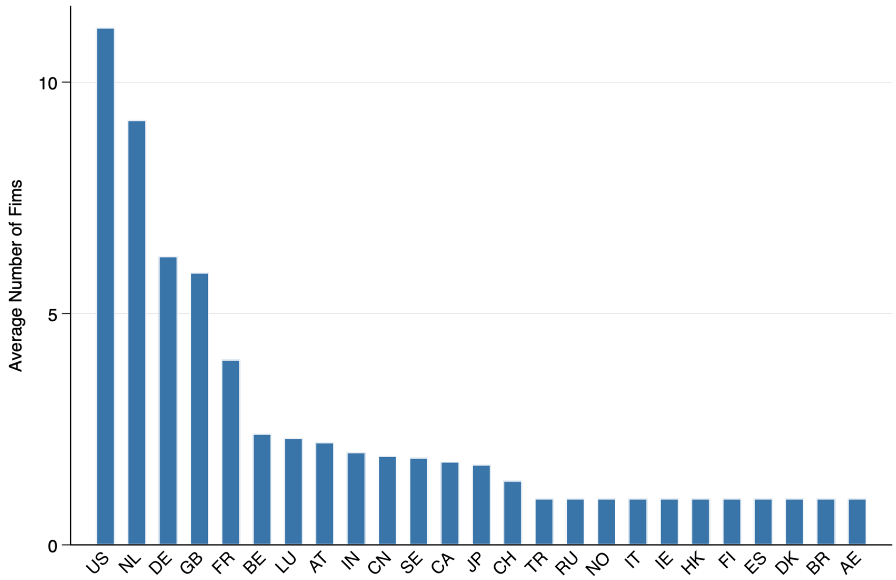
Number of New Foreign Affiliates by Country of the DP



The figure shows the average number of new Belgian foreign affiliates by country of origin of the DP.

Figure A-3

Number of New Foreign Affiliates by Country of the GUO

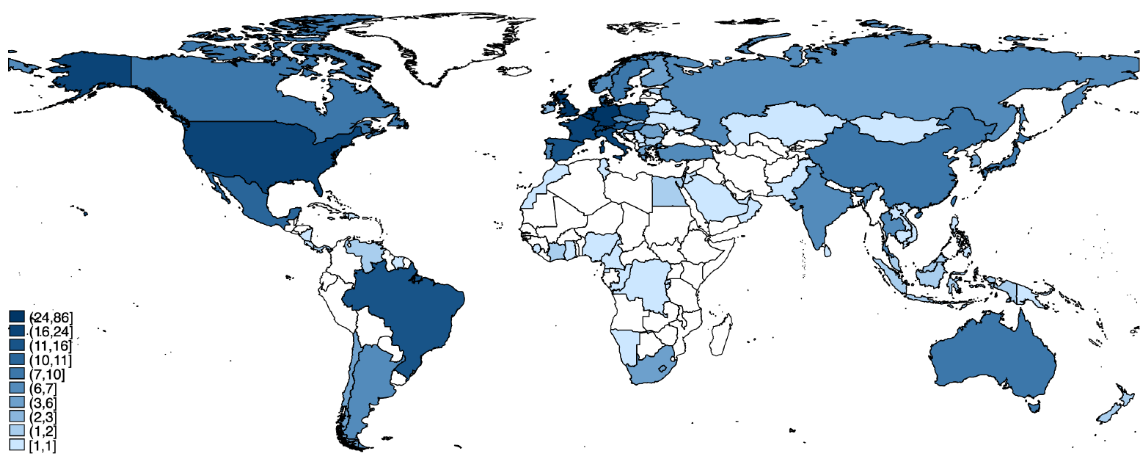


The figure shows the number of new Belgian foreign affiliates by country of origin of the GUO.

Figure A-4 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 A-4

Global Presence of Direct Parents

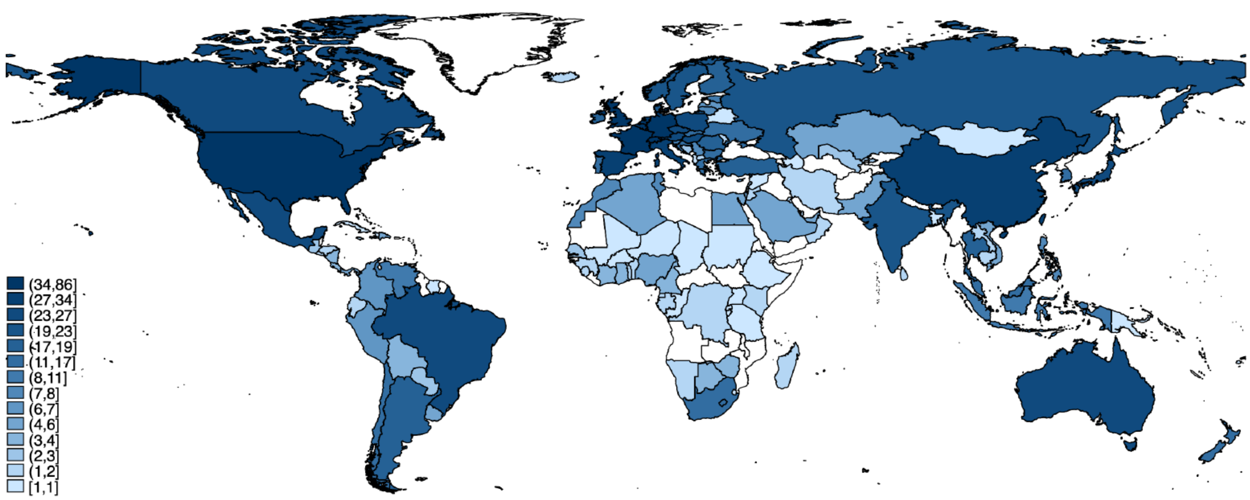


The figure illustrates the countries in which the parents of Belgian firms acquired during our sample period have a presence.

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.[39] 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. Figure A-5 illustrates the set of countries in which the GUO of new Belgian affiliates have a presence.

Figure A-5

Global Presence of GUOs of Belgian Affiliates



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

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

A-2 MNC Ownership and Overall Trade Participation

A-2.1 Event Study

We estimate the following equation:

$$y_{it} = \sum_{s=-k_l}^{k_u} \theta_s MNC_{it}^s + \delta_i + \delta_t + \varepsilon_{it}. \tag{26}$$

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, or from which it imports, and the total value of its exports/imports.[40] 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.[41]

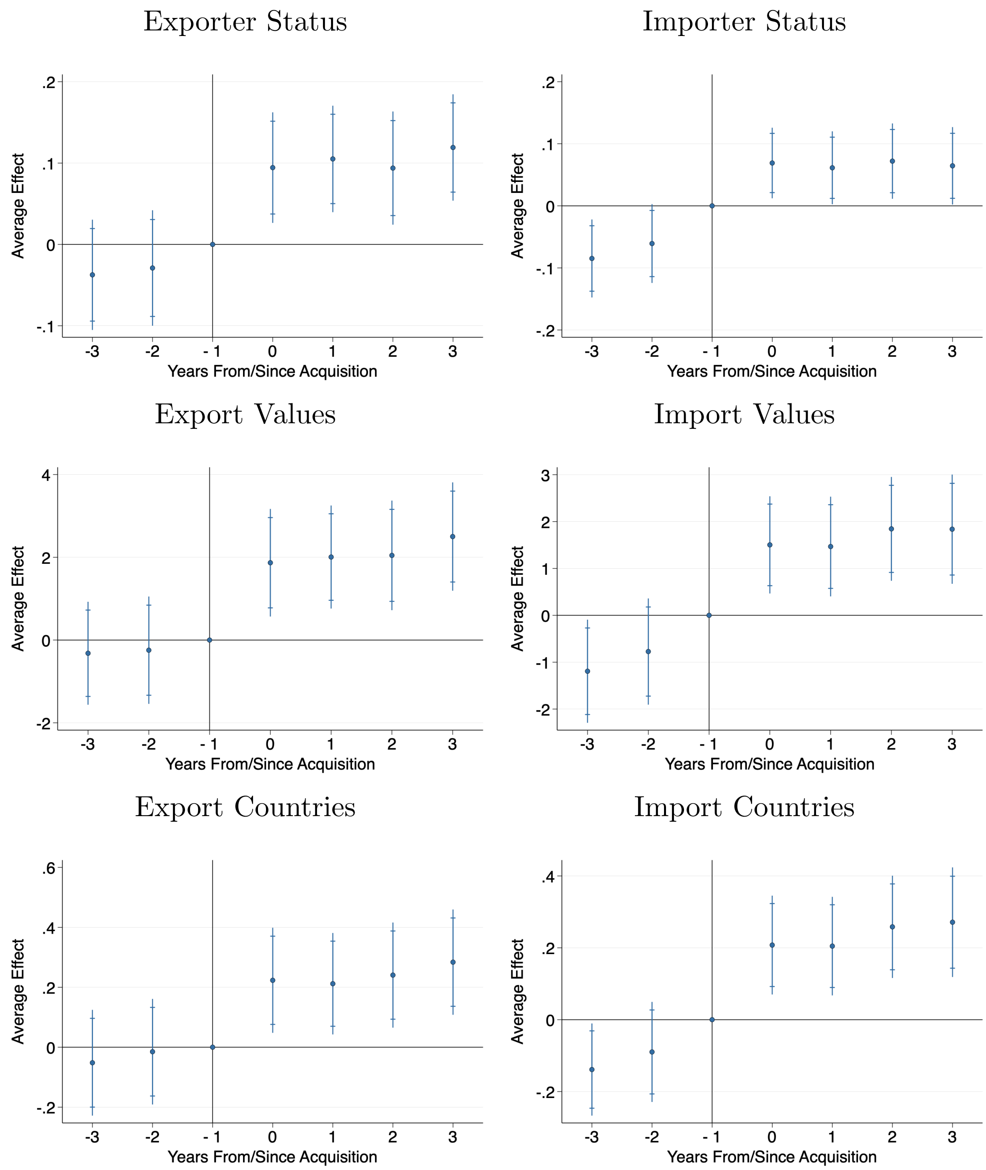
The recent literature surveyed by de Chaisemartin and D'Haultfœuille (2023) emphasizes that estimating event studies with a two-way fixed-effects (TWFE) estimator may fail to recover the treatment effect when the roll-out is staggered and treatment effects are time-varying. We deal with this concern 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 (26) 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-6. 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%).

[40]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 time-varying treatment effects.

[41]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-6
Event Studies



The figure reports the results of estimating equation (26) 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-6 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	4.45	4.33	0.66	0.88	–0.22	–0.13
Lag Log No. Export Products	3.73	3.73	1.59	1.80	–0.08	–0.03
Lag Log No. Import Products (DE)	2.79	2.75	1.20	1.24	–0.00	–0.26
Lag Log No. Import Products (FR)	2.12	2.31	1.32	1.15	–0.06	–0.23
Lag Log No. Import Products (GB)	1.74	1.46	1.11	1.04	0.02	0.41
Lag Log No. Import Products (NL)	2.95	3.00	1.46	1.32	–0.56	–0.26
Lag Log No. Import Products (US)	1.75	1.47	1.47	1.71	0.21	0.52
Lag Log No. Import Products (JP)	0.82	1.14	0.92	1.86	1.24	1.37
Lag Log No. Export Products (DE)	1.38	1.44	1.22	1.32	0.54	0.57
Lag Log No. Export Products (FR)	1.46	1.62	1.49	1.42	0.34	0.42
Lag Log No. Export Products (GB)	1.21	1.22	1.12	1.12	0.57	0.69
Lag Log No. Export Products (NL)	1.70	1.68	1.67	1.40	0.43	0.50
Lag Log No. Export Products (US)	1.18	1.20	0.83	1.19	0.38	0.94
Lag Log No. Export Products (JP)	0.71	0.91	0.48	1.02	0.51	1.02
Lag Log Imports (DE)	14.44	14.35	3.88	4.07	–0.38	–0.67
Lag Log Imports (FR)	13.42	13.87	6.13	4.62	–0.88	–0.79
Lag Log Imports (GB)	12.67	12.30	4.20	6.52	–0.27	–0.38
Lag Log Imports (NL)	14.05	14.30	5.14	4.64	–0.23	–0.66
Lag Log Imports (US)	12.21	11.87	7.19	9.89	–0.09	–0.15
Lag Log Imports (JP)	11.50	11.77	8.09	11.88	–0.39	0.12
Lag Log Exports (DE)	14.04	14.32	8.90	6.02	–1.13	–0.96
Lag Log Exports (FR)	14.42	14.93	7.59	4.49	–1.83	–1.15
Lag Log Exports (GB)	13.43	13.93	8.07	6.35	–1.16	–0.99
Lag Log Exports (NL)	14.65	14.67	6.39	4.85	–0.95	–1.15
Lag Log Exports (US)	12.41	13.00	8.88	8.18	–0.43	–0.08
Lag Log Exports (JP)	11.78	12.05	4.10	7.38	–0.23	–0.05

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	16.27	1.60	2.33	–0.03	0.57
Lag Log Employees	4.93	4.95	1.08	1.24	–0.23	0.29
Lag Log Sales	17.44	17.45	1.32	2.06	–0.09	–1.04
Lag Log No. Export Countries	2.64	2.67	0.95	1.16	–0.35	–0.38
Lag Log No. Import Countries	2.32	2.33	0.30	0.35	–0.36	–0.50
Lag Log Exports	16.82	16.83	2.82	3.33	–1.02	–0.81
Lag Log Imports	16.43	16.44	1.97	2.30	–0.07	–0.03
Growth Rate Sales	0.08	0.10	0.15	0.29	0.68	7.75
Growth Rate Exports	–0.07	–0.05	1.77	0.92	–3.18	–2.95
Growth Rate Imports	0.04	0.04	0.58	0.47	–1.65	–1.33
Growth Rate No. Export Countries	0.01	0.02	0.15	0.16	0.82	0.57
Growth Rate No. Import Countries	0.03	0.03	0.07	0.07	0.41	0.35
Log Distance	7.78	7.78	0.55	0.46	–1.16	–0.95
Lag Log GDP Per Capita (PPP)	20.84	20.85	0.19	0.25	–0.13	–0.50
Longitude	15.22	15.24	160.77	161.07	–0.22	0.06
Latitude	39.90	39.85	72.95	70.63	–0.86	–0.50

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)	(2)
	Export Entry	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 equations (16) and (18). 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)	(2)
	Export Entry	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 equations (16) and (18). 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) Export Entry	(2) 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 equations (16) and (18). 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. 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.

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 (14) into equation (12) and plugging the resulting expression together with equation (11) into equation (6). We approximate the probability function using a linear model:

$$\Pr(i \text{ exports to } c \text{ in } t) = \beta_3^x(MNC_{i(p)t} \times In\ MNC_{cp}) + k^x + \lambda_{ct}^x + \lambda_{it}^x + \lambda_{ic}^x + \varepsilon_{i(p)ct}^x. \quad (27)$$

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 (15) into equation (13) and plugging the resulting expression together with equation (11) into equation (7) delivers the following estimating equation for the intensive margin of exports:

$$\log r_{i(p)ct} = \tilde{\beta}_3^x(MNC_{i(p)t} \times In\ MNC_{cp}) + \tilde{k}^x + \tilde{\lambda}_{ct}^x + \tilde{\lambda}_{it}^x + \tilde{\lambda}_{ic}^x + \tilde{\varepsilon}_{i(p)ct}^x, \quad (28)$$

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:

$$\Pr(i \text{ imports from } c \text{ in } t) = \beta^m_3(MNC_{i(p)t} \times In\ MNC_{cp}) + \lambda^m_{ct} + \lambda^m_{it} + \lambda^m_{ic} + \varepsilon^m_{i(p)ct}. \quad (29)$$

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:

$$\log m_{i(p)ct} = \tilde{\beta}^m_3(MNC_{i(p)t} \times In\ MNC_{cp}) + \tilde{\lambda}^m_{ct} + \tilde{\lambda}^m_{it} + \tilde{\lambda}^m_{ic} + \tilde{\varepsilon}^m_{i(p)ct}, \quad (30)$$

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 7.

B-2.1 Decomposing Variation in Export and Import Entry

We employ the Shapley decomposition to decompose the variance of $Entry_{ict}$, the dependent variable in either equation (16) or equation (18), 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 the high-dimensional fixed effects in equation (16) and equation (18), we modify it to 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 11 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.

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}. We define the ratio Y''_{it}/Y'_{it} as the share of sales attributable to MNC network effects in year t. The average of this ratio across firms and years in our sample is 13.0%. Multiplying this number by the total change in sales due to MNC acquisitions reported in the second column of 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:

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

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 $L^{(1)}_{it}$. We define the ratio $L^{(2)}_{it}/L^{(1)}_{it}$ as the share of labor demand attributable to MNC network effects in year t. The average of this ratio across firms and years in our sample is 14.1%. Multiplying this number by the total change in employment due to MNC acquisitions reported in the first column of Table 2 allows us to infer the average annual change in employment due to MNC network effects.

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National Bank of Belgium
Limited liability company
Brussels RLE – Company's number : 0203.201.340
Registered office : 14 Boulevard de Berlaimont – BE-1000 Brussels
www.nbb.be

Editor

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Layout : Analysis and Research Group
Cover : NBB CM – Prepress & Image

Published in September 2024