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Exporting, Global Sourcing, and Multinational Activity: Theory and Evidence from the United States

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ABSTRACT

Multinational firms (MNEs) dominate trade flows, yet their global production decisions are often ignored in firm-level studies of exporting and importing. Using newly merged data on US firms' trade and multinational activity by country, we show that MNEs are more likely to trade not only with countries in which they have affiliates, but also with other countries within their affiliates' region. We rationalize these patterns with a new source of firm-level scale economies that arises when country-specific fixed costs to source from, or sell in, a market are shared across all the MNE's plants. These shared fixed costs create interdependencies between a firm's production and trade locations that generate third-market responses to bilateral trade policy changes.

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1 Introduction

Firms increasingly organize their production using global value chains, with different stages of production located in different countries (Antràs and Chor, 2022). Recent disruptions to these global value chains, such as the US-China trade war and COVID pandemic, highlight just how interdependent countries have become in the production of goods. This interrelated nature of global supply chains complicates domestic policy, and leads to a propagation of shocks across countries that is often hard to rationalize using existing trade models.

Take as an example the US anti-dumping duties placed on washing machine imports from Korea in 2012. While standard trade models predict an increase in US washing machine prices, prices instead fell as Korean manufacturers relocated production to China. The higher bilateral trade costs between the US and Korea thus increased Chinese exports to the United States. Exports of washing machine parts from Korea to China also rose, highlighting the importance of multinational firms' use of imported inputs by their affiliates (Flaaen et al., 2020).

In this paper, we study the relationship between firms' foreign production locations and their international trade patterns. We first construct a comprehensive new dataset that captures the domestic and foreign activities of all firms with US operations. We combine 2007 data on firms' US sales, employment, and trade flows by country from the Census Bureau with inward foreign direct investment (FDI) data on firms' foreign ownership and outward foreign affiliate activity by country from the Bureau of Economic Analysis (BEA). We focus on firms that manufacture in the United States and define US MNEs as firms with majority-owned foreign manufacturing affiliates. Foreign MNEs are majority owned by a foreign ultimate parent.

We next show that MNEs account for a disproportionate share of US international trade, and that their trade dominance seems intimately tied to the number of countries with which they trade. Firms that import from 26+ countries account for 71 percent of US manufacturers' imports, of which 93 percent are mediated by MNEs. Exports are even more skewed; 83 percent are mediated by firms that export to over 25 countries, with 90 percent of these flows sold

by MNEs. These larger 'extensive margins of trade' by MNEs cannot be explained solely by their US size. We show that US MNEs import from about 56 percent more countries than multi-country domestic importers, and export to about 64 percent more countries, even after controlling for their US sales, number of US establishments, and firm age. Moreover, the number of countries with which they trade is increasing in the number of foreign countries in which they manufacture goods, suggesting a potential complementarity between trade and FDI. US MNEs' larger extensive margins of trade persist when limiting the data to arm's-length transactions, thereby ruling out within-firm input shipments as an explanation.

A primary contribution of our paper is to show that the countries from which US MNEs import, and the markets to which they export, are systematically related to their foreign manufacturing locations. Not only are US MNEs are more likely to trade with countries in which they have affiliates, they are also more likely to trade with countries that are proximate to their foreign manufacturing affiliates. Table 1 presents the probabilities that US manufacturers import from, or export to, particular countries, for the top six countries based on the number of US importers or exporters. China is the number two import country with 8 percent of firms importing and 4 percent exporting. For firms that manufacture in the same region as China, however, these probabilities jump dramatically: 88 percent of firms with an affiliate in Eastern Asia (but no affiliate in China itself) import from China, while 86 percent export. This stark increase in trade probabilities is similar across countries. Only 3 percent of US manufacturers import from, or export to, Italy, but these probabilities jump to 80 percent for importing and 84 percent for exporting when conditioning on firms that manufacture in *other* Southern European countries.[1]

One possible explanation for the high conditional trade probabilities in Table 1 is that trade and FDI both require fixed costs, and these are correlated within firms and regions. We also calculate the probability that a firm will import from a country conditional on exporting to the region, but not exporting to the country itself. We similarly calculate the probability of

[1]We do not present conditional probabilities for Canada since Bermuda, Greenland, and Saint Pierre and Miquelon are the only other foreign countries in North America.

Table 1: Unconditional and Conditional Probabilities of Importing and Exporting by Country

		Probability of Importing			Probability of Exporting		
		All	Firms with Regional		All	Firms with Regional	
Country	Region	Firms	Assembly	Exporting	Firms	Assembly	Importing
Canada	North America	0.15			0.19		
China	Eastern Asia	0.08	0.88	0.31	0.04	0.86	0.19
Germany	North & Western Europe	0.05	0.75	0.15	0.05	0.73	0.21
Great Britain	North & Western Europe	0.04	0.72	0.13	0.06	0.79	0.25
Taiwan	Eastern Asia	0.04	0.77	0.17	0.03	0.81	0.11
Italy	Southern Europe	0.03	0.80	0.14	0.03	0.70	0.23
Mexico	Latin America & Caribbean	0.03	0.79	0.06	0.06	0.90	0.28
Japan	Eastern Asia	0.03	0.80	0.11	0.04	0.84	0.14
Hong Kong	Eastern Asia	0.02	0.56	0.06	0.03	0.83	0.15
Australia	Oceania	0.01	D	0.05	0.04	D	0.37

Sources: 2007 Economic censuses, LBD, LFTTD, and BEA inward and outward datasets. Table presents the probability that US manufacturers import or export from a particular country. Conditional on 'Firms with Regional Assembly' uses the subset of firms with affiliates in the same region as the country, but not the country itself. Conditional on 'Firms with Regional Exporting' or 'Importing' uses the subset of firms that export to, or import from, other countries in the region, but not the country itself. Table contains the top 6 countries based on number of importers and exporters. Variables rounded per Census disclosure rules. 'D' denotes suppressed cells. Conditional probabilities omitted for Canada given limited other countries in the region.

exporting conditional on importing from the region. Firms that export to Eastern Asia are 31 percent more likely to import from China, while those that import from that region are 19 percent more likely to export to China. These conditional probabilities are thus higher than the raw probabilities, but substantially smaller than probabilities conditional on manufacturing in the region. Correlated fixed costs of trading across countries thus do not seem to account for the very high regional correlations between US manufacturers' foreign production and domestic trade patterns.

We extend this analysis to all countries and control for firm and country characteristics by estimating the probability of importing from a particular country as a function of the firm's foreign manufacturing locations. US MNEs are not only more likely to import from countries in which they have affiliates, but also more likely to import from other countries in the same region as their affiliates. Even after controlling for firm and country fixed effects and firms' trade in other countries in the region, US MNEs are 5.0 percentage points more likely to import from countries in which they do *not* have affiliates, but that are in the same region as one of their manufacturing plants. By contrast, we find no statistically significant relationship between a

firms' manufacturing locations and the amount it imports from a country, conditional on having positive imports. US MNEs' exports are also oriented towards their foreign manufacturing locations: they are 8.7 percentage points more likely to export to a country in their affiliate's region.

To unpack the underlying forces that drive the geographic correlations between a US MNEs' trade and foreign production locations, we construct gravity-based measures of proximity between a particular country j and affiliate country k. US MNEs are more likely to trade with countries that are physically close to their affiliates: they are 25 percentage points more likely to import from a country within 500 kilometers (km) of their affiliate, but just 4.1 points more likely to import from a country more than 4,000 km away. Firms with one affiliate that shares a free-trade agreement with country j are 5.8 percentage points more likely to import from the country. We find similar relationships for exporting. By contrast, firms are no more likely to trade with countries that share a common language with their affiliates, and only exporting is correlated with sharing a legal origin with affiliate countries.

Our evidence on the spatial correlations between US MNEs' import and export countries and their foreign manufacturing locations is novel and not predicted by current models of FDI. Many papers study the importance of vertical FDI, in which firms ship inputs between their domestic plants and foreign affiliates (Antràs and Helpman, 2004; Keller and Yeaple, 2013; Garetto, 2013), including in models that also feature horizontal motives (Ramondo and Rodríguez-Clare, 2013; Irarrazabal et al., 2013). Those models feature a complementarity between vertical FDI and domestic trade that arises due to intra-firm shipments of inputs between a firm's domestic plants and its affiliates. Such motives cannot explain the increased probability of imports and exports that we document between a firm's domestic plants and countries that are proximate to its affiliates, but that have no affiliate themselves.

We rationalize MNEs' higher trade probabilities with countries that are proximate to their affiliates using a new source of firm-level scale economies. The model features heterogeneous firms that choose production locations, sales markets, and input source countries. Firms must

incur a country-specific marketing cost to sell their goods in a country (as in Eaton et al., 2011; Arkolakis et al., 2018), and a country-specific fixed cost to source inputs (as in Antràs et al., 2017). In our framework, however, the sourcing fixed cost allows *all* of the firm's plants to sell in the country, consistent with a firm's employment of a Chief Procurement Officer who manages its supply chain and sourcing decisions.[2] Similarly, the marketing fixed cost is shared across *all* of the firm's plants. As a result, the marginal benefit of activating a particular destination or input market is higher for firms with more plants, and particularly so for markets that are 'proximate' to the firm's plants since they face lower bilateral trade costs for buying inputs or selling final goods there.[3]

The model generates new complementary forces between FDI and trade decisions with distinct implications for policy. We illustrate such implications in a simple partial-equilibrium example in which firms in one country (the United States) respond to a trade agreement between two other countries (North and South). While traditional models predict that this liberalization would reduce US exports to those markets (trade diversion), we show that US exports and imports may instead increase due to new US FDI (trade creation). The North-South trade liberalization increases the profitability of FDI in those countries, such that US firms are more likely to open new production plants in one or both locations, which in turn increases the profitability of activating those markets as sales destinations or input sources. More generally, the interdependencies generated by our model can explain why FDI responds to trade policy shocks (as documented in McCaig et al., 2022), with potential spillovers in markets that undergo no policy changes (e.g., as in Head and Mayer, 2019).

Our paper makes three main contributions to the literature. First, we add to empirical work on US firm heterogeneity in trade and FDI. Doms and Jensen (1998) link the 1987 Census of

[2]For example, Ford lists a vice-president of supply chains who manages procurement for the company (https://media.ford.com/content/fordmedia/fna/us/en/people/jonathan-jennings.html).

[3]This complementarity between a US firm's foreign production and US export locations is absent from Arkolakis et al. (2018) because they model single-product firms that serve each market from the unique, lowest marginal-cost location. Their model thus does not explain our finding that US MNEs are more likely to export to countries close to their affiliates, or evidence in Garetto et al. (2019) that MNEs sell in the same market using both local and other foreign affiliates.

Manufactures to an indicator for 10 percent foreign ownership from the BEA and infer outward FDI for firms with over 500 employees using the Census Large Firm Survey. They show that MNEs' US manufacturing plants are relatively productive, but have no information on US MNEs with less than 500 workers or on firm-level trade flows. More recent work links Customs trade data to the LBD and identifies multinationals by flagging all firms with any related-party trade transactions (Bernard et al., 2009, 2018). This work led to a new dataset for studying US firms and trade, but the inference for MNEs cannot distinguish US versus foreign MNEs, relies on 5 or 10 percent ownership thresholds, and misses all affiliate locations without US trade flows. Boehm et al. (2020) merge the Census data to directories of international corporate structure, but similarly lack information on firms' foreign affiliate activity.

This paper and Kamal et al. (2022) are the first to merge Census and BEA outward FDI data.[4] In contrast to past work, we measure the full range of all firms' US activities and provide firm-by-country details on US firms' imports, exports, and foreign affiliate activities. Kamal et al. (2022) document how MNEs and domestic firms differ in terms of sales, employment, and productivity across sectors and geography. We are the first to exploit the firm-by-country details and show that US MNEs have larger extensive margins of trade that are systematically related to their foreign manufacturing locations.

Our empirical findings ground our contribution to a large literature on horizontal FDI, which is often modeled as a 'proximity-concentration tradeoff' in which firms serve a foreign market with local assembly plants or via exporting (Brainard, 1997; Helpman et al., 2004; Gumpert et al., 2020), including by exporting from their foreign affiliates (Tintelnot, 2017; Arkolakis et al., 2018). In these papers, lower trade costs discourage FDI since they raise the relative profits from exporting. While calibrated models match moments in aggregate data consistent with this substitutability, our evidence points to a complementarity between exports and FDI at odds with these models and that cannot be explained by input trade. Similarly, other work shows

[4]This paper and Kamal et al. (2022) are outcomes of a collaborative data construction effort which has led to the new BEA-Census data bridge now available in the Federal Statistical Research Data Centers. See Kamal et al. (2022) for details on the merge led by those authors.

that Belgian firms export to a market before *and* after opening an affiliate (Conconi et al., 2016), and that Belgian firms acquired by foreign MNEs begin trading with the MNE's headquarter country and other countries in which it has affiliates (Conconi et al., 2022). Garetto et al. (2019) find that US MNEs' affiliate sales in certain countries are unaffected by their affiliate activities in other countries, so they model affiliate sales as independent across markets.[5] We show that under this same independence on the intensive margin, a common fixed cost to sell in a market that is shared across all of the firm's plants generates a complementary force between FDI and exporting on the extensive margin. This complementarity is novel and implies that trade cost reductions encourage FDI and thus potentially trade with third markets.[6]

Finally, the idea that firms may leverage key technologies across plants and countries has long provided a fundamental explanation for FDI (Markusen, 1984; Helpman, 1985; Carr et al., 2001). The role of fixed costs and selection are also well-established features of FDI (Yeaple, 2009; Ramondo, 2014). Plant-level fixed costs to engage in various activities, such as importing, exporting, and FDI create complementarities across these activities within plants due to a scale effect (Bernard et al., 2018). Such scale effects can also lead to complementarities between horizontal and vertical FDI (Yeaple, 2003; Grossman et al., 2006). To our knowledge, ours is the first framework to feature firm-by-country rather than plant-by-country level fixed costs of sourcing and marketing, and to show that these fixed costs rationalize US MNEs' export and import patterns.

The rest of the paper is structured as follows. Section 2 documents several benefits of the new data. Section 3 exploits the novel firm-by-country details to provide four new facts on how MNEs' foreign manufacturing locations relate to their extensive-margin trade patterns. We rationalize these facts in a model in Section 4, which generates novel, third market effects of trade policy changes as shown in Section 5. We conclude in Section 6.

[5] Garetto et al. (2019) are limited to affiliate sales to Canada, the United Kingdom, and Japany.

[6] Firm-level fixed costs to source from a country can also rationalize evidence from Carballo et al. (2021) who show that domestic Chilean firms that trade with MNEs are more likely to start exporting to the MNEs' headquarter country. Our assumption that firms produce different varieties in each country is in line with evidence from Danish firms that import the same detailed goods that they produce domestically when they offshore, though domestic varieties have higher unit values that rise after importing begins (Bernard et al., 2020).

2 New Data on US Multinational Activity

A central contribution of this paper is to advance the construction and analysis of a new dataset that combines BEA data on multinational firms with US Census Bureau data on all US establishments and their firm-by-country trade flows. Such a merge is now feasible thanks to a new Memorandum of Understanding between agencies. We describe the new data and demonstrate their benefits by highlighting the key role of MNEs in US manufacturing and documenting much larger MNE size premia relative to past work.

2.1 Data Description

We use the Census Bureau's 2007 Longitudinal Business Database (LBD) to identify all private, non-farm employer establishments in the United States. The LBD provides an establishment's industry and employment, as well as a firm identifier (firmid) that assigns all establishments under common ownership or control in a given year to a firm.[7] We merge the LBD to the 2007 Economic Censuses (ECs) of Manufacturing, Wholesale Trade, Retail Trade, Construction, Mining, Transportation, Communications, and Utilities, and Services to obtain establishment-level sales information. We focus on 2007 since it was the latest Economic Census year for which all datasets were available at the time of our dataset construction.

We augment the US data with import and export information from the 2007 Longitudinal Firm Trade Transaction Database (LFTTD). The LFTTD contains Customs Transactions at the firm-country-product level of merchandise good shipments by firms in the United States. They also include an indicator for whether a transaction between the US importer or exporter takes place with a related party in the foreign country.[8]

We combine the Census data with the BE-11 survey that provides annual information on

[7] An establishment is a single, physical location where business transactions take place and for which payroll and employment are recorded. See Jarmin and Miranda (2002) and Chow et al. (2021) for details on the LBD.

[8] See Bernard et al. (2007) and Kamal and Ouyang (2020) for additional details on the LFTTD. The matched data cover about 80 percent of total exports and imports. We follow Antràs, Fort and Tintelnot (2017) in dropping mineral trade (HS2=27) so that we exclude trade in oil from the analysis.

US-based firms' *outward* foreign affiliate employment, and their local, US, and third-market sales, by affiliate country and industry. These data are collected for all US persons (in the broad legal sense, including all US and foreign firms with establishments in the United States) that have 10 percent or greater ownership shares in foreign affiliates with sales, assets, or net income greater than $60 million. The outward data thus contain both US and foreign-owned firms.[9] We focus only on foreign affiliates in which the US entity has a 50 percent or higher ownership stake to capture affiliate decisions controlled by the US parent.

We also use data from the BE-12 survey, which identifies foreign firms with *inward* activity in the United States. Since this is a benchmark survey, all foreign firms with a 10 percent or higher voting ownership interest in a US affiliate are required to file the BE-12 form. We identify foreign-owned firms as those that are majority-owned by a foreign firm. A limitation of these data is that we do not observe foreign firms' foreign activities, except for their affiliates that are directly owned by their US plants as noted above. We build on and contribute to extensive work by Kamal et al. (2022) to match the BEA surveys to Census datasets using Employer Identification Numbers (EINs), and by name and address. Details on the matching algorithms are in Appendix Section A.1.

Although the Census and BEA data both have firm identifiers, we rely on the Census firmid to aggregate activity to the firm level. The Census firmid is constructed with information from the Company Organization Survey (COS), which collects a list of all majority-owned establishments and their EINs for large, multi-unit firms. By contrast, firms typically only report their primary EIN in the BE-11 survey. As a result, a single Census firmid may encompass multiple BEA firmids.

A key feature of our match is that we separate US versus Foreign MNEs. In principle, all firms in the BE-12 survey with majority foreign ownership could be classified as foreign. In practice, however, this approach overstates the aggregate share of foreign ownership in the United States relative to published BEA totals. This overstatement likely arises because the

[9]For example, a foreign firm with North American headquarters in the United States appears in the outward data if its US affiliates also own affiliates in other countries.

Census firmid encompasses EINs that BEA treats as separate firms.[10] We therefore exploit BEA ultimate ownership information along with multinational activity data from the COS to distinguish US versus foreign firms. Appendix Section A.2 provides details.

The new data allow us to identify all firms in the United States that manufacture goods and quantify the importance of MNEs in their domestic activities. This exercise is not possible using only the BEA data, since MNEs' domestic activities are collected at the firm level and domestic firms are entirely absent. Similarly, arm's-length imports and exports are aggregated at the firm level, while the Census data provide all flows by country. On the other hand, the BEA data allow us to distinguish US versus foreign firms, identify firms' foreign affiliate locations, and separate manufacturing versus other affiliates. We can thus provide the first evidence on the relationship between US MNEs' foreign manufacturing locations and their import and export countries.

2.2 MNEs in the Aggregate and US Manufacturing

We first present statistics for all firms with private, non-farm employer establishments in the United States in 2007. Table 2 presents the total number of firms, US employment, sales, imports, and exports by firms' multinational status. Foreign MNEs are majority owned by a foreign firm. US MNEs have majority-owned foreign affiliates and are majority owned by a US ultimate owner. MNEs are scarce: we identify just over 10 thousand MNEs in the entire US economy. These MNEs comprise less than 0.3 percent of firms, yet account for a quarter of private sector employment, 44 percent of sales, 69 percent of imports, and 72 percent of exports.

Comparing our results to estimates from trade-based measures of US MNEs suggests that the latter overstates the number of MNEs and their role in trade, but understates their domestic size dominance. Using the related-party trade indicator to flag MNEs, Bernard et al. (2009) identify 74 thousand MNEs in 2000 (7 times more than we find), which account for 1.4 percent of all

[10] Another difference between the BEA and Census firmids arises because the BE-12 survey assigns US affiliates to the foreign BEA firmid with the highest *direct* foreign-ownership share, even if another firm indirectly owns a higher share of the US affiliate, while the Census firmid is based on majority shares.

firms, 18 percent of US employment, and 80 percent of imports and exports (versus 69 and 72 percent here). Those authors calculate that almost a quarter of trading firms are multinational, whereas our linked data indicate that less than 2.6 percent of trading firms are MNEs.[11] The higher MNE count and trade shares in past work are likely due to the lower related-party trade ownership thresholds (5 and 10 percent for imports and exports, respectively), versus our threshold of 50 percent. Indeed, we calculate that 41,500 domestic firms have related-party imports and 25,900 have related-party exports. On the other hand, the trade-based method misses MNEs that do not engage in related-party trade, which can explain the lower share of aggregate employment they attribute to MNEs (18 versus 25 percent here).

Table 2: Aggregate statistics for US-based firms in 2007, by MNE status

	Firms (000s)		Employment (000s)		Sales ($ billions)		Imports ($ billions)		Exports ($ billions)	
Domestic	4,554	0.998	84,509	0.75	15,532	0.56	439	0.31	272	0.28
Foreign MNEs	7.6	0.002	6,964	0.06	3,764	0.13	478	0.33	229	0.23
US MNEs	2.8	0.001	21,666	0.19	8,655	0.31	518	0.36	481	0.49
Total	4,564	1.00	113,139	1.00	27,951	1.00	1,435	1.00	983	1.00

Sources: 2007 Economic censuses, LBD, LFTTD, and BEA inward and outward datasets. Table presents firms, employment, sales, imports, and exports, in 2007 by firm type. Sample is all private, non-farm, employer establishments with positive sales and employment. 'Domestic' firms are non-multinationals. 'Foreign MNEs' are majority owned by a foreign firm. 'US MNEs' are majority owned by a US firm and have majority-owned foreign affiliates. Observations rounded per Census disclosure rules.

This paper studies how firms' production location decisions interact with their foreign sourcing and export choices. We therefore focus on manufacturers by limiting the analyses to all firms with one or more manufacturing plants in the United States (as in Fort et al., 2018). Table 3 shows that this sample of manufacturing firms (which includes domestic and multinational firms) accounts for almost a quarter of total US employment, 38 percent of sales, more than two-thirds of US imports, and almost 80 percent of US exports. We use this sample of firms throughout the remainder of the paper.

US MNEs' importance in manufacturing is striking. Given our interest in US firms that also

[11] We calculate the ratio of MNEs to all domestic traders plus MNEs. Since all MNEs do not trade this calculation is an upper bound.

manufacture abroad, we divide US MNEs into those with and without majority-owned foreign manufacturing affiliates. Table 3 shows that there are 1,500 US MNEs that manufacture in the United States, of which the majority (1,200) also manufacture overseas. Despite comprising only 0.6 percent of US manufactures, US MNEs account for one third of manufacturing employment, 48 percent of manufacturers' imports ((0.03+0.29)/0.67), and 58 of their exports ((0.02+0.44)/0.79). MNEs with foreign manufacturing affiliates account for the bulk of these activities, particularly for trade flows.[12]

Table 3: Manufacturing firms' share of aggregate activities, by MNE status

Firm Type	Firms	Emp	Sales	M Emp	M Sales	Imports	Exports
Domestic	242,000	0.10	0.09	0.58	0.35	0.09	0.12
Foreign MNEs	2,200	0.03	0.10	0.12	0.22	0.26	0.21
US MNEs							
No foreign manuf affiliates	350	0.04	0.05	0.03	0.03	0.03	0.02
With foreign manuf affiliates	1,200	0.06	0.14	0.27	0.40	0.29	0.44
Total	245,750	0.23	0.38	1.00	1.00	0.67	0.79

Sources: 2007 Economic censuses, LBD, LFTTD, and BEA inward and outward datasets. Table presents firm counts and shares of total and manufacturing (M) employment and sales, imports, and exports, for all firms with US manufacturing plants in 2007. M firms comprise 5% of total US firms. 'Domestic' firms are non-multinationals. 'Foreign MNEs' are majority owned by a foreign firm. 'US MNEs' are majority owned by a US firm and have majority-owned foreign affiliates.

2.3 MNE versus Domestic Trader Size Premia

It is well-established that trading firms and multinationals are larger and more productive than domestic firms (Bernard et al., 2009; Doms and Jensen, 1998). We similarly find that arm's-length traders are larger than domestic firms and about 10 percent more productive. Firms with related-party trade are larger still, almost double the size and productivity of arm's length traders. Most notably, MNEs are substantially larger and more productive than all

[12]We present comparable statistics for firms without US manufacturing plants in Appendix Table A.2. There are only 150 US MNEs that manufacture solely abroad, accounting for just 1 percent of US sales and imports, and less than 1 percent of employment and exports. Kamal et al. (2022) provides sectoral employment statistics for all MNEs, regardless of their US manufacturing status.

domestic firms, including those with related-party trade. US MNEs that manufacture both in the United States and abroad are 5.37 log points bigger than domestic non-traders, which corresponds to three times the size premia of related-party traders (see Appendix Table A.6).[13] These distinctions highlight MNEs' extreme size advantage over domestic traders, and were not feasible to make using past US datasets.

We also calculate that 19 percent of employment in US MNEs that manufacture in the US and abroad is in Management and Professional Services establishments (NAICS 54 and 55), compared to just 12 percent for Foreign MNEs and 3 percent for domestic firms (see Appendix Table A.1). These sectors comprise establishments that provide support services such as management, R&D, and marketing for other establishments of the firm, consistent with US MNEs' performing fixed-cost activities at home that support their foreign production.[14]

We also build on past work finds that importers' relative size advantage is increasing in the number of countries from which they import (Antràs et al., 2017). In Figure 1, we extend their analysis by showing that the size premia associated with sourcing from more markets are *lower* when controlling for firms' MNE status.[15] Indeed, controlling for the firm's MNE status reduces the US size premium associated with importing or exporting from over 25 countries by almost 1 log point.

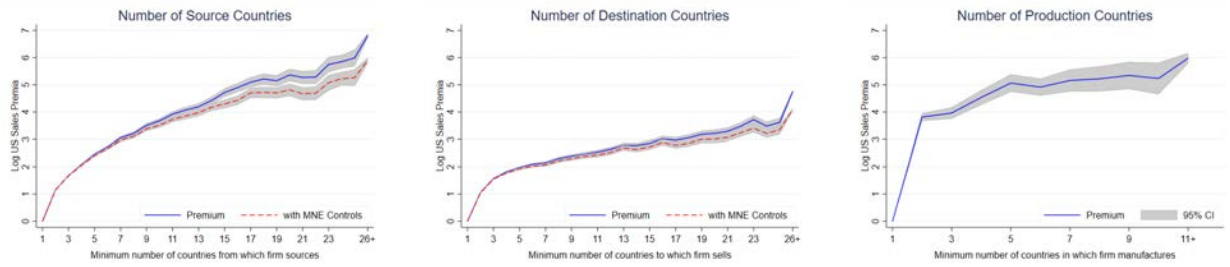
We conclude this section by showing how US MNEs' considerable US size premia are related to their foreign manufacturing locations. Figure 1 plots the cumulative coefficient estimates from regressing the log of firms' US sales on indicators for the minimum number of countries in which they have majority-owned foreign manufacturing affiliates. Firms that manufacture in foreign countries are almost 4 log points larger than firms that manufacture only in the United

[13]US sales by firms with related-party imports or exports are 1.71 and 1.63 log points larger than domestic firms' sales, respectively.

[14]We also estimate the share of firm employment in NAICS 54 and 55 and find that US MNEs with US and foreign manufacturing plants employ 8.9 percentage points more workers in these sectors than domestic firms when controlling for industry and firm age. Kamal et al. (2022) document similar patterns.

[15]To construct the figure, we regress the log of firm sales on cumulative dummies for the number of countries from which a firm sources and industry controls. The omitted category is non-importers, so the premia are interpreted as the difference in size between non- importers and firms that import from at least one country, at least two countries, etc. The horizontal axis denotes the number of countries from which a firm sources, with 1 corresponding to firms that do not import. We perform analogous steps for export and affiliate countries.

Figure 1: Firms' US Sales Premia by Number of Import, Export, and Affiliate Countries



Sources: 2007 Economic censuses, LBD, LFTTD, and BEA inward and outward datasets. Figure depicts estimates of the US sales advantage of firms that import from, export to, or produce in at least 1 country, 2 countries, etc. The omitted category in each figure is firms that do not engage in the specified activity. With MNE Controls denotes estimates from specifications that include indicators for the firm's US or Foreign MNE status. Sample is all firms with US manufacturing plants in 2007.

States. These premia increase as we constrain firms to a larger number of foreign countries manufacturing countries, such that those producing in 11 or more countries are about 6 log points larger than domestic manufacturers.

3 New Facts on MNEs' Trade Patterns

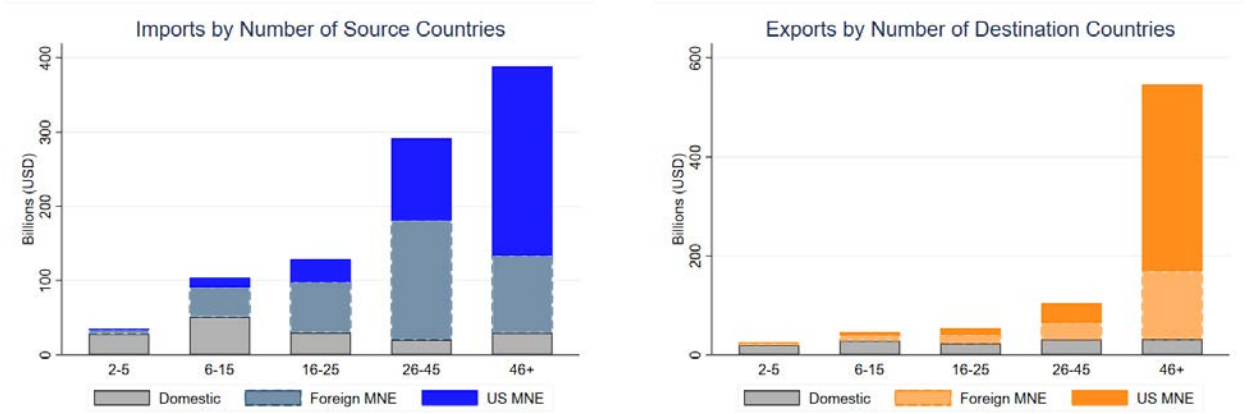
In this section, we document four new facts about US manufacturers' trade patterns and how they relate to their foreign manufacturing locations. MNEs trade with more countries and import and export higher values than domestic firms, even after controlling for differences in their US size and activities. In addition, US MNEs' exports and imports are oriented not only towards the countries in which they have affiliates, but also towards other countries in the same region as those affiliates.

3.1 MNEs' Extensive and Intensive Margins of Trade

We first exploit the detailed firm-by-country trade data to illustrate how MNE status relates to manufacturers' extensive margins of trade across countries. Prior work finds that multi-country traders account for the majority of trade (Bernard et al., 2018). We investigate these firms' dominance by decomposing their trade flows into multiple bins based on the number of countries with which they trade and their multinational status.

Figure 2 illustrates the skewness in both imports (left panel) and exports (right panel). Firms that import from over 25 countries account for 71 percent of imports, with 93 percent of those flows mediated by MNEs. Exports are even more skewed: 83 percent are sold by firms that export to over 25 countries, with MNEs accounting for 90 percent of those flows.[16]

Figure 2: US Exports and Imports by Traders' Extensive Margin of Countries



Sources: 2007 Economic censuses, LBD, LFTTD, and BEA inward and outward datasets. Figure decomposes manufacturing firms' total US imports and exports by the number of countries with which the importer sources or the exporter sells and firm type. 'Foreign MNE' denotes firms that are majority owned by a foreign firm. 'US MNE' denotes majority-owned US firms with majority-owned foreign manufacturing affiliates. Figure depicts total trade by multi-country importers and exporters, which account for 99% of each trade type by manufacturing firms.

One possibility is that MNEs dominate aggregate trade flows due to their significant size and productivity advantage (Bernard et al., 2009, 2018). To assess whether MNEs' have larger extensive margins when controlling for size, we estimate:

$$ln(\text{Num import countries}_f) = \beta_S ln(\text{sales}_f^{US}) + \beta_E ln(\text{estabs}_f^{US}) + \beta_F \text{Foreign MNE}_f + \beta_M \text{US MNE}_f + \beta_A \text{MNE}_f \times ln(\text{num affiliate countries}) + \varepsilon_f, \quad (1)$$

where sales_f^{US} are the firm's US sales, estabs_f^{US} is a count of the firms' US establishments, Foreign MNE_f is an indicator for foreign-owned firms, and US MNE_f is an indicator for US firms with foreign manufacturing affiliates. We interact an MNE indicator (absorbed by the two

[16]This figure is based on manufacturing firms that import from, or export to, at least two countries. These flows comprise 99 percent of manufacturers' imports and exports. Essentially all single-country traders are domestic firms.

MNE dummies) with the number of foreign countries in which the firm manufactures goods.

Table 4 presents the results from estimating equation (1) via Ordinary Least Squares (OLS) on the subset of multi-country importers. Column 1 shows that Foreign MNEs import from 34 percent more countries than domestic firms of similar size, while US MNEs import from over 55 percent more. In Column 2, we add the interaction of the log number of countries in which the firm has manufacturing affiliates, as well as a control for the number of distinct six-digit NAICS manufacturing industries in which the firm has US plants. The results indicate that, even after controlling for the extent to which they may span more industries, MNEs import from more countries than domestic firms, and this relationship is increasing in the number of countries in which they manufacture. For the average US MNE that manufactures in 6.42 countries, the results imply that it will source from 57 percent more countries than domestic multi-country importers ($0.352 + 0.115 \times ln(6.42) = 0.57$).

A number of models predict that MNEs source inputs from their foreign affiliates (e.g., Garetto, 2013). To assess whether intra-firm inputs can fully account for these patterns, we restrict the analysis to arm's-length transactions. Since the majority of Foreign MNEs' trade is with related parties, we focus on US firms in this specification. The coefficient on the US MNE indicator is slightly larger in column 3, while the estimate on the interaction term is essentially unchanged. Even among arm's-length transactions, US MNEs import from more countries than multi-country domestic importers, and their larger extensive margin is increasing in the number of foreign countries in which they manufacture.

We present comparable results for export countries in columns 4 to 6 of Table 4. Consistent with evidence on foreign firms operating in China (Wang, 2021), we find that foreign MNEs export to more countries than domestic firms. US MNEs export to 64 percent more countries than domestic multi-country exporters, and about 50 percent more countries than Foreign MNEs. Their extensive margin of exports is also increasing in the number of countries in which they manufacture goods, and these positive relationships persist when limiting the analysis to arm's-length transactions.

Table 4: Multinational firms' extensive and intensive margin trade premia

Panel A:	ln(number of import countries)			ln(number of export countries)		
	All Imports		Arm's-Length	All Exports		Arm's-Length
	(1)	(2)	(3)	(4)	(5)	(6)
Foreign MNE	0.343***	0.337***		0.130***	0.123***	
	(0.013)	(0.013)		(0.019)	(0.019)	
US MNE	0.558***	0.352***	0.368***	0.643***	0.461***	0.520***
	(0.017)	(0.022)	(0.024)	(0.025)	(0.033)	(0.036)
MNE × ln(Affiliate countries)		0.115***	0.116***		0.072***	0.069***
		(0.012)	(0.013)		(0.017)	(0.019)
Panel B:	**ln(imports)**			**ln(exports)**		
	All Imports		Arm's-Length	All Exports		Arm's-Length
Foreign MNE	1.651***	1.644***		0.854***	0.843***	
	(0.045)	(0.045)		(0.038)	(0.038)	
US MNE	1.343***	0.963***	0.737***	1.363***	0.983***	0.888***
	(0.061)	(0.080)	(0.082)	(0.050)	(0.065)	(0.071)
ln(Affiliate countries)		0.256***	0.179***		0.203***	0.141***
		(0.041)	(0.044)		(0.034)	(0.038)
ln(US manuf inds)	No	Yes	Yes	No	Yes	Yes
Observations (000s)	33.5	33.5	31.5	39	39	37.5

Sources: 2007 Economic censuses, LBD, LFTTD, and BEA inward and outward datasets. 'Foreign MNEs' are majority owned by a foreign firm. 'US MNEs' are majority owned by a US firm and have majority-owned foreign manufacturing affiliates. Omitted category is all other traders. Affiliate countries is the number of countries in which an MNE has majority-owned foreign manufacturing affiliates. All regressions control for firm's primary 4-digit US NAICS, firm age, log of US sales, and log number of US establishments. US manuf inds is the number of distinct six-digit NAICS manufacturing industries of the firm's US plants. Import and export samples are limited to firms that import from, or export to, 2+ countries, respectively.

Panel B in Table 4 documents similar patterns for the intensive margins of imports and exports. US MNEs import and export more than domestic firms, even after controlling for differences in industry, firm age, US sales, the number of US establishments, and the number of distinct six-digit NAICS industries in which their US plants manufacture. As for the extensive margins, these MNE trade intensity premia are increasing in the number of countries in which MNEs manufacture goods.

We summarize the key take-aways from Figure 2 and Table 4 in the following fact:

Fact 1. *US MNEs are more trade-intensive than domestic firms: they import from, and export to, more countries even after controlling for their US sales, number of US manufacturing plants, and number of US manufacturing industries. These MNE trade premia are increasing in the*

number of foreign countries in which the firm manufactures goods.

3.2 Relationship between FDI and Importing

We now study how firms' imports by country relate to their foreign manufacturing affiliate locations, or for Foreign MNEs, to their headquarter country. We first assess firms' extensive-margin import decisions by estimating the following linear probability model:

$$\begin{aligned} Pr(I_{fjr}=1) = \quad & \beta_A \text{Affiliate}_{fjr} + \beta_{AR} \text{Affiliate Region}_{fj'\neq jr} + \\ & \beta_F \text{Foreign HQ}_{fjr} + \beta_{FR} \text{Foreign Region HQ}_{fj'\neq jr} + \gamma_f + \gamma_j, \end{aligned} \tag{2}$$

where I_{fjr} is an indicator equal to one if firm f imports from country j in region r. Affiliate_{fjr} is an indicator for whether the firm has a majority-owned manufacturing affiliate in country j and region r. $\text{AffiliateRegion}_{frj'\neq j}$ is an indicator for whether the firm has a majority-owned manufacturing affiliate in the same region as country j. To isolate the role of proximate affiliates, we set this indicator to one only for firms that do not have affiliates in country j itself.[17] Foreign HQ_{fjr} is an indicator for whether the firm is majority-owned by a firm headquartered in country j, and Foreign Region $\text{HQ}_{frj'\neq j}$ is an indicator for whether the firm is owned by a firm with headquarters in the same region as country j, though not in country j itself.

A primary goal of this analysis is to document how firms' US import patterns related to their foreign production locations. We therefore include firm and country fixed effects and use the sample of multi-country importers to avoid incorrect inference (e.g., see Correia, 2015). The limitation to multi-country importers also makes the comparison to domestic importers more similar. As noted above, this sample covers approximately 99 percent of the value of US imports by manufacturing firms.[18] The firm fixed effects control for all unobservable firm characteristics,

[17] We define 13 regions using the United Nation's sub-region codes as listed here https://unstats.un.org/unsd/methodology/m49/overview/, except for combining Northern and Western Europe and using the aggregate Oceania region to avoid disclosure limitations.

[18] We also limit the analysis to the set of countries for which the CEPII data have GDP and distance.

so that the patterns we document cannot be explained by the relative size advantage of MNEs. The country fixed effects mean that we rely exclusively on the firm-by-country variation from the affiliate and foreign headquarter country indicators. We two-way cluster the standard errors by country and by firm.

We similarly assess how firms' intensive margin of imports relates to their foreign manufacturing activity by estimating

$$\begin{aligned} y_{fjr} = \quad & \beta_A \text{Affiliate}_{fjr} + \beta_{AR} \text{Affiliate Region}_{fj' \neq jr} + \\ & \beta_F \text{Foreign HQ}_{fjr} + \beta_{FR} \text{Foreign Region HQ}_{fj' \neq jr} + \gamma_f + \gamma_j + \varepsilon_{fjr}, \end{aligned} \tag{3}$$

where y_{fjr} is the log of firm f imports from country j in region r, and the remaining variables are identical to those in equation (2). These intensive-margin regressions are based on the subset of firms with positive import flows in the extensive-margin regressions.

Table 5 presents the results from estimating equations (2) and (3) via OLS. Columns 1 to 3 present the extensive-margin estimates, while columns 4 to 6 present the intensive-margin results. The estimates in column 1 indicate that US firms are 53.7 percentage points more likely to import from a country in which they have a majority-owned foreign manufacturing affiliate, while Foreign MNEs are 69 percentage points more likely to import from their headquarter country. These patterns are consistent with firms importing both inputs and final goods produced by their affiliates, as well as arm's-length inputs from other firms.[19]

The most novel results we document in Table 5 are the higher probabilities that a firm will import from a country in the *same region* as its foreign manufacturing affiliates or its headquarter country, despite not having an affiliate or being headquartered in that country. Column 1 indicates that US MNEs are 7.0 percentage points more likely to import from a

[19] We use the product and material trailer files from the CMF to identify a firm's US input purchases and sales of domestically produced goods. When linking these to firms' imports, we find that large share of US MNEs' imports are classified as both inputs and final goods. Imports of the same goods that the firm produces domestically are largest for related-party imports, suggesting that firms manufacture similar goods in multiple countries, including the United States, all of which they sell at home. See Appendix Table A.7.

country if they have an affiliate in the region (but not the country). Foreign MNEs are 10.5 percentage points more likely to import from the same region as their headquarters. These estimates are economically large: less than 3 percent of firm-country pairs have positive imports. MNEs are thus more than twice as likely to import from a country in the same region as their affiliate, relative to the sample mean.

A possible explanation for the geographic correlation between a firm's extensive margins of importing and foreign production could be that firms face spatially correlated fixed costs to engage in foreign activities. In columns 2 and 3 we therefore include indicators for whether the firm exports to country j, exports to other countries in the same region as j (but not from j itself), and imports from other countries in the same region as j. While firms that export to a particular country j are 15.6 percentage points more likely to import from it, firms that export to other countries in the region are no more likely (or even slightly less likely) to import from it. Even firms that import from other countries in the same region are only 1.4 percentage points more likely to import from j. Having an affiliate in the same region is thus associated with a probability of importing more than three times greater than importing from other countries in the region.

Columns 4 to 6 in Table 5 provide results on firms' intensive-margin import decisions. Focusing on column 4, the estimates suggest that US MNEs import 2.34 log points more from countries in which they have a foreign affiliate, while foreign MNEs import 3.83 log points more. By contrast, there is no statistically significant relationship between the amount a US MNE imports from a country and the presence of its affiliates in the region. Foreign MNEs, however, also import relatively more from countries in their headquarter region, in line with similar evidence for China (Wang, 2021; Li, 2021).

In sum, US MNEs are more likely to import from countries in which they have affiliates, and from other countries in those affiliates' region. Conditional on importing from a set of countries, however, they do *not* import more from other countries in their affiliates' region. In addition, a comparable regional-trade measure using exports has a zero relationship with firms' import

Table 5: Foreign Production and the Margins of Firm-Country Imports

	$\Pr(\text{Import}_{fjr}=1)$			$\ln(\text{Imports}_{fjr})$		
	(1)	(2)	(3)	(4)	(5)	(6)
Affiliate_{fjr}	0.537***	0.458***	0.457***	2.338***	2.280***	2.287***
	(0.028)	(0.024)	(0.024)	(0.113)	(0.114)	(0.114)
Foreign HQ_{fjr}	0.690***	0.607***	0.607***	3.829***	3.598***	3.589***
	(0.045)	(0.041)	(0.041)	(0.227)	(0.207)	(0.208)
$\text{Affiliate in Region}_{fj'\neq jr}$	0.070***	0.052***	0.050***	0.166	0.148	0.150
	(0.015)	(0.012)	(0.012)	(0.109)	(0.111)	(0.114)
$\text{Foreign HQ in Region}_{fj'\neq jr}$	0.115***	0.105***	0.102***	0.560***	0.559***	0.550***
	(0.023)	(0.021)	(0.021)	(0.176)	(0.171)	(0.169)
Exporter_{fjr}		0.156***	0.154***		0.789***	0.761***
		(0.011)	(0.011)		(0.094)	(0.085)
$\text{Exporter to Region}_{fj'\neq jr}$		0.00	-0.002**		0.033	-0.005
		(0.001)	(0.001)		(0.057)	(0.046)
$\text{Importer from Region}_{fj'\neq jr}$			0.014***			0.299***
			(0.004)			(0.111)
Adj. R2	0.28	0.31	0.31	0.28	0.29	0.30
Observations (000s)	6200	6200	6200	177	177	177
Firm & Country Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes

Source: 2007 Economic censuses, LBD, LFTTD, and BEA inward and outward datasets. Dependent variable is an indicator for whether firm f imports from, or exports to, country j in region r. Sample is all firms with manufacturing establishments in the United States in 2007 that import from multiple countries. Observations in 1000s and rounded per Census disclosure rules. Standard errors two-way clustered by firm and by country. *,**, *** denote p<0.10, p<0.05, and p<0.01, respectively.

decisions. These findings are consistent with the premise that the set of countries from which US MNEs purchase inputs is related to the geography of their foreign production locations, which we summarize in the following fact:

Fact 2. *US MNEs are more likely to import from a country in which they have an affiliate, or from other countries in their affiliates' region. By contrast, there is no statistically significant relationship between the amount a US MNE imports from a country in its sourcing set and the presence of an affiliate in the same region. Foreign MNEs are both more likely to import, and import more, not only from their headquarter country, but also from countries in their headquarter region.*

3.3 Relationship between FDI and Exporting

We also explore the relationship between firms' foreign production and export decisions. A large body of work models FDI and exporting as two, alternative ways by which a firm can serve foreign markets. FDI allows firms to avoid trade costs, but also reduces the benefits of increasing returns to scale from serving multiple markets from a single location. In this setting, exports and FDI to a particular country are substitutes.

To assess the extensive margin of exporting, we estimate a variant of equation (2), where the dependent variable is an indicator equal to one if the firm exports to country j. Table 6 presents the results. A US MNE is 47.2 percentage points more likely to export to a country in which it also has an affiliate. While this pattern seems to contradict the assumption that exports and FDI are substitutes, it might be explained by intra-firm shipments of inputs from MNEs' US plants to their foreign plants, in line with complementary mechanisms in past work (Irarrazabal et al., 2013; Keller and Yeaple, 2013; Ramondo and Rodríguez-Clare, 2013). We also find that foreign firms are more likely to export to their headquarter country, in line with evidence on foreign firms operating in China (Wang, 2021).

Most notably, the estimates indicate that an MNE is 10.9 percentage points more likely to export to another country in the same region as its affiliate. This pattern is the opposite of what is predicted by models in which assembly locations are independent (e.g., Garetto et al., 2019) or substitutes (e.g., Tintelnot, 2017), and cannot be explained by shipments of inputs from the firm's headquarters to its affiliates, since by definition the firm has no affiliates in the country when the region indicator equals one. While this evidence does not rule out the possibility that substitution forces between FDI and exports are present, the data suggest that they are dominated by complementary forces beyond those due to input shipments between affiliates and their headquarters. MNEs' exports are spatially oriented towards countries in the same regions in which they manufacture goods.

As for the import regressions, we also assess the potential for spatially correlated fixed costs across activities to rationalize these patterns. Columns 2 and 3 in Table 6 include estimates

Table 6: Foreign Production and the Margins of Firm-Country Exports

	$\Pr(\text{Export}_{fjr}=1)$			$\ln(\text{Exports}_{fjr})$		
	(1)	(2)	(3)	(4)	(5)	(6)
Affiliate_{fjr}	0.472***	0.309***	0.310***	1.997***	1.699***	1.708***
	(0.035)	(0.029)	(0.029)	(0.102)	(0.096)	(0.093)
Foreign HQ_{fjr}	0.534***	0.326***	0.326***	1.302***	0.915***	0.926***
	(0.042)	(0.030)	(0.030)	(0.155)	(0.159)	(0.160)
$\text{Affiliate in Region}_{fj'\neq jr}$	0.109***	0.086***	0.087***	0.143*	0.097	0.113
	(0.017)	(0.014)	(0.014)	(0.080)	(0.076)	(0.077)
$\text{Foreign HQ in Region}_{fj'\neq jr}$	0.061***	0.020*	0.018*	-0.096	-0.222*	-0.218*
	(0.015)	(0.010)	(0.010)	(0.126)	(0.121)	(0.122)
Importer_{fjr}		0.292***	0.290***		0.858***	0.854***
		(0.015)	(0.015)		(0.055)	(0.055)
$\text{Importer from Region}_{fj'\neq jr}$		0.016***	0.013***		-0.063*	-0.073**
		(0.003)	(0.003)		(0.033)	(0.031)
$\text{Exporter to Region}_{fj'\neq jr}$			0.015***			0.189***
			(0.003)			(0.064)
Adj. R2	0.27	0.30	0.30	0.42	0.44	0.44
Observations (000s)	7070	7070	7070	350	350	350
Firm & Country Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes

Source: 2007 Economic censuses, LBD, LFTTD, and BEA inward and outward datasets. Dependent variable is an indicator for whether firm f imports from, or exports to, country j in region r. Sample is all firms with manufacturing establishments in the United States in 2007 that import from multiple countries. Observations in 1000s and rounded per Census disclosure rules. Standard errors two-way clustered by firm and by country. *,**, *** denote p<0.10, p<0.05, and p<0.01, respectively.

on indicators for whether the firm imports from, or exports to, other countries in the region. While both of these controls are positive and significant, they are relatively small, indicating at most a 1.6 percentage point increase in the probability of exporting to a country. Moreover, the affiliate in the region dummy remains large, positive, and statistically significant: it is more than 5 times larger than either of the trade-in-other-regions dummies. By contrast, columns 4 to 6 indicate that the positive correlation between how much a firm exports to country and its affiliate presence in the region is statistically insignificant once we control for the firm's other trade in the region. We summarize these results in our final fact:

Fact 3. *US MNEs are more likely to export not only to countries in which they have an affiliate, but also to other countries in their affiliates' region. Foreign MNEs are also more likely to export*

to their headquarter country and to other countries in the same region as their headquarters. By contrast, conditional on exporting to a country, there is not a consistently statistically significant relationship between the amount that a US MNE exports and the presence of an affiliate in the region.

These results point to complementarities between firms' domestic and foreign production plants beyond those that arise from intra-firm input shipments. While canonical models of horizontal FDI feature cannibalization of sales across manufacturing plants, the US data are consistent with US MNEs serving their foreign customers using both domestic and foreign manufacturing plants. Such patterns are consistent with a new complementarity between exporting and FDI that contrasts with the substitution force that has been the focus of past work.

3.4 Affiliate Gravity and the Extensive Margins of US Trade

The US data indicate that MNEs are more likely to import from, and export to, countries that are in the same region as their affiliates. To gain insight into the potential sources of these complementarities, we conclude this section by assessing the potential role of standard gravity variables in these correlations. To do so, we estimate the following linear probability model

$$Pr(I_{fjr}=1) = \sum_{i=1}^{5}(\beta_D \text{Closest Affiliate}_{fjri}{=}1) + \beta_{FTA}\ln(1+\text{Affiliates}_{fFTA_j}) + \beta_{Leg}\ln(1+\text{Affiliates}_{fLegal_j}) + \beta_{Lang}\ln(1+\text{Affiliates}_{fLang_j}) + \gamma_f + \gamma_j, \quad (4)$$

where Closest Affiliate_{fjri} is a set of mutually exclusive indicators that denote whether the firm has at least one affiliate within 500 km, 501 to 1,000 km, 1,001 to 2,000 km, 2,001 to 4,000 km, or over 4,000 km from country j. The omitted category is no affiliates. $\text{Affiliates}_{fFTA_j}$ is a count of the firm's affiliates that share a free trade agreement or Customs Union with country j. $\text{Affiliates}_{fLegal_j}$ and $\text{Affiliates}_{fLang_j}$ are counts of the firm's affiliates that share common legal

origins or a common language with j. We also consider Affiliates$_{fContiguous_j}$, which denotes the number of affiliates in countries that are contiguous to j, though do not include this measure in the same specifications with the distance indicators due to collinearity. We construct these variables using the CEPII gravity database from Conte et al. (2022). For details, see Appendix A.8. We focus on the subset of US firms for these specifications, since we do not observe the universe of foreign firms' foreign affiliates.

Table 7: Gravity in Foreign Production and the Probabilities of Importing and Exporting

	Pr(Import$_{fjr}$ = 1)			Pr(Export$_{fjr}$ = 1)		
	(1)	(2)	(3)	(4)	(5)	(6)
Affiliate$_{fjr}$	0.460***	0.426***	0.429***	0.391***	0.336***	0.351***
	(0.024)	(0.024)	(0.024)	(0.030)	(0.030)	(0.030)
Affiliate$_{fj'<500km \text{ from } j}$	0.250***		0.146***	0.264***		0.112**
	(0.029)		(0.035)	(0.036)		(0.046)
Affiliate$_{f501<j'<1000km \text{ from } j}$	0.161***		0.078***	0.218***		0.087**
	(0.022)		(0.026)	(0.029)		(0.036)
Affiliate$_{f1001<j'<2000km \text{ from } j}$	0.090***		0.036*	0.179***		0.087***
	(0.013)		(0.019)	(0.027)		(0.032)
Affiliate$_{f2001<j'<4000km \text{ from } j}$	0.054***		0.032***	0.134***		0.076***
	(0.010)		(0.010)	(0.025)		(0.025)
Affiliate$_{fj'>4000km \text{ from } j}$	0.041***		0.035***	0.096***		0.062***
	(0.007)		(0.011)	(0.023)		(0.023)
ln(1+Affiliates$_{fFTA_j}$)		0.084***	0.070***		0.099***	0.092***
		(0.013)	(0.015)		(0.017)	(0.020)
ln(1+Affiliates$_{fCommLegal_j}$)		-0.006	-0.004		0.051***	0.048***
		(0.010)	(0.010)		(0.015)	(0.014)
ln(1+Affiliates$_{fCommLanuage_j}$)		0.008	0.003		-0.022	-0.023
		(0.012)	(0.012)		(0.018)	(0.018)
ln(1+Affiliates$_{fContiguous_j}$)		0.069***			0.069**	
		(0.024)			(0.029)	
Adj. R2	0.273	0.274	0.274	0.26	0.262	0.262
Observations (000s)	5860	5860	5860	6750	6750	6750
Firm & Country Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes

Source: 2007 LBD, LFTTD, and BEA inward and outward datasets. Dependent variable is the log of imports by firm f from country j in region r or similarly the log of firm exports. Sample is all firms with manufacturing establishments in the United States in 2007 that import from, or export to, multiple countries. Observations in 1000s and rounded per Census disclosure rules. Standard errors two-way clustered by firm and by country. *,**, *** denote p<0.10, p<0.05, and p<0.01, respectively.

Table 7 presents results from estimating equation (4) via OLS on US firms. Column 1 indicates

that US firms are considerably more likely to import from countries that are geographically proximate to their foreign affiliates. They are 25 percentage points more likely to import from a country within 500 km from an affiliate, and only 4.1 points more likely to import from a country more than 4,000 km away. Column 4 presents comparable estimates for the probability that a firm exports to country j. Firms are 11.2 percentage points more likely to export to a country within 500 km of an affiliate, and only 6.2 points more likely to export to one over 4,000 km away. Physical distance from an affiliate is thus strongly related to the probability that a firm's domestic plants will trade with a particular country, with a stronger relationship for exporting than importing.

The estimates in Columns 2 and 5 also imply that firms with one affiliate that shares a free-trade agreement with a particular country are 5.8 percentage points more likely to import from it, while firms with five affiliates in the trade zone are 13.5 points more likely. For exporting, firms with one affiliate that shares a free-trade agreement with the country are 6.9 percentage points more likely to export there, and those with 5 affiliates are almost 16 points more likely. Manufacturing in countries that share a common border with a country is also associated with higher probabilities that an MNEs' domestic plants will import or export from the country. By contrast, firms are not more likely to trade with countries that share an official language with their affiliates' countries, and only the probability of exporting is higher for firms that have affiliates in countries that share legal origins with a particular destination. In Appendix Table A.8, we show that these correlations are generally absent or statistically insignificant for firms' intensive margins of imports and exports.

Fact 4. *US MNEs' domestic plants are more likely to import from, and export to, countries that are geographically proximate or share free-trade agreements with the countries in which they have foreign manufacturing affiliates.*

3.5 Summary of New Facts

The facts in this section demonstrate that MNEs import from, and export to, a substantially larger number of countries than domestic firms, even after controlling for their US sales, number of establishments, and number of distinct US manufacturing industries. MNEs extensive-margins of trade are not oriented towards those countries in which they have foreign production plants, but also towards countries that are geographically close and share free-trade agreements with their affiliates. In the next section, we develop a new framework in which firms jointly determine their foreign production, foreign sourcing, and exporting decisions to rationalize these results.

4 Framework

In this section, we develop a framework that rationalizes the tilting of US MNEs' domestic exports and imports towards countries that are proximate to their foreign manufacturing affiliates. Our key insight is that country-specific fixed costs to sell in, or source from, a particular market that are incurred at the *firm* level interact with variable trade costs to create novel complementarities between firms' foreign production and domestic import and export decisions.

4.1 Environment

We consider a world in which individuals in J countries consume differentiated manufactured goods produced by heterogeneous firms. Although each firm produces a single good, we assume that this firm's good is differentiated based on its production country and that the same firm may produce in multiple countries.[20]

We index firms by φ and varieties within firms by k. Given our Armington assumption, k also corresponds to an index for production locations. We assume a CES structure for preferences

[20]This Armington assumption simplifies the exposition of the model, and can be micro-founded using an isomorphic set of equations that arises from a Ricardian model with production efficiency differences à la Eaton and Kortum (2002), as in Tintelnot (2017). See Antràs et al. (2022) for details.

with a common degree of substitutability across varieties produced by different firms and across varieties produced by the same firm. More formally, preferences are given by:

$$U_{Mi} = \left(\int_{\varphi \in \Omega_i} \sum_{k \in \mathcal{K}(\varphi)} q_i \left(\varphi, k\right)^{(\sigma-1)/\sigma} \mathrm{d}\varphi \right)^{\sigma/(\sigma-1)}, \quad \sigma > 1, \tag{5}$$

where Ω_i is the endogenous measure of firms selling differentiated goods in country i and $\mathcal{K}\left(\varphi\right) \subseteq J$ is the set of locations from which firm φ sells varieties in country i. These preferences imply that consumers in country i spend an amount

$$S_i(\varphi, k) = \left(\frac{p_i(\varphi, k)}{P_i} \right)^{1-\sigma} E_i \tag{6}$$

of their income on variety k produced by firm φ. E_i is total spending on manufactured goods in country $i \in J$, while P_i is is the manufacturing ideal price index in country i.

We assume that total manufacturing spending E_i and wages w_i in all countries are independent of the equilibrium in the manufacturing sector (see Appendix Section B.1 for more details).

4.2 Manufacturing Production

Manufactured varieties are produced under increasing returns to scale and monopolistic competition. The variable φ used to index final-good firms also corresponds to their 'core' productivity, and following Melitz (2003), we assume that firms only learn their productivity φ after incurring an entry cost equal to f^e units of labor in their 'headquarter' country.

After paying its fixed entry cost, each firm acquires blueprints to produce varieties of a final good. Although the firm could produce its varieties anywhere in the world, we assume that opening an assembly plant in a given country $k \in J$ incurs a fixed overhead cost equal to f_k^a units of labor in country k. In equilibrium, firms therefore open a limited number of assembly plants (possibly a single one). We denote the optimal set of countries $k \in J$ for which firm φ has paid the associated fixed cost of assembly by $\mathcal{K}\left(\varphi\right) \subseteq J$, and refer to it as the firm's *global*

assembly strategy.

Production of final-good varieties requires local labor and a bundle of tradable intermediate inputs. The productivity with which firm φ can manufacture in each location k is thus shaped by its core productivity, local wages in k, a location-specific productivity parameter Z_k^a, and the costs of its intermediate inputs. Following our approach for preferences, we assume that inputs sourced from different countries are imperfect substitutes, with a constant elasticity of substitution ρ.[21]

The first key assumption is that a firm must incur a country-specific fixed cost $w_j f_j^s$ to source inputs from a particular country j. Although this assumption is similar to Antràs et al. (2017), a crucial distinction here is that the fixed cost is incurred at the firm level, thereby granting *all* of the firm's assembly plants $k \in \mathcal{K}(\varphi)$ access to inputs from that country. We denote the set of countries for which a firm φ has paid the fixed costs of sourcing by $\mathcal{J}(\varphi) \subseteq J$ and refer to it as the firm's *global sourcing strategy.*

Intermediates are produced worldwide by a competitive fringe of suppliers that sells its products at marginal cost, since we assume that input varieties *within* countries are perfect substitutes. All intermediates are produced with labor under a linear technology delivering Z_j^s units of output per unit of labor. Shipping intermediates from country j to country k entails iceberg trade costs τ_{jk}^s. As a result, the cost at which firms producing in k can procure inputs from country j is given by $\tau_{jk}^s w_j / Z_j^s$.

The overall marginal cost for firm φ to produce units of the final-good variety in country k is thus given by

$$c(\varphi, k) = \frac{1}{\varphi} \frac{1}{Z_k^a} (w_k)^{1-\alpha} \left(\sum_{j \in \mathcal{J}(\varphi)} \left(\frac{\tau_{jk}^s w_j}{Z_j^s} \right)^{1-\rho} \right)^{\alpha/(1-\rho)}, \tag{7}$$

where $1-\alpha$ is the value-added (labor) share in final-good production. Intuitively, marginal costs are decreasing in the firm's core productivity φ, productivity in assembly country k, and the efficiencies of the firm's input-source countries, while they are increasing in those countries'

[21] This Armington assumption can also be micro-founded using productivity heterogeneity à la Eaton and Kortum (2002), as in Antràs et al. (2017).

wages. Marginal costs to produce in country k are also increasing in bilateral trade costs between k and the firm's input-source countries.

A second key assumption is that a firm incurs a fixed marketing cost of f_i^x units of labor in country i to sell its goods in country i. As for inputs, this country-specific fixed cost allows the firm to sell in country i from *all* its assembly plants. We use the superscript x to denote these fixed costs, but note that when $k = i$, the fixed cost of assembly allows plants in k to sell to local consumers. We denote the optimal set of countries $i \in J$ for which a firm with productivity φ has paid the associated fixed cost of marketing by $\Upsilon(\varphi) \subseteq J$, and refer to it as the firm's *global marketing strategy*. Shipping final goods from country k to country i also entails variable (iceberg) trade costs τ_{ki}^a.

To summarize, we use three subindices to denote countries: k denotes a country in which the firm locates final-good production; j denotes a country from which the firm sources inputs; and i denotes a country in which the firm sells its final goods to consumers. For simplicity, our framework does not feature any *direct* dependence of the cost function in (7) on the firm's headquarter country, so there is no headquarter subindex.

4.3 Firm Behavior Conditional on Extensive-Margin Strategies

We first describe optimal firm behavior for given marketing, assembly, and sourcing strategies. The model delivers a simple, closed-form solution for the share of intermediate inputs sourced by an assembly plant in $k \in \mathcal{K}(\varphi)$ from any country j. From the last term of the cost function in (7), it is straightforward to see that this share is simply given by

$$\chi_{jk}(\varphi) = \frac{\left(\tau_{jk}^s w_j / Z_j^s\right)^{1-\rho}}{\sum_{j' \in \mathcal{J}(\varphi)} \left(\tau_{j'k}^s w_{j'} / Z_{j'}^s\right)^{1-\rho}} \quad \text{if } j \in \mathcal{J}(\varphi), \tag{8}$$

and $\chi_{jk}(\varphi) = 0$ otherwise. We refer to the term $\xi_j^s \equiv \left(w_j / Z_j^s\right)^{1-\rho}$ as the *sourcing potential* of country j, since it captures that country's potential to lower the firm's variable costs. Countries in the firm's sourcing strategy $\mathcal{J}(\varphi)$ with lower wages w_j or more advanced input technologies

Z_j^s have higher market shares across *all* of the firm's assembly plants. Although all of the firm's plants source inputs from the same set of countries, each plant's expenditure shares are oriented towards countries with lower bilateral trade costs (τ_{jk}^s).

The model also delivers a simple, closed-form solution for sales of an assembly plant in k to each market i in the firm's global marketing strategy. The cost function in (7) together with the constant markup rule implied by (5) and the spending function (6) imply that firm φ obtains sale revenue in country $i \in \Upsilon(\varphi)$ from varieties shipped from k equal to

$$S_{ki}(\varphi) = \kappa_S \varphi^{\sigma-1} \xi_k^a \left(\tau_{ki}^a\right)^{1-\sigma} \left(\sum_{j \in \mathcal{J}(\varphi)} \xi_j^s \left(\tau_{jk}^s\right)^{1-\rho} \right)^{\alpha(\sigma-1)/(\rho-1)} E_i \left(P_i\right)^{\sigma-1}, \tag{9}$$

where κ_S is a constant and $\xi_k^a \equiv \left((w_k)^{1-\alpha}/Z_k^a\right)^{1-\sigma}$ captures country k's *assembly potential*.

Holding market demand $E_i P_i^{\sigma-1}$ and the firm's extensive-margin strategies constant, equation (9) indicates that an increase in the assembly potential ξ_k^a of country k or the sourcing potential ξ_j^s of *any* country $j \in \mathcal{J}(\varphi)$ increases sales of plants based in k to all countries $i \in \Upsilon(\varphi)$. Reductions in the associated bilateral trade costs τ_{ki}^a and τ_{jk}^s generate analogous effects. These changes improve efficiency in plant k, which increases its sales. Conversely, changes in $\xi_{k'}^a$, $\tau_{k'i}^a$, or $\tau_{jk'}^s$ generate no effects on the sales of plants in $k \neq k'$ to country i. This independence in sales across countries is driven by our assumptions of Armington differentiation and a common substitutability across all final-good varieties, and contrasts with many models of horizontal FDI in which plants cannibalize sales from each other (e.g., Tintelnot, 2017). Recent work also invokes these assumptions and obtains the same independence across assembly locations (Garetto et al., 2019).[22]

Given the assumption of Cobb-Douglas production technology in (7), equation (9) aggregated across activated sales markets $i \in \Upsilon(\varphi)$ and the share $\chi_{jk}(\varphi)$ in equation (8) jointly imply that

[22] In Antràs et al. (2022) we show that independence in firm sales across countries arises when the standard *demand cannibalization* effect is exactly offset by a *demand complementarity* effect.

imports by plants in k from a given sourcing location j are given by:

$$M_{jk}(\varphi) = \kappa_M \varphi^{\sigma-1} \xi_j^s \left(\tau_{jk}^s\right)^{1-\rho} \left(\sum_{j' \in \mathcal{J}(\varphi)} \xi_{j'}^s \left(\tau_{j'k}^s\right)^{1-\rho} \right)^{\frac{\alpha(\sigma-1)}{(\rho-1)}-1} \sum_{i \in \Upsilon(\varphi)} \xi_k^a \left(\tau_{ki}^a\right)^{1-\sigma} E_i \left(P_i\right)^{\sigma-1}, \quad (10)$$

where κ_M is a constant.

Holding market demand $E_i P_i^{\sigma-1}$ and a firm's extensive-margin strategies constant, equation (10) indicates that an increase in country k's assembly potential ξ_k^a or a reduction in any bilateral trade cost τ_{ki}^a for $i \in \Upsilon(\varphi)$ increases input purchases $M_{jk}(\varphi)$ by plants in k from *all* countries in the firm's sourcing strategy $j \in \mathcal{J}(\varphi)$. The addition of a new country i' to the firm's marketing strategy also increases input purchases $M_{jk}(\varphi)$ by plants in *all* locations from *all* countries in the firm's sourcing strategy. A reduction in a bilateral input-trade costs τ_{jk}^s increases input purchases $M_{jk}(\varphi)$ from country j by plants based in k and raises those plants' efficiency, thus increasing their sales.

As highlighted in Antràs et al. (2017), a decrease in τ_{jk}^s also affects plant k's input purchases $M_{j'k}(\varphi)$ from all other countries j' in the firm's sourcing strategy, with the sign of that dependence governed by the relative size of $\alpha(\sigma-1)$ and $(\rho-1)$. Because the primary focus of this paper is to study interdependencies between final-good production, sourcing, and exporting, below we assume that $\alpha(\sigma-1) = \rho - 1$. Under these parametric restrictions, sourcing flows are independent across countries, which allows us to isolate complementarities between final-good production, sourcing, and exporting.

4.4 Optimal Marketing, Assembly, and Sourcing Strategies

Having solved for optimal firm sales and input purchases by country, we now analyze the optimal set of countries in which a firm sells final goods (i.e., its global marketing strategy $\Upsilon(\varphi) \subseteq J$), the optimal set of countries from which it sources inputs (i.e., its global sourcing strategy $\mathcal{J}(\varphi) \subseteq J$), and the optimal set of countries in which it locates final-good assembly plants (i.e., its global assembly strategy $\mathcal{K}(\varphi) \subseteq J$). Starting from equation (9), invoking the constant

markup rule, and imposing $\alpha(\sigma-1)=\rho-1$, firm profits can be expressed as:

$$\begin{aligned}\pi\left(\varphi,\Upsilon\left(\varphi\right),\mathcal{K}\left(\varphi\right),\mathcal{J}\left(\varphi\right)\right) &= \kappa\varphi^{\sigma-1}\sum_{i\in J}\mathcal{I}_i^x\cdot E_iP_i^{\sigma-1}\left[\sum_{k\in J}\mathcal{I}_k^a\cdot\xi_k^a\left(\tau_{ki}^a\right)^{1-\sigma}\left(\sum_{j\in J}\mathcal{I}_j^s\cdot\xi_j^s\left(\tau_{jk}^s\right)^{1-\rho}\right)\right] \\ &\quad -\sum_{i\in J}\mathcal{I}_i^x\cdot w_if_i^x-\sum_{j\in J}\mathcal{I}_j^s\cdot w_jf_j^s-\sum_{k\in J}\mathcal{I}_k^a\cdot w_kf_k^a, \qquad (11)\end{aligned}$$

where κ_π is a constant and the indicators $\mathcal{I}_i^x$, $\mathcal{I}_k^a$, and $\mathcal{I}_j^s$ take a value of 1 when $i\in\Upsilon\left(\varphi\right)$, $k\in\mathcal{K}\left(\varphi\right)$ and $j\in\mathcal{J}\left(\varphi\right)$ (respectively), and 0 otherwise. Solving for the strategies that maximize equation (11) is a complex combinatorial problem, but it is straightforward to characterize certain features of its solution by exploiting three of its technical properties.

First, firm profits are additively separable in $(\mathcal{I}_i^x,\mathcal{I}_{i'}^x)$ for $i,i'\in\{1,...,J\}$ and $i\neq i'$. As a result, the profitability of activating one country as a sales market (e.g., France) is unaffected by the firm's other active sales markets (e.g., Portugal and Spain). This is a standard result in the vast majority of papers on exporting that assume constant marginal costs.[23] Second, firm profits are also additively separable in $(\mathcal{I}_k^a,\mathcal{I}_{k'}^a)$ for $k,k'\in\{1,...,J\}$ and $k\neq k'$. This separability implies that the profitability of one assembly location is independent of the firm's other assembly locations. This independence contrasts with many models of horizontal and export-platform FDI in which a firm's sales in one market affect its sales in other markets (Tintelnot, 2017; Arkolakis et al., 2021), but is in line with the recent work of Garetto et al. (2019). Third, firm profits are also additively separable in $\left(\mathcal{I}_j^s,\mathcal{I}_{j'}^s\right)$ for $j,j'\in\{1,...,J\}$ and $j\neq j'$. This separability implies that the profitability of adding a source country is independent of the other countries from which the firm imports. This result hinges on the parametric assumptions we impose between the elasticities of demand for final goods versus inputs, and contrasts with prior work that finds source countries are complements (Antràs et al., 2017) or substitutes (Boehm et al., 2020).

These three features of the profit function imply that *within* each extensive margin, the

[23] Exceptions to independence in exporting include models with 'extended gravity' in which the fixed costs to export to a market are decreasing in its proximity to other active export markets for the firm (Morales et al., 2019) or models in with decreasing returns to scale in production (Almunia et al., 2021).

firm's decision to add a country to one set is independent of the other countries in the set. While the parametric restrictions that ensure this independence within margins are unlikely to hold in reality, they allow us to focus on the novel interdependencies *across* marketing, assembly, and sourcing strategies. In Section 4.5, we discuss whether relaxing independence in each of these margins could provide an alternative explanation for the empirical patterns we document.

The two novel interdependencies in our framework arise from the fact that the profit function in (11) features increasing differences in (a) $(\mathcal{I}_i^x, \mathcal{I}_k^a)$ for any $i, k \in \{1, ..., J\}$; (b) $\left(\mathcal{I}_i^x, \mathcal{I}_j^s\right)$ for any $i, j \in \{1, ..., J\}$; and (c) $\left(\mathcal{I}_k^a, \mathcal{I}_j^s\right)$ for $k, j \in \{1, ..., J\}$. As a result, the activation of a sales destination, an assembly location, or an input source can only increase the profitability of activating other locations for other purposes. Inspection of equation (11) also reveals that the profit function is supermodular in φ and the firm's marketing, assembly, and sourcing strategies, which invoking Topkis's monotonicity theorem leads to the following result:

Proposition 1. Consider two firms with $\varphi_H \geqslant \varphi_L$. If the distinct country-specific fixed costs of marketing, assembly, and sourcing, are common across firms then $\Upsilon(\varphi_L) \subseteq \Upsilon(\varphi_H)$, $\mathcal{K}(\varphi_L) \subseteq \mathcal{K}(\varphi_H)$ and $\mathcal{J}(\varphi_L) \subseteq \mathcal{J}(\varphi_H)$ for $\varphi_H \geqslant \varphi_L$.

Proposition 1 states that our model delivers a strict hierarchical order in the extensive margins of global marketing, assembly, and sourcing. This hierarchy further implies that even in the presence of i.i.d. heterogeneity in fixed costs across firms, more productive firms should, on average, sell in more markets, assemble final goods in more locations, and source inputs from more countries. As a result, increased globalization, for example due to reductions in trade costs, magnifies initial heterogeneity in firm productivity. The fact that larger firms choose richer strategies $\Upsilon(\varphi)$, $\mathcal{K}(\varphi)$, and $\mathcal{J}(\varphi)$ immediately implies differences in world sales across firms that are magnified relative to the differences that would arise in a world without global assembly, exporting, and sourcing.

Although the analysis here focuses on firm behavior given a residual demand level, Appendix Section B.1, characterizes the model's industry equilibrium and outline its general equilibrium.

4.5 Connecting the Model to the New Facts

The model can rationalize the facts on MNEs' extensive margins of trade presented in Section 3.

Fact 1: Selection into Exports, Imports, and FDI Fact 1 summarizes evidence that MNEs trade with more countries than domestic firms, even after controlling for their US size. While some existing models of FDI predict that MNEs will export to, and import from, more countries, that result tends to be driven by either their productivity advantage (e.g. Arkolakis et al., 2018; Bernard et al., 2018) or intra-firm input trade between a parent and its affiliates (e.g., Ramondo and Rodríguez-Clare, 2013; Keller and Yeaple, 2013). The estimates in Table 4, however, indicate that MNEs have larger extensive margins of imports and exports even after *controlling for their domestic size* and restricting the flows to *arm's-length transactions*.

Our model can account for these facts because the firm-level fixed costs of importing and exporting are shared across all of the firm's plants. An MNE thus obtains relatively larger benefits from activating a foreign market or input source, since such an addition not only increases sales by its domestic plants, but also by its plants abroad. Although the model requires additional heterogeneity in (some) of the fixed costs to participate in foreign markets to rationalize the data (otherwise the firm's core productivity will fully determine its assembly, sourcing, and marketing strategies), in Appendix Section B.2, we show that heterogeneity in the fixed costs of assembly interact with the complementarities in our model to generate these patterns. More formally, if there are two firms, an MNE and a non-MNE, with the same domestic size and the same fixed costs of exporting and importing, but one firm features richer extensive margins of exporting and importing, then this firm must necessarily be the MNE. Moreover, the marginal benefit of activating an additional foreign market or export source is increasing in the number of foreign countries in which it manufacture goods, as documented in columns 2, 3, 5 and 6 of Table 4. We also show that similar results apply in the presence of firm-level heterogeneity in the fixed costs of exporting or of sourcing.

The model's prediction on larger extensive margins of trade also implies that MNEs will

have higher ratios of imports and exports to domestic sales, with both ratios increasing in the number of countries to which firms export and from which they import (see Appendix Section B.3 for a formal proof). The evidence in Table 4 is exactly in line with this prediction, which is absent from the majority of FDI models in which MNEs are larger than domestic firms, but do not trade more intensively.

Indeed, canonical models of horizontal and export-platform FDI with cannibalization effects and plant-level fixed costs of trade cannot account for this fact. Those models predict that a US MNE with the same domestic size as a non-MNE will be *less* likely to export. Intuitively, as we show in Appendix Section B.4, under weak assumptions, an MNE's domestic operations face greater *within-firm* competition abroad than at home, which results in relatively lower profitability abroad than at home. This relative difference in turn decreases both their incentive to export and the ratio of their worldwide to US sales (for a given level of domestic sales). The canonical export-platform model is thus inconsistent with Fact 1. Furthermore, these models cannot explain either why an MNE imports from more countries than a comparably sized domestic firm, as US plants of the same size find it equally profitable to source inputs from a particular country.

Facts 2 and 4: Spatial Correlation in Foreign Production and Importing Our model also rationalizes the regional correlations we document between US MNEs' foreign production and US import locations. Consider the change in firm profits from adding a new source country j to a firm's global assembly strategy $\mathcal{J}(\varphi)$. Given equation (11), this change is given by

$$\Delta\pi\left(\varphi, \mathcal{K}\left(\varphi\right), \mathcal{J}\left(\varphi\right) \cup j\right) = \kappa_\pi \varphi^{\sigma-1} \xi_j^s \sum_{k \in \mathcal{K}(\varphi)} \left[\left(\tau_{jk}^s\right)^{1-\rho} \xi_k^a \left(\sum_{i \in \Upsilon(\varphi)} \left(\tau_{ki}^a\right)^{1-\sigma} E_i P_i^{\sigma-1} \right) \right] - w_j f_j^s, \tag{12}$$

and naturally increases in the firm's core productivity φ and country j's sourcing potential, and decreases in the fixed cost of sourcing $w_j f_j^s$.

A key feature of the model is that the marginal benefit of adding a given sourcing location j is increasing in the assembly and market potentials of *all* countries k in the firm's assembly strategy.

This relationship is consistent with our finding in Table 4 that the number of countries from which MNEs import is increasing in the number of countries in which they manufacture goods. Moreover, the term $\left(\tau_{jk}^{s}\right)^{1-\rho}$ in equation (12) indicates that the strength of this complementarity is decreasing in the bilateral trade costs between location j and the firm's mix of assembly plants. The model thus predicts that the firm's domestic imported inputs will tilt towards countries with lower bilateral trade costs with its affiliates, in line with the extensive-margin orientation of firm's imports towards countries in the firm's affiliate regions in Table 5 and with the 'gravity' evidence in Table 7.[24]

To illustrate the role of firm-level fixed costs in this result, we solve for the same change in profits from activating an additional input source, but when the fixed costs to do so are incurred at the plant, rather than firm, level. In this case, the change in profits is given by

$$\Delta\pi\left(\varphi,\Upsilon_{k}\left(\varphi\right),\mathcal{K}\left(\varphi\right),\mathcal{J}_{k}\left(\varphi\right)\cup j\right)=\kappa_{\pi}\varphi^{\sigma-1}\xi_{j}^{s}\left(\tau_{jk}^{s}\right)^{1-\rho}\left(\sum_{i\in\Upsilon_{k}(\varphi)}\xi_{k}^{a}\left(\tau_{ki}^{a}\right)^{1-\sigma}E_{i}P_{i}^{\sigma-1}\right)-w_{j}f_{j}^{s,p}. \tag{13}$$

This expression still features complementarity between country j's sourcing potential and plant k's market potential, which is in turn shaped by plant k's export strategy. But the locations of the firm's *other* assembly plants and their respective plant-level export strategies are now entirely irrelevant for the decision on sourcing from j.

In sum, when the fixed costs of importing are incurred at the plant – rather than firm – level, MNEs' plants operate independently from each other, making import decisions that are indistinguishable from domestic firms with the same core productivity and fixed cost parameters.

Facts 3 and 4: Spatial Correlation in Foreign Production and Exporting The model can also rationalize the fact that US MNEs are more likely to export to countries that are 'near' their affiliates. Starting with profits in (11), and holding the firm's assembly and sourcing

[24]The summation of the terms involving $\left(\tau_{jk}^{s}\right)^{1-\rho}$ in equation (12) also motivates the inclusion of controls for the number of affiliates that share a free-trade agreement or a common border with j in Table 7.

strategies fixed, the change in profits from adding destination market i to the set $\Upsilon(\varphi)$ can be expressed as

$$\Delta\pi\left(\varphi,\Upsilon\left(\varphi\right)\cup i,\mathcal{K}\left(\varphi\right),\mathcal{J}\left(\varphi\right)\right)=\kappa_{\pi}\varphi^{\sigma-1}E_{i}P_{i}^{\sigma-1}\sum_{k\in\mathcal{K}(\varphi)}\left[\xi_{k}^{a}\left(\tau_{ki}^{a}\right)^{1-\sigma}\left(\sum_{j\in\mathcal{J}(\varphi)}\xi_{j}^{s}\left(\tau_{jk}^{s}\right)^{1-\rho}\right)\right]-w_{i}f_{i}^{x}. \tag{14}$$

This marginal benefit is increasing in the firm's core productivity φ and the level of demand in country i ($E_{i}P_{i}^{\sigma-1}$), while it is decreasing in the fixed cost $w_{i}f_{i}^{x}$. These are the standard forces in canonical models of selection into exporting.

A key distinction in our framework is that the marginal benefit of activating an export destination is also enhanced by richer assembly and sourcing strategies. In particular, the change in profits in (14) is increasing in the number of activated assembly locations $k\in\mathcal{K}\left(\varphi\right)$, in line with our results in Table 4 indicating that the extensive margin of exporting is increasing in the number of foreign affiliates of an MNE. Furthermore, the term $\left(\tau_{ki}^{a}\right)^{1-\sigma}$ in equation (14) indicates that the change in profits is disproportionately large if the set $\mathcal{K}\left(\varphi\right)$ includes production locations k with high assembly potentials and low bilateral trade costs with i. Our 'regional' results in Table 6 and our 'gravity' results in Table 7 are precisely in line with these predictions. US MNEs are more likely to export to countries that are near their affiliates or that have free-trade agreements with them.

As for importing, this spatial correlation between assembly and exporting is absent from models with plant-level fixed costs of exporting. The change in profits from adding country j when doing so entails a plant-level (rather than a firm-level) fixed cost is

$$\Delta\pi\left(\varphi,\Upsilon_{k}\left(\varphi\right)\cup i,\mathcal{K}\left(\varphi\right),\mathcal{J}_{k}\left(\varphi\right)\right)=\kappa_{\pi}\varphi^{\sigma-1}\xi_{k}^{a}\left(\tau_{ki}^{a}\right)^{1-\sigma}E_{i}P_{i}^{\sigma-1}\left(\sum_{j\in\mathcal{J}_{k}(\varphi)}\xi_{j}^{s}\left(\tau_{jk}^{s}\right)^{1-\rho}\right)-w_{i}f_{i}^{x,p}. \tag{15}$$

Unlike equation (14) which contains all the firm's assembly plants, the marginal benefit of adding destination market i is now independent of the firm's assembly plants in other countries.

As a result, even with firm heterogeneity in fixed costs to assemble across countries, domestic firms and MNEs with the same core productivity will have the same gains from activating a particular US export market, and MNEs' US export markets will not be correlated with their foreign manufacturing locations. In contrast to existing work on export-platform FDI, our model therefore predicts that a firm's domestic plants will tend to sell in markets that are proximate to its affiliates.

Alternative Explanations An alternative explanation for the spatial patterns we document is that firms draw heterogeneous and spatially correlated fixed costs to export, import, and manufacture abroad. Indeed, models of 'extended gravity' document precisely these types of spatial correlations, with firms being more likely to export to new markets that are proximate to, or share a common language with, countries to which they exported in the past (Morales et al., 2019). The results in columns 2, 3, 5, and 6 in Tables 5 and 6, however, suggest that such spatial correlations in fixed-cost draws are not the primary drivers of the positive correlations we document between US MNEs' foreign production locations and their extensive-margin trade choices. Firms are not more likely to import from countries that are in the same region as countries to which they export, and only 1.3 percentage points more likely to export to countries in the same region from which they import. By contrast, firms are 5.0 points more likely to import and 8.7 points more likely to export to countries that are in the same region as their affiliate.

To isolate the key mechanisms in our paper, we shut down interdependencies across assembly decisions and across importing decisions. One possibility is that a model with interdependencies within those margins could match our evidence, even in the presence of plant-level fixed costs of trade. As discussed above, a model with cannibalization effects would *not* match our facts regarding the richer extensive margins of exports by MNEs for a given domestic size. While a model with demand complementarities across assembly locations (as in Antràs et al., 2022) would rationalize the export patterns we find, it could not account for MNEs' richer extensive margin of imports (conditional on domestic size). Introducing the type of sourcing interdependencies

highlighted in Antràs et al. (2017) would complicate the mapping between firm size and the number of imported sources, but they would be of little help in relating the extensive margin of exports and imports to the extensive margin of assembly (provided again that the fixed costs of trade are at the plant- rather than the firm-level).

We conclude this section by relating our framework to models that feature a direct dependence between an affiliate's productivity and its distance from its headquarter country ('headquarter gravity') (Arkolakis et al., 2018; Head and Mayer, 2019). In Appendix Section B.5, we show that including an additional cost of production for an affiliate in country k owned by a firm headquartered in h does not increase that firm's domestic imports and exports from countries that are more proximate to the affiliate. In addition, our framework predicts that foreign affiliate sales are decreasing in their distance from headquarters, without any additional assumption on affiliate production or marketing costs. Instead, the assumption that the fixed costs to market goods or source inputs are incurred at the firm level delivers this prediction. First, because it is more profitable for a firm's domestic plants to export to proximate markets, the firm's affiliates that are closer to home enjoy higher firm-specific market potentials, since they face lower variable trade costs to reach those activated markets. Second, the firm is more likely to source from countries that are near its headquarters since these entail lower variable costs, which in turn imply that marginal trade costs for an affiliate's inputs will be relatively lower for affiliates that are also closer to home. The simple shift from plant to firm-level fixed costs of marketing and sourcing can thus explain patterns of 'headquarter' gravity documented in prior work (e.g., Wang, 2021).

5 Implications for the Effects of Trade Policy

We close our analysis with an example to illustrate how the new source of scale economies in our framework can generate increased trade in third markets in response to changes in bilateral trade costs in other countries. These positive effects contrast with the typical trade diversion

effects that feature in past work, and are absent from models with plant-level country-specific fixed costs (such as Bernard et al., 2018).

Consider a scaled down version of our model with only three countries: USA (us), North (N), and South (S). We consider the optimal strategy of a firm that always produces in the US and also sources domestic inputs in the US. We wish to illustrate the effect of 'third-market' trade policy shocks on US exports, so it is also convenient to assume that the firm's goods are only demanded in one of the two foreign countries, which we choose to be the North, so $E_N > E_{us} = E_S = 0$. The fixed cost of selling goods in the North is given by f_N^x. Without loss of generality we normalize the US assembly and sourcing potentials such that $\xi_{us}^a \left(\tau_{us,N}^a\right)^{1-\sigma} = \xi_{us}^s = 1$, and we ignore domestic trade costs $\tau_{ii}^s = \tau_{ii}^a = 1$ for all i. Finally, we assume that the fixed costs of assembling in the North or of sourcing in the South are prohibitively high, while the fixed costs of assembling in the South or of sourcing in the North are bounded and given by f_S^a and f_N^s, respectively.

Given these assumptions, the firm's extensive margin decisions are (i) whether to activate North as a destination of sales; (ii) whether to set up an assembly plant in the South; and (iii) whether to activate North as a source of inputs. Our goal is to study how these decisions respond to reductions in bilateral trade costs for final goods between the South and the North, with a focus on the implications for US exports to the North. When doing comparative statics for a single firm below, we hold the market demand level $E_N P_N^{\sigma-1}$ faced by the firm in the North constant, and set $\kappa\varphi^{\sigma-1} E_N P_N^{\sigma-1} = 1$ (remember that wages are also kept unchanged).

The firm's problem can be expressed as choosing $\left(\mathcal{I}_N^x, \mathcal{I}_S^a, \mathcal{I}_S^s\right) \in \{0,1\}^3$ to maximize

$$\begin{aligned}\pi \quad = \quad & \mathcal{I}_N^x \cdot \left[1 + \mathcal{I}_N^s \cdot \xi_N^s \left(\tau_{N,us}^s\right)^{1-\rho}\right] + \mathcal{I}_N^x \cdot \mathcal{I}_S^a \cdot \xi_S^a \left(\tau_{S,N}^a\right)^{1-\sigma} \cdot \left[\left(\tau_{us,S}^s\right)^{1-\rho} + \mathcal{I}_N^s \cdot \xi_N^s \left(\tau_{N,S}^s\right)\right] \\ & - \mathcal{I}_N^x \cdot f_N^x - \mathcal{I}_N^s \cdot f_N^s - \mathcal{I}_S^a \cdot f_S^a,\end{aligned}$$

and the resulting firm-level exports from the US to North are given by

$$S_{us,N} = \sigma \cdot \mathcal{I}_N^x \cdot \left[1 + \mathcal{I}_N^s \cdot \xi_N^s \left(\tau_{N,us}^s\right)^{1-\rho}\right]. \tag{16}$$

It is clear from these expressions that the North-South bilateral trade cost parameters $\tau_{N,S}^s$ and $\tau_{S,N}^a$ have no *direct* impact on US exports to North. Nevertheless, given the complementarities between each extensive margin, a lower value of $\tau_{S,N}^a$ increases the marginal benefit of activating South as an assembly location, and this in turn (weakly) increases the marginal benefit of activating North both as a destination of sales as well as a source of inputs.

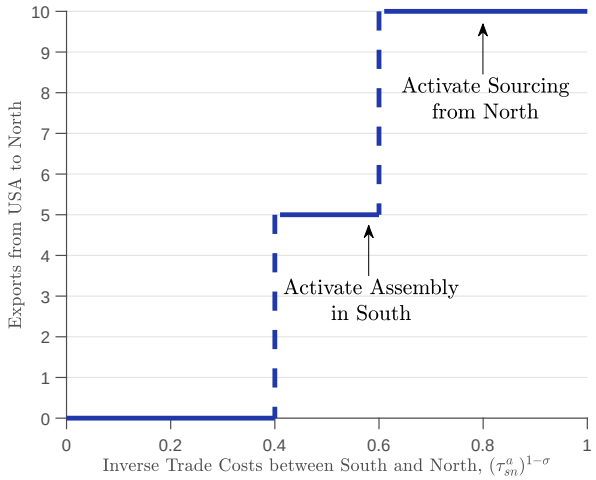
Figure 3 shows how US plant exports to North respond to a gradual decline of bilateral trade costs between North and South. For simplicity, we only reduce trade costs for final goods here, and show that reductions in input costs generate similar effects (see Appendix Section B.6). Under our chosen parameter values, the US plant only activates North as a destination of sales if it can share the fixed costs of marketing to do so with a Southern production plant.[25] For high values of $\tau_{S,N}^a$, setting up that Southern assembly plant is not profitable, and the firm's US exports to North are thus zero. For a lower value of $\tau_{S,N}^a$, the firm finds it optimal to activate assembly in South and at the same time, it activates North as an export destination. The firm's US exports thus increase on impact when it becomes a multinational firm.

As bilateral trade costs between North and South ($\tau_{S,N}^a$) continue to fall, the firm's overall scale increases such that input sourcing from North is also profitable, with the ensuing marginal-cost reduction benefiting both its US and Southern plants. This productivity improvement further increases the firm's US exports to North, as illustrated by the second discontinuous jump in Figure 3. In sum, US exports are enhanced by the global production activities of the firm, both when setting up assembly plants and when activating input sources.

Firm-, rather than plant, level fixed costs of both marketing and sourcing in a particular country are necessary to generate the patterns in Figure 3. If the fixed costs of marketing in

[25] Specifically, we assume $\sigma = 5$; $\left(\tau_{N,us}^s\right)^{1-\rho} = \left(\tau_{us,N}^s\right)^{1-\rho} = 0.5$; $\tau_{N,S}^s = 1$; $\xi_N^s = 2$; $\xi_S^a = 5$; $f_S^a = 0.5$; $f_N^s = 7$; and $f_N^x = 1.5$.

Figure 3: Third Market Effects of Trade Policy Shocks



North were incurred at the plant level, the profitability of exporting from the South to the North would be *independent* of the scale of the Southern assembly plant, and under the parameters in Figure 3, the US plant's exports would remain flat at 0 for any value of $\tau^a_{S,N}$. Similarly, if the fixed costs of sourcing in the North were incurred by each plant independently, the firm's US sourcing from North would *not* be shaped by its Southern plant's sourcing decision. Under the parameter values in Figure 3, the US plant would not activate North as a source of inputs, and thus the second discontinuous jump in exports would not occur. In sum, the positive impact of third-market trade liberalization on US exports crucially depends on the fixed costs of marketing and of sourcing being at the firm level rather than the plant level.

Although we have shown these results using a stylized version of our model, in Appendix Section B.6 we demonstrate their generality within our framework and prove that:

Proposition 2. Holding constant the market demand levels $E_i P_i^{\sigma-1}$ in all countries i, a decrease in bilateral final-good trade costs $\tau^a_{N,S}$ and $\tau^s_{N,S}$ between countries N and S weakly increases final-good sales $S_{hi}(\varphi)$ by plants in a third country h (with $h \neq N$ and $h \neq S$) to any market i, and also weakly increases intermediate-input imports $M_{jh}(\varphi)$ by plants in h from any source country j.

Thus, any trade agreement between two countries increases both exports and imports by

plants in third countries not involved in the agreement. These firm-level forces may explain why empirical work sometimes fails to find trade diversion effects of preferential trade agreements (see Clausing, 2001; Bagwell et al., 2016). In Appendix Section B.6, we also compare these predictions to those delivered by a model of FDI featuring plant-level fixed costs of marketing and sourcing *and* cannibalization effects. In that model, bilateral trade liberalization between North and South (weakly) *decreases* the firm's US exports to either North or South (holding constant the market-demand level faced all firms in those markets).

6 Conclusion

We exploit a novel dataset to show that MNEs trade with disproportionately more countries than domestic firms, and that those countries tend to be closer to their foreign production locations. On the import side, these patterns point to the importance of production fragmentation across countries, with MNEs' domestic plants employing global input-sourcing strategies that align with those of their foreign plants. On the export side, the patterns suggest complementary forces between FDI and exports that cannot be explained solely by input-trade, and that dominate the substitution effects that have been the focus of past work on horizontal FDI.

We rationalize these geographic correlations between firms' US trade patterns and foreign production locations in a multi-country model in which firms jointly decide the countries in which to produce final goods, source their inputs, and market their goods. The model features a new source of scale economies in which the fixed costs to source inputs from, or market goods in, a particular country are shared across all of the firm's plants. This assumption matches key features in how actual firms make sourcing and export decisions, such as their use of Chief Procurement Officers to manage supply chain operations and disproportionate employment in Management establishments that perform activities such as marketing to support other establishments of the firm.

These firm-level fixed costs deliver rich complementarities between an MNE's international

trade and foreign production decisions with important implications for policy. We show that a bilateral trade agreement between two countries can generate third market effects, as firms in other countries have increased incentives to open plants there. Such positive indirect effects of trade policy on FDI differ from predictions in many export-platform models, undermine standard infant-industry arguments for protection, and seem relevant in real-world examples such as Vietnam (McCaig et al., 2022). An exciting venue for future work is to incorporate these complementarities between trade and FDI when analyzing how changes in trade costs ripple through economies as they influence the distribution and scale of firms' global operations.

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Online Appendix

A Data Appendix

A.1 Matching the Census and BEA data

We build on the matching method first developed by Brad Jensen and Fariha Kamal and subsequent work by Kamal, McCloskey and Ouyang (2022) to merge the BEA and Census data. The BEA data contain several employer identification numbers (EINs) per firm, as well as name and address information. We merge these data to the Census Bureau's Business Register (BR) data, which includes EIN, name, and address information by establishment.

The matching method proceeds as follows. First we perform three merges of the BEA data to the BR separately on EIN, name and address. Not all three match successfully; we almost never find a match using the address merge. If all three methods match to a unique record in the BR, then we have found a match and we stop. However, if we find many possible matches in the BR then we follow a series of rules to choose the best match. To implement these rules we also use information on state, two-digit NAICS and employment which we have in both the BEA and BR data. We also prioritize BR records that are multi-unit and in the County Business Pattern (CBP) data. The rules proceed as follows:

1. the record that matches on EIN, name, state, and NAICS and is contained in CBP;
2. the record that matches on EIN, state, and NAICS and is contained in CBP;
3. the record that matches on the max number of EIN, name, state, and NAICS and is contained in CBP;
4. the record that matches on the max number of EIN, name, state, and NAICS, has closest ratio of BR employment to BEA employment, is contained in CBP and is multi-unit;
5. the record that matches on the max number of EIN, name, state, and NAICS, has closest ratio of BR employment to BEA employment, and is contained in CBP;
6. the match that is contained in the CBP, is multi-unit and has the closest employment ratio;
7. the match that is multi-unit;
8. the pair where the match was by EIN;
9. randomly for the remaining multiple matches.

For a subset of the largest MNEs, we use a clerical match provided by Fariha Kamal. In the event of conflicts with the original algorithm, we use the clerical matches which were done by hand. Finally, we use links between BEA firmids and Census firmids from the Business R&D and Innovation Survey.

A.2 Distinguishing US and Foreign-Owned Firms

An important contribution of our match algorithm is to distinguish US versus Foreign MNEs. We cannot classify all Census firms that appear in the inward survey as foreign-owned, because this approach overstates the share of foreign-owned activity relative to the published totals by the BEA. The over-assignment to foreign status likely arises because the Census firm identifier sometimes includes more EINs (and thus establishments) than the BEA firm identifier. Indeed, some firms that are unique to one survey using the BEA firm identifier are in both surveys when using the Census $firmid$.

The differences between the Census versus BEA firmids likely arise for (at least) two reasons. First, large, multi-unit firms often organize their establishments such that payroll and employment are recorded under many different employer identification numbers (EINs). The Census Bureau's annual Company Organization Survey (COS) collects ownership information from all the biggest firms, including a list of all of the firm's EINs. By contrast, firms typically only report their primary EIN in the BE-11 survey. Since there are large firms in the Census data with 100s of EINs, the Census $firmid$ therefore encompasses more EINs and thus more US establishments than the BEA firmid. In practice, we observe that domestic firm-level employment and sales are larger for some firms when using the Census firmid.

Second, the BE-12 survey assigns US affiliates to a foreign BEA firmid with the highest *direct* foreign-ownership share, even if another foreign firm indirectly owns a higher share of the affiliate via another one of its US affiliates. By contrast, the COS data use majority-ownership shares to assign establishments (and their corresponding EINs) to a common firm.[26] Although Census firms that appear in both the outward and inward BEA surveys are small in number, they account for a large share of aggregate activity.

To classify these firms as US versus foreign-owned, we combine ownership and voting share information from the BEA data with foreign affiliate and foreign ownership information from the Census Bureau's Company Organization Survey (COS). The COS asks firms whether they are majority owned by a foreign firm and whether they own foreign affiliates. Before relying on the COS data, we analyze the accuracy of these previously unused variables by comparing the related party trade status and shares of firms that the COS identifies as foreign-owned or owning foreign affiliates. This analysis is available as technical documentation inside our project and provides reassuring evidence that the COS data do indeed contain relevant information for identifying MNEs.

For the subset of firms that appear in both the outward and inward BEA data, and which the BEA classifies as majority foreign-owned, we use the COS and BR data to distinguish whether they are most likely US MNEs or foreign firms when using the broader Census firm definition. First, we use the COS data and identify firms as "Foreign-owned" whenever those firms report that they are majority owned by a foreign firm in the COS. (Note that in this case, the BEA and Census COS data agree so

[26]The BEA-12 Supplement B data contain additional information on these direct versus indirect shares. Although these data were not available for our matching purposes, future work may analyze these ownership patterns with the additional data.

this seems conservative.) Second, for firms that are missing the COS data, we aggregate the BEA data to the BEA-EIN level and calculate the share of the firm's employment at establishments that belong to EINs that the BEA flags as foreign-owned. We then identify firms as "foreign-owned" if their share of US "foreign-owned" employment is greater than 49 percent according to the Census firm definition. Finally, we classify the remaining firms as "US MNEs."

To summarize:

1. All firms that appear only in the BEA inward data are classified as "foreign-owned" firms,
2. All firms that appear only in the BEA outward data are classified as "US MNEs",
3. All firms that appear in the BEA outward and inward data, and for which the firm reports the United States as the ultimate owner country to BEA are classified as "US MNEs",
4. For firms that appear in the BEA inward and outward data, and for which the firm reports majority-ownership by an ultimate owner outside the United States:
    - Classify as foreign if firm reports being majority foreign-owned in the COS data,
    - Classify as foreign if firm is missing from the COS but has greater than 49 percent of its US employment (per the Census firm definition) in establishments with EINs present in the BEA inward data,
    - Classify remaining firms as "US MNEs"

This approach results in approximately 7,600 foreign-owned MNEs and 2,800 US MNEs. These firms' share of employment, sales, and trade are reported in Table 2.

A.3 Sample Description

We start with the universe of firms in the LBD with positive sales and employment in 2007, including the Census of Manufactures administrative records. Although these observations tend to have imputed information for sales, they are surprisingly important for matching the LBD/EC data to the Customs Transactions database. Since our goal is to capture those foreign activities as completely as possible, we retain these records.

We use the LFTTD data which is matched from the LBD to the trade transactions data by the Center for Economic Studies. Import data match rates are generally quite high, with the exception of nine countries like Djibouti, Tonga, etc. Since the focus of the paper is on manufacturing, we drop mineral imports and exports (HS2=27) from our analyses.

Table A.2 presents the analog to Table 3 for non-manufacturing firms.

Table A.1: Sales, employment, and trade flows for all firms with US estabs in 2007

Firm Type:	(1) Domestic Firms	(2) Foreign MNEs	(3) US MNEs No Foreign Manuf	(4) US MNEs With Foreign Manuf	(5) Total
Panel A: Firms with US Manufacturing Plants					
Firms	242,000	2,200	350	1,200	245,750
Global Sales ($ billions)	2,629	3,541	1,695	6,710	14,575
Sales by US Estabs	2,629	2,702	1,446	3,853	10,630
Manufacturing	1,819	1,155	175	2,096	5,246
Non-Manufacturing	809	1,547	1,271	1,757	5,384
Sales by Foreign Estabs		839	249	2,857	3,945
Manufacturing		364		1,708	2,072
Non-Manufacturing		475	249	1,149	1,873
Global Employment (thousands)	11,059	4,179	5,338	11,883	32,459
Employment in US Estabs	11,059	3,536	4,349	6,556	25,500
Manufacuturing	7,644	1,535	333	3,601	13,113
NAICS 54 & 55	359	431	432	1,250	2,471
Other Non-Manufacturing	3,056	1,570	3,585	1,705	9,916
Employment in Foreign Estabs		643	989	5,327	6,959
Manufacturing		348	-	4,203	4,551
Non-Manufacturing		295	989	1,124	2,408
Imports ($ billions)	126	379	39	410	954
Arm's-Length	89	80	33	160	361
Related-Party	37	300	7	250	593
Exports ($ billions)	123	203	22	437	785
Arm's-Length	103	118	16	253	491
Related-Party	19	85	5	184	294
Panel B: Firms without US Manufacturing Plants					
Firms	4,312,000	5,400	1,100	150	4,318,650
Global Sales ($ billions)	12,903	1,086	3,992	345	18,326
Sales by US Estabs	12,903	1,062	3,183	173	17,321
Non-Manufacturing	12,903	1,062	3,183	173	17,321
Sales by Foreign Estabs	-	24	809	172	1,005
Manufacturing	-	1	-	24	25
Non-Manufacturing	-	22	809	149	980
Global Employment (thousands)	73,450	3,505	13,258	732	90,945
Employment in US Estabs	73,450	3,428	10,400	361	87,639
NAICS 54 & 55	7,212	335	1,072	54	8,672
Other Non-Manufacturing	66,238	3,093	9,328	308	78,967
Employment in Foreign Estabs	-	77	2,858	371	3,306
Manufacturing	-	4	-	78	83
Non-Manufacturing	-	73	2,858	292	3,223
Imports ($ billions)	313	99	57	12	481
Arm's-Length	241	29	53	6	329
Related-Party	72	69	4	6	152
Exports ($ billions)	150	26	19	3	198
Arm's-Length	133	20	16	2	171
Related-Party	17	7	4	1	28

Source: 2007 Longitudinal Business Database, Economic Censuses, Longitudinal Firm Trade Transactions Database, BEA inward and outward surveys. Table presents total number of firms and their global sales, global employment, and US merchandise good trade flows by firm type and manufacturing plant locations. Sample is all firms with US estabs in 2007.

Table A.2: Non-manufacturing firms' share of aggregate activities, by MNE status

Firm Type	Firms	Emp	Sales	Imports	Exports
Domestic	4,312	0.65	0.46	0.22	0.15
Foreign	5.40	0.03	0.04	0.07	0.03
US MNEs					
No foreign manuf affiliates	1.10	0.09	0.11	0.04	0.02
With foreign manuf affiliates	0.15	0.00	0.01	0.01	0.00
Total	4,319	0.77	0.62	0.34	0.20

Sources: 2007 Economic censuses, LBD, LFTTD, and BEA inward and outward datasets. Table presents firm counts (000s) and shares of employment, sales, imports, and exports, for all firms without US manufacturing plants in 2007. 'Domestic' firms are non-multinationals. 'Foreign MNEs' are majority owned by a foreign firm. 'US MNEs' are majority owned by a US firm and have majority-owned foreign affiliate activity.

A.4 Trade patterns

Panel A in Table A.3 shows that essentially all US manufacturing MNEs export, and the vast majority (92 percent) import. Similarly, 91 percent of Foreign MNEs import and export. By contrast, only 25 and 27 percent of domestic firms import and export, respectively. MNEs also trade disproportionately more. US MNEs that also manufacture abroad import 11 percent of their sales and export 10 percent, which is double the 5 percent for each flow by domestic firms.

MNEs are also more likely to engage in related-party trade and have higher shares of these flows than domestic firms. Panel B in Table A.3 shows that over 90 percent of firms that manufacture in the US and abroad have related-party imports and exports. Among manufacturers, 20 percent of domestic firms have related-party imports, while 16 percent have related-party exports. At the same time, these related-party indicators are likely to miss some MNEs, since the shares of US and Foreign MNEs with related-party trade transactions range from 70 to 92 percent.

Table A.5 presents import and export statistics for the subset of *manufacturing* firms that import from, or export to, *at least two* countries. Note that to match the regression definitions, in this table we define US MNEs as US firms with majority-owned foreign manufacturing plants. US firms with non-manufacturing affiliates are included with Domestic firms. These multi-country importers comprise just over half of all US importers, and an overwhelming 99 percent of total imports.[27] Columns 3 and 4 indicate that even among multi-country importers, MNEs source from a much larger set of countries. Domestic manufacturers import from an average of 4 countries, with the median importer sourcing from just 3. Foreign-owned firms import from an average of 12 countries and a median of 8 countries.

[27]Essentially all single-country importers (and exporters) are domestic firms. The data in this table are limited to countries for which gravity variables from the CEPII are available, and from which multiple US firms import and export. This was done to match the sample of firms used in gravity regressions in an early draft.

US MNEs have the most expansive sourcing strategies, importing from an average of 21 and a median of 17 foreign countries.[28]

Table A.3: Manufacturing firms' trade participation margins

Firm Type	A: Margins for All Trade				B: Margins for Related-Party Trade			
	Importers / Firms	Exporters / Firms	Imports / Sales	Exports / Sales	RP Importers / Importers	RP Exporters / Exporters	RP Imports / Imports	RP Exports / Exports
Domestic	0.25	0.27	0.05	0.05	0.20	0.16	0.29	0.16
Foreign	0.91	0.91	0.14	0.08	0.85	0.70	0.79	0.42
US MNEs								
No foreign manuf affiliates	1.00	1.00	0.03	0.01	0.86	0.86	0.17	0.25
With foreign manuf affiliates	0.92	1.00	0.11	0.11	0.91	0.92	0.61	0.42

Sources: 2007 Economic censuses, LBD, LFTTD, and BEA inward and outward datasets. 'Domestic' firms are non-multinationals. 'Foreign MNEs' are majority owned by a foreign firm. 'US MNEs' are majority owned by a US firm and have majority-owned foreign affiliate activity. Sample is all firms with a US manufacturing plant in 2007. This table could go to the appendix.

Table A.4: Non-manufacturing firms' trade participation margins

Firm Type	All Trade Margins				Related-Party Trade Margins			
	Importers / Firms	Exporters / Firms	Imports / Sales	Exports / Sales	RP Importers / Importers	RP Exporters / Exporters	RP Imports / Imports	RP Exports / Exports
Domestic	0.05	0.04	0.02	0.01	0.14	0.09	0.23	0.11
Foreign	0.52	0.44	0.09	0.02	0.68	0.46	0.70	0.26
US MNEs								
No foreign manuf affiliates	0.73	0.73	0.02	0.01	0.63	0.56	0.07	0.18
With foreign manuf affiliates	0.67	1.00	0.07	0.02	0.90	0.53	0.52	0.22

Sources: 2007 Economic censuses, LBD, LFTTD, and BEA inward and outward datasets. 'Domestic' firms are non-multinationals. 'Foreign MNEs' are majority owned by a foreign firm. 'US MNEs' are majority owned by a US firm and have majority-owned foreign affiliate activity. Sample is all firms without a US manufacturing plant in 2007.

Panel B of Table A.5 presents comparable statistics for manufacturing firms' export behavior by MNE status. Multi-country exporters comprise 57 percent of exporters and account for 99 percent of US manufacturers' exports. The extensive margin of exporting is generally larger than the import margin, though also more skewed. Domestic exporters sell to an average of 8 countries, twice their median of 4. Foreign MNEs export to an average of 19 countries and a median of 10. Finally, US MNEs sell to the largest number of countries, with an average of 40 and a median of 35.

[28] Census disclosure avoidance rules preclude us from disclosing the true median. We therefore calculate a fuzzy median equal to the average number of countries for firms in the 49th to the 51st percentiles.

Table A.5: Import and export statistics in 2007 for US manufacturing firms that import to, or export from, multiple countries, by firm type

	Panel A: Import Statistics				Panel B: Export Statistics			
	Share of Aggregate		No. of Countries		Share of Aggregate		No. of Countries	
Firm Type	Importers	Imports	Avg	Median	Exporters	Exports	Avg	Median
Domestic	0.48	0.17	4	3	0.52	0.18	8	4
Foreign MNE	0.03	0.40	12	8	0.03	0.27	19	10
US MNE	0.02	0.43	21	17	0.02	0.54	40	35

Source: 2007 Economic censuses, LBD, LFTTD, and BEA inward and outward datasets. Panel A presents the share of US importers and import value, and the average and median number of countries from which firms import by firm type. Panel B presents comparable statistics for US exports. 'Domestic' firms are US firms that do not own a foreign manufacturing affiliate. 'Foreign MNEs' are firms that are majority owned by a foreign firm. 'US MNEs' are firms that are majority owned by a US firm with majority-owned foreign manufacturing affiliates. Sample consists of all firms with US manufacturing establishments that import from 2 or more countries (left panel) or export to 2 or more countries (right panel).

A.5 Comparison of our data to past work

We demonstrate the implications of using our definitions of multinational firms relative to those in past work by estimating size and productivity premia for domestic traders and MNEs. We define categorical variables for domestic traders with only arm's-length imports or exports, domestic traders with at least some related-party (RP) imports, Foreign MNEs, US MNEs without foreign manufacturing affiliates, and US MNEs that also manufacture abroad. Since the majority of MNEs engage in all forms of trade, we do not distinguish MNEs that trade or not.[29]

Table A.6 displays the coefficient estimate from regressing the firm attributed noted in the column header on the trader and MNE indicators, controlling for the firm's age and primary four-digit NAICS industry. Consistent with past work, we find that arm's-length importers and exporters are larger than domestic firms and about 10 percent more productive. Firms with at least some related-party trade are larger still, almost double the arm's length traders size and productivity.

Most notably, Table A.6 shows that MNEs are substantially larger and more productive than all domestic firms, including those with related-party trade. Among US MNEs, those that manufacture both in the United States and abroad are the largest. They are 4.77 log points bigger than domestic non-traders, and about three times the size of related-party importers or exporters. Distinguishing firms with majority-owned foreign manufacturing activity from those that trade with parties with 5 to 10 percent ownership thresholds not only reduces the implied number of US MNEs dramatically, but also identifies systematically larger firms.

Both US and Foreign MNEs are just over 60 percent more productive than domestic firms (column 3). Focusing only on firms' manufacturing labor productivity, however, indicates that US MNEs are

[29] All US MNEs trade and over 90 percent engage in related-party trade. See Appendix Table A.3.

Table A.6: Size premia for domestic traders and multinationals

	All Sectors			Manufacturing	
	ln(emp)	ln(sales)	ln($\frac{\text{sales}}{\text{emp}}$)	ln(sales)	ln($\frac{\text{sales}}{\text{emp}}$)
	(1)	(2)	(3)	(4)	(5)
Importers, only arm's-length	0.868***	0.979***	0.111***	0.972***	0.115***
	(0.006)	(0.007)	(0.003)	(0.007)	(0.003)
Importers, some related-party	1.461***	1.711***	0.250***	1.682***	0.260***
	(0.012)	(0.013)	(0.006)	(0.013)	(0.006)
Exporters, only arm's-length	0.695***	0.792***	0.097***	0.791***	0.097***
	(0.006)	(0.007)	(0.003)	(0.007)	(0.003)
Exporters, some related-party	1.434***	1.632***	0.198***	1.616***	0.207***
	(0.013)	(0.014)	(0.006)	(0.014)	(0.006)
Foreign MNEs	3.183***	3.804***	0.620***	3.715***	0.632***
	(0.024)	(0.026)	(0.011)	(0.026)	(0.011)
US MNEs, no foreign manuf affiliates	3.983***	4.437***	0.453***	3.908***	0.571***
	(0.061)	(0.064)	(0.029)	(0.064)	(0.029)
US MNEs, with foreign manuf affiliates	4.768***	5.373***	0.605***	5.337***	0.710***
	(0.033)	(0.035)	(0.016)	(0.035)	(0.016)
Adj. R2	0.474	0.545	0.344	0.511	0.337
Observations (000s)	246	246	246	246	246

Sources: 2007 Economic censuses, LBD, LFTTD, and BEA inward and outward datasets. Table presents coefficient estimates from regressing the log of the firm attribute in each column header on indicators for domestic firms' import and export statues and MNE types. Omitted category is non-trading domestic firms. 'Foreign MNEs' are majority owned by a foreign firm. 'US MNEs' are majority owned by a US firm and have majority-owned foreign manufacturing affiliates. Regressions control for firm's primary 4-digit NAICS and firm age. Sample is all firms with a US manufacturing plant in 2007.

about 71 percent more productive than domestic firms, compared to just 63 percent for foreign firms. This result is qualitatively similar to Doms and Jensen (1998), who find that manufacturing plants of US MNEs are the most productive. We provide additional context for that result by comparing US MNEs' manufacturing versus total firm labor productivity.

A.6 Types of imports

To assess what manufacturing firms import to the United States, we link firms' imports to detailed information on the products they make from the Census of Manufactures (CMF) product trailer files and the inputs they purchase from the CMF material trailer files. We map these NAICS codes to HS codes using the concordance from Pierce and Schott (2012) and flag all imported products as "Produced," "Input," "Input & Produced", or "Not Input or Produced". Table A.7 presents the shares import types for domestic firms, Foreign MNEs, and US MNEs. Among all firms, imports of the same good the firm produces domestically are higher than imports of inputs. The majority (59 percent) of US and Foreign MNEs' imports are of goods that the firm reports producing in the United States. There is substantial overlap, however, of products that are flagged as both produced and purchased as inputs. This overlap is particularly high for US MNEs, where 33 percent of their imports consist of

goods that we flag as both "Input & Produced". We further decompose these shares into arm's-length versus related-party imports and find that produced-good import shares are substantially higher for related-party imports. The evidence here thus supports the premise that firms manufacture similar goods in the United States and abroad, and import some of their foreign production to sell to US customers, consistent with evidence using much more detailed data from Denmark Bernard et al. (2020). Future work is needed to try to disentangle these flow types.

Table A.7: Manufacturing Firms' US Import Shares by Transaction and Good Type

	Input & Produced	Not Input Produced	Input Not Produced	Not Input Not Produced
Domestic Firms				
All Imports	0.08	0.25	0.09	0.58
Arm's-Length	0.07	0.22	0.10	0.61
Related-Party	0.13	0.30	0.08	0.49
Foreign MNEs				
All Imports	0.20	0.39	0.12	0.30
Arm's-Length	0.25	0.17	0.19	0.40
Related-Party	0.18	0.45	0.10	0.27
US MNEs				
All Imports	0.33	0.26	0.09	0.32
Arm's-Length	0.26	0.16	0.13	0.46
Related-Party	0.38	0.33	0.07	0.22

Sources: 2007 Economic censuses, LBD, LFTTD, and BEA inward and outward datasets. Table presents share of firm imports based on whether the firm also reports purchasing the imported goods as inputs in the CMF material trailers and/or producing the goods in the CMF product trailers. Sample is all firms with a US manufacturing plant in 2007.

A.7 BEA Country Classifications

When matching the Census data to the BEA data, we find several countries that are aggregated in the BEA data (e.g., the French Islands, Kiribati, etc.). We aggregate the trade data to match the level of aggregation in the BEA data. Generally gravity variables are only available for the main country in those cases. If there are multiple countries with gravity data, we use the data for the one with the largest population (e.g., in the case of Australia, Cocos Island, Norfolk Islands, Heard and McDonald Islands, etc., we use the gravity data on Australia).

A.8 Gravity

We measure distance between countries using the population-weighted harmonic mean distance between the most populated cities of each country (distw_harmonic). We define affiliates that share a free-trade agreement with country j as those that are in a free-trade or a regional trade agreement using the variables fta_wto and rta_type (using the max of these two). We define affiliates that share a common language with country j as those that share an official language, using the variable commlang_off. We define affiliates that share common legal origins with country j as those that have common legal origins prior to the USSR transition, using the variable commleg_pretrans. We define affiliates that are contiguous with country j using the variable contig.

Table A.8: Gravity in Foreign Production and the Intensive Margins of Imports and Exports

	$\ln(\text{Imports}_{fjr})$			$\ln(\text{Exports}_{fjr})$		
	(1)	(2)	(3)	(4)	(5)	(6)
Affiliate_{fjr}	2.241***	2.239***	2.221***	1.999***	1.977***	1.977***
	(0.129)	(0.127)	(0.120)	(0.120)	(0.115)	(0.112)
$\text{Affiliate}_{fj'<500km text from j}$	0.287		0.091	0.085		-0.191
	(0.372)		(0.418)	(0.270)		(0.309)
$\text{Affiliate}_{f501<j'<1000km \text{ from } j}$	-0.057		-0.158	0.029		-0.176
	(0.325)		(0.357)	(0.257)		(0.280)
$\text{Affiliate}_{f1001<j'<2000km \text{ from } j}$	-0.130		-0.189	0.081		-0.103
	(0.295)		(0.322)	(0.247)		(0.252)
$\text{Affiliate}_{f2001<j'<4000km \text{ from } j}$	0.003		-0.061	0.266		0.041
	(0.250)		(0.233)	(0.218)		(0.190)
$\text{Affiliate}_{fj'>4000km text from j}$	-0.114		-0.122	0.222		0.045
	(0.245)		(0.253)	(0.218)		(0.201)
$\log(1+\text{Affiliates}_{fFTA_j})$		0.156	0.116		0.053	0.1
		(0.145)	(0.163)		(0.092)	(0.107)
$\log(1+\text{Affiliates}_{fCommLegal_j})$		-0.275*	-0.260*		0.181*	0.157
		(0.146)	(0.144)		(0.106)	(0.104)
$\log(1+\text{Affiliates}_{fCommLanuage_j})$		0.236	0.198		0.151	0.149
		(0.168)	(0.161)		(0.109)	(0.106)
$\log(1+\text{Affiliates}_{fContiguous_j})$		0.022			-0.095	
		(0.225)			(0.147)	
Adj. R2	0.264	0.264	0.264	0.407	0.407	0.407
Observations (000s)	156	156	156	318	318	318
Firm & Country Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes

Source: 2007 LBD, LFTTD, and BEA inward and outward datasets. Dependent variable is the log of imports by firm f from country j in region r or similarly the log of firm exports. Sample is all firms with manufacturing establishments in the United States in 2007 that import from multiple countries. Observations in 1000s and rounded per Census disclosure rules. Standard errors two-way clustered by firm and by country. *,**, *** denote p<0.10, p<0.05, and p<0.01, respectively.

B Theory Appendix

B.1 Industry and General Equilibrium

In this Appendix we provide more details of the industry and general equilibrium of the model. As stated in the main text, we assume that total manufacturing spending E_i and wages w_i in all countries are independent of the equilibrium in the manufacturing sector. There are at least two ways to microfound this assumption.

A first approach is to represent consumer preferences as being Cobb-Douglas in the consumption of differentiated manufactured varieties and the consumption of the output of a non-manufacturing sector, with consumers spending a constant share η of their income on manufactured goods. As long as (i) the non-manufacturing sector is perfectly competitive, (ii) its output is freely tradable, (iii) its technology features constant-returns-to scale in labor, and (iv) η is low enough, this non-manufacturing sector's output will be produced in all countries, and wages will be pinned down by the constant value of the marginal product in this 'outside sector'. Given free entry into the manufacturing sector, profits in the economy are zero and thus all income is labor income. As a result, spending on manufacturing varieties is equal to $E_i = \eta w_i L_i$ and is independent of the equilibrium in the manufacturing sector.

An alternative approach is to dispense with the 'outside' non-manufacturing sector and introduce Cobb-Douglas preferences over a continuum of manufacturing sectors, with our model capturing the equilibrium in one of those sectors. If free entry prevails in all sectors, then spending on any sector will be a constant share of labor income in the economy, and the wage rate will again be unaffected by idiosyncratic changes in a given manufacturing sectors.

For fixed wages it is then straightforward to solve for the equilibrium in the manufacturing sector that is our focus in the main text. Given our assumption that final-good producers only observe their productivity after paying the fixed cost of entry, we can use equation (11) to express the free-entry condition in manufacturing as

$$\int_{\tilde{\varphi}_i}^{\infty} \pi\left(\varphi, \Upsilon\left(\varphi\right), \mathcal{K}\left(\varphi\right), \mathcal{J}\left(\varphi\right)\right) dG_h\left(\varphi\right) = w_i f^e, \tag{B.1}$$

where $G_h\left(\varphi\right)$ is the distribution of productivity of potential entrants in country h. In the lower bound of the integral, $\tilde{\varphi}_i$ denotes the productivity of the least productive active firm headquartered in country i. Because expected profits are zero, all income is wage income, so $E_i = \eta w_i L_i$, where η is the share of income spent on the manufacturing good. The firm's marketing $\Upsilon\left(\varphi\right)$, assembly $\mathcal{K}\left(\varphi\right)$ and sourcing $\mathcal{J}\left(\varphi\right)$ strategies are endogenously set to maximize profits, but notice that for given wages w_i and spending E_i, the only remaining endogenous variables are the manufacturing price indices P_i in all countries. As a result, equation (B.1) constitutes a system of J equations from which the J price indices can be solved as a function of w_i, E_i, and all the parameters of the model. Finally, from these price indices and the other parameters of the model, one can solve for the measure of entrants in each

country.

B.2 The Margins of Trade

Here we study our model's implications for the relative propensities to export and import of domestic firms versus MNEs with the *same* domestic size (i.e., the same sales by their by domestic plants). With that in mind, take two firms with core productivity levels φ_{NM} and φ_M. We assume that firm φ_{NM} is not a MNE, while firm φ_M has foreign assembly plants. From equation (9) and $\alpha(\sigma-1)=(\rho-1)$, the sales of a firm φ in its home country h (US in our empirical application) are given by

$$S_h(\varphi)=\kappa_S\varphi^{\sigma-1}\xi_h^a\left(\sum_{i\in\Upsilon(\varphi)}\left(\tau_{hi}^a\right)^{1-\sigma}E_i\left(P_i\right)^{\sigma-1}\right)\left(\sum_{j\in\mathcal{J}(\varphi)}\xi_j^s\left(\tau_{jh}^s\right)^{1-\rho}\right).$$

If the two firms φ_{NM} and φ_M face the same country-wide parameters ξ_h^a, τ_{hi}^a, ξ_j^s, τ_{jh}^s, E_i, and P_i, it is then clear that the two firms can only have the same sales ($S_h(\varphi_M)=S_h(\varphi_{NM})$) if

$$\left(\frac{\varphi_M}{\varphi_{NM}}\right)^{\sigma-1}\frac{\left(\sum_{i\in\Upsilon(\varphi_M)}\left(\tau_{hi}^a\right)^{1-\sigma}E_i\left(P_i\right)^{\sigma-1}\right)\left(\sum_{j\in\mathcal{J}(\varphi_M)}\xi_j^s\left(\tau_{jh}^s\right)^{1-\rho}\right)}{\left(\sum_{i\in\Upsilon(\varphi_{NM})}\left(\tau_{hi}^a\right)^{1-\sigma}E_i\left(P_i\right)^{\sigma-1}\right)\left(\sum_{j\in\mathcal{J}(\varphi_{NM})}\xi_j^s\left(\tau_{jh}^s\right)^{1-\rho}\right)}=1. \tag{B.2}$$

In the absence of heterogeneity in the fixed costs to import, export, or open foreign assembly plants, this condition can only hold if $\varphi_M=\varphi_{NM}$, $\mathcal{J}(\varphi_M)=\mathcal{J}(\varphi_{NM})$, and $\Upsilon(\varphi_M)=\Upsilon(\varphi_{NM})$. These conditions must hold because, absent heterogeneity in fixed costs of marketing, sourcing, or assembly, Proposition 1 implies that for any two firms φ_1 and φ_2, if $\varphi_1>\varphi_2$, then $\mathcal{J}(\varphi_2)\subseteq\mathcal{J}(\varphi_1)$ and $\Upsilon(\varphi_2)\subseteq\Upsilon(\varphi_1)$ so for $\varphi_M>\varphi_{NM}$, we would have

$$\left(\frac{\varphi_M}{\varphi_{NM}}\right)^{\sigma-1}\frac{\sum_{i\in\Upsilon(\varphi_M)}\left[\left(\tau_{hi}^a\right)^{1-\sigma}\left(\sum_{j\in\mathcal{J}(\varphi_M)}\xi_j^s\left(\tau_{jh}^s\right)^{1-\rho}\right)^{\alpha(\sigma-1)/(\rho-1)}E_i\left(P_i\right)^{\sigma-1}\right]}{\sum_{i\in\Upsilon(\varphi_{NM})}\left[\left(\tau_{hi}^a\right)^{1-\sigma}\left(\sum_{j\in\mathcal{J}(\varphi_{NM})}\xi_j^s\left(\tau_{jh}^s\right)^{1-\rho}\right)^{\alpha(\sigma-1)/(\rho-1)}E_i\left(P_i\right)^{\sigma-1}\right]}>1,$$

contradicting equation (B.2). And for $\varphi_M<\varphi_{NM}$, we would have

$$\left(\frac{\varphi_M}{\varphi_{NM}}\right)^{\sigma-1}\frac{\sum_{i\in\Upsilon(\varphi_M)}\left[\left(\tau_{hi}^a\right)^{1-\sigma}\left(\sum_{j\in\mathcal{J}(\varphi_M)}\xi_j^s\left(\tau_{jh}^s\right)^{1-\rho}\right)^{\alpha(\sigma-1)/(\rho-1)}E_i\left(P_i\right)^{\sigma-1}\right]}{\sum_{i\in\Upsilon(\varphi_{NM})}\left[\left(\tau_{hi}^a\right)^{1-\sigma}\left(\sum_{j\in\mathcal{J}(\varphi_{NM})}\xi_j^s\left(\tau_{jh}^s\right)^{1-\rho}\right)^{\alpha(\sigma-1)/(\rho-1)}E_i\left(P_i\right)^{\sigma-1}\right]}<1,$$

which also contradicts equation (B.2).

But if $\varphi_M = \varphi_{NM}$, then $\mathcal{J}(\varphi_M) = \mathcal{J}(\varphi_{NM})$, and $\Upsilon(\varphi_M) = \Upsilon(\varphi_{NM})$, so our model cannot rationalize the initial assumption that firm φ_M has foreign affiliates, while firm φ_{NM} does not, without introducing heterogeneity in some of the fixed costs incurred by firms.

Having established the need to introduce heterogeneity in fixed costs, we now study their implications. To simplify matters, we consider heterogeneity in the fixed costs of assembly, of exporting, or of sourcing one at at time. We also restrict attention to a case in which such heterogeneity only affects the level of these fixed costs but not their relative rankings, so that some firms face (weakly) lower fixed costs in *all* countries.

Heterogeneous Fixed Costs of Assembly In this case, Proposition 1 does not impose a strict hierarchical order, and we can have $\varphi_M < \varphi_{NM}$, while also $\mathcal{J}(\varphi_{NM}) \subseteq \mathcal{J}(\varphi_M)$ or $\Upsilon(\varphi_{NM}) \subseteq \Upsilon(\varphi_M)$ (or both). Our goal is to show that if $\mathcal{K}(\varphi_{NM}) = \{h\} \subset \mathcal{K}(\varphi_M)$, then it must be the case that $\mathcal{J}(\varphi_{NM}) \subseteq \mathcal{J}(\varphi_M)$ or $\Upsilon(\varphi_{NM}) \subseteq \Upsilon(\varphi_M)$, implying that if one of the two firms features richer extensive margins of exporting and importing, then this firm must necessarily be the MNE (it cannot be the non-MNE). We will prove this result by establishing a series of contradictions.

First, we show that if φ_M and φ_{NM} have the same size at Home, then we must have $\varphi_M \leqslant \varphi_{NM}$, so that the MNE must have a weakly lower core productivity level. Indeed, given the increasing differences properties of the profit function (11), if $\varphi_M > \varphi_{NM}$, the richer assembly strategy of firm φ_M together with its higher core productivity level, would necessarily lead to $\mathcal{J}(\varphi_{NM}) \subseteq \mathcal{J}(\varphi_M)$ and $\Upsilon(\varphi_{NM}) \subseteq \Upsilon(\varphi_M)$. Intuitively, the MNE's richer assembly strategy puts it in a better position to amortize more of the firm-level fixed costs of exporting to foreign markets from its multiple assembly locations. But $\varphi_M > \varphi_{NM}$, $\mathcal{J}(\varphi_{NM}) \subseteq \mathcal{J}(\varphi_M)$ and $\Upsilon(\varphi_{NM}) \subseteq \Upsilon(\varphi_M)$ would jointly imply

$$\left(\frac{\varphi_M}{\varphi_{NM}}\right)^{\sigma-1} \frac{\sum_{i\in\Upsilon(\varphi_M)} \left[\left(\tau_{hi}^a\right)^{1-\sigma} \left(\sum_{j\in\mathcal{J}(\varphi_M)} \xi_j^s \left(\tau_{jh}^s\right)^{1-\rho} \right)^{\alpha(\sigma-1)/(\rho-1)} E_i \left(P_i\right)^{\sigma-1} \right]}{\sum_{i\in\Upsilon(\varphi_{NM})} \left[\left(\tau_{hi}^a\right)^{1-\sigma} \left(\sum_{j\in\mathcal{J}(\varphi_{NM})} \xi_j^s \left(\tau_{jh}^s\right)^{1-\rho} \right)^{\alpha(\sigma-1)/(\rho-1)} E_i \left(P_i\right)^{\sigma-1} \right]} > 1,$$

which again contradicts equation (B.2). Thus, we must have $\varphi_M \leqslant \varphi_{NM}$.

We can now tackle our goal, which is to show that, if one of the two firms features richer extensive margins of exporting and importing, then this firm must necessarily be the MNE. We prove this by contradiction. Given that $\varphi_M \leqslant \varphi_{NM}$, if the non-MNE features richer extensive margins of trade, then

we would have $\mathcal{J}(\varphi_M) \subseteq \mathcal{J}(\varphi_{NM})$ and $\Upsilon(\varphi_M) \subseteq \Upsilon(\varphi_{NM})$, and thus

$$\left(\frac{\varphi_M}{\varphi_{NM}}\right)^{\sigma-1} \frac{\sum_{i\in\Upsilon(\varphi_M)}\left[\left(\tau_{hi}^a\right)^{1-\sigma}\left(\sum_{j\in\mathcal{J}(\varphi_M)}\xi_j^s\left(\tau_{jh}^s\right)^{1-\rho}\right)^{\alpha(\sigma-1)/(\rho-1)}E_i\left(P_i\right)^{\sigma-1}\right]}{\sum_{i\in\Upsilon(\varphi_{NM})}\left[\left(\tau_{hi}^a\right)^{1-\sigma}\left(\sum_{j\in\mathcal{J}(\varphi_{NM})}\xi_j^s\left(\tau_{jh}^s\right)^{1-\rho}\right)^{\alpha(\sigma-1)/(\rho-1)}E_i\left(P_i\right)^{\sigma-1}\right]} < 1,$$

which contradicts the equal domestic size condition (B.2). In other words, the MNE must have either a richer extensive margin of exports, a richer extensive margin of imports, or both. Indeed, even if $\varphi_M \leqslant \varphi_{NM}$, our model is perfectly consistent with the MNE exporting to and importing from more countries than the non-MNE, or $\mathcal{J}(\varphi_{NM}) \subseteq \mathcal{J}(\varphi_M)$ *and* $\Upsilon(\varphi_{NM}) \subseteq \Upsilon(\varphi_M)$, as indicated by our empirical results. The reason again is that the MNE's richer assembly strategy puts it in a better position to amortize more of the firm-level fixed costs of exporting to foreign markets from its multiple assembly locations. Alternatively, the MNE has a larger marginal benefit from incurring the fixed costs to activate more export markets or input sources since they also increase its sales by its foreign plants.

Heterogeneous Fixed Costs of Exporting Consider next the case in which both firms φ_{NM} and φ_M share the same fixed costs of assembly and of sourcing, but have heterogeneous fixed costs of exporting. Suppose first that the non-MNE φ_{NM} features a richer marketing strategy due to its lower fixed costs of exporting. Consider then the relative incentives of the two firms to source. From equation (12), and given common fixed costs of sourcing, the non-MNE will be more likely to import from some source country j whenever

$$\left(\frac{\varphi_{NM}}{\varphi_M}\right)^{\sigma-1} \frac{\left(\tau_{jh}^s\right)^{1-\rho}\xi_h^a\left(\sum_{i\in\Upsilon(\varphi_{NM})}\left(\tau_{hi}^a\right)^{1-\sigma}E_iP_i^{\sigma-1}\right)}{\sum_{k\in\mathcal{K}(\varphi_M)}\left[\left(\tau_{jk}^s\right)^{1-\rho}\xi_k^a\left(\sum_{i\in\Upsilon(\varphi_M)}\left(\tau_{ki}^a\right)^{1-\sigma}E_iP_i^{\sigma-1}\right)\right]} > 1.$$

Plugging in the common-size condition (B.2), this condition reduces to

$$\frac{\sum_{j\in\mathcal{J}(\varphi_M)}\xi_j^s\left(\tau_{jh}^s\right)^{1-\rho}}{\sum_{j\in\mathcal{J}(\varphi_{NM})}\xi_j^s\left(\tau_{jh}^s\right)^{1-\rho}} \frac{\left(\tau_{jh}^s\right)^{1-\rho}\xi_h^a\left(\sum_{i\in\Upsilon(\varphi_M)}\left(\tau_{hi}^a\right)^{1-\sigma}E_i\left(P_i\right)^{\sigma-1}\right)}{\sum_{k\in\mathcal{K}(\varphi_M)}\left[\left(\tau_{jk}^s\right)^{1-\rho}\xi_k^a\left(\sum_{i\in\Upsilon(\varphi_M)}\left(\tau_{ki}^a\right)^{1-\sigma}E_iP_i^{\sigma-1}\right)\right]} > 1. \tag{B.3}$$

Now note that the second term in the left-hand-side is evidently lower than one, while the first term cannot be higher than one if $\mathcal{J}(\varphi_M) \subseteq \mathcal{J}(\varphi_{NM})$, so this condition cannot possibly be met. Therefore, the MNE has disproportionately higher incentives to source from more countries, and it cannot possibly feature a less rich sourcing strategy. In sum, the non-MNE cannot possibly feature a richer marketing

strategy *and* a richer sourcing strategy.

Conversely, it is perfectly possible for the MNE to feature richer margins of both exports and imports. If the MNE happens to have lower fixed costs of exporting, then equation in the left-hand-side of (B.3) can still be lower than one (implying a higher incentive of the MNE to source) even when $\mathcal{J}(\varphi_{NM}) \subset \mathcal{J}(\varphi_M)$. Thus, the patterns we observe in the data are entirely consistent with the model's predictions.

Heterogeneous Fixed Costs of Importing The final case to consider involves heterogeneity in the fixed costs of sourcing. Suppose first that the non-MNE φ_{NM} features a richer sourcing strategy due to its lower fixed costs of sourcing, and consider the two firms' relative incentive to select into exporting. From equation (14), and given common fixed costs of exporting, the non-MNE will be more likely to export to some destination market i whenever

$$\left(\frac{\varphi_{NM}}{\varphi_M}\right)^{\sigma-1} \frac{\xi_h^a \left(\tau_{hi}^a\right)^{1-\sigma} \left(\sum\limits_{j\in\mathcal{J}(\varphi_{NM})} \xi_j^s \left(\tau_{jh}^s\right)^{1-\rho}\right)}{\sum\limits_{k\in\mathcal{K}(\varphi_M)} \left[\xi_k^a \left(\tau_{ki}^a\right)^{1-\sigma} \left(\sum\limits_{j\in\mathcal{J}(\varphi_M)} \xi_j^s \left(\tau_{jk}^s\right)^{1-\rho}\right)\right]} > 1.$$

Plugging in the common-size condition (B.2), this condition reduces to

$$\frac{\sum\limits_{i\in\Upsilon(\varphi_M)} \left(\tau_{hi}^a\right)^{1-\sigma} E_i \left(P_i\right)^{\sigma-1}}{\sum\limits_{i\in\Upsilon(\varphi_{NM})} \left(\tau_{hi}^a\right)^{1-\sigma} E_i \left(P_i\right)^{\sigma-1}} \times \frac{\xi_h^a \left(\tau_{hi}^a\right)^{1-\sigma} \left(\sum\limits_{j\in\mathcal{J}(\varphi_M)} \xi_j^s \left(\tau_{jh}^s\right)^{1-\rho}\right)}{\sum\limits_{k\in\mathcal{K}(\varphi_M)} \left[\xi_k^a \left(\tau_{ki}^a\right)^{1-\sigma} \left(\sum\limits_{j\in\mathcal{J}(\varphi_M)} \xi_j^s \left(\tau_{jk}^s\right)^{1-\rho}\right)\right]} > 1. \tag{B.4}$$

The second term of the left-hand-side of this condition is evidently lower than one, while the second term cannot be higher than one if $\Upsilon(\varphi_M) \subseteq \Upsilon(\varphi_{NM})$, so this condition cannot possibly be met. In sum, the MNE necessarily has disproportionately higher incentives to export to specific countries due to its foreign plants, and it thus cannot possibly feature a less rich export strategy. As a result, the non-MNE cannot possibly feature a richer marketing strategy *and* a richer sourcing strategy.

By contrast, and similarly to the case with heterogeneous fixed costs of exporting, the MNE having richer extensive margins of exporting and importing is perfectly consistent with condition (B.4) above.

B.3 Export Intensity

We now show that MNEs' export and import intensities are higher than those of non-MNEs.

From equation (9), we have that the ratio of domestic sales to total sales is given by

$$\frac{S_{hh}(\varphi)}{\sum\limits_{i\in\Upsilon(\varphi)} S_{hi}(\varphi)} = \frac{\left(\tau_{hh}^a\right)^{1-\sigma} E_h \left(P_h\right)^{\sigma-1}}{\sum\limits_{i\in\Upsilon(\varphi)} \left(\tau_{hi}^a\right)^{1-\sigma} E_i \left(P_i\right)^{\sigma-1}},$$

and thus is monotonically decreasing in the extensive margin of exports, as reflected by the set $\Upsilon(\varphi)$. Because multinational firms are predicted to have richer marketing strategies, they will also feature a higher export intensity.

Similarly, from equation (10), we have that the share of domestic inputs over total import purchases is

$$\frac{M_{hh}(\varphi)}{\sum_{j\in\mathcal{J}(\varphi)} M_{jh}(\varphi)} = \frac{\xi_h^s (\tau_{hh}^s)^{1-\rho}}{\sum_{j\in\mathcal{J}(\varphi)} \xi_j^s \left(\tau_{jh}^s\right)^{1-\rho}},$$

which is monotonically decreasing in the extensive margin of imports, as reflected by the set $\mathcal{J}(\varphi)$. Because multinational firms are predicted to have richer sourcing strategies, they will also feature a higher import intensity.

B.4 The Margins of Trade with Cannibalization Effects

In this subsection, we show that in a version of our model with cannibalization effects and with plant-level exporting and sourcing strategies, the relative profitability of exporting and importing is typically lower for establishments that are part of MNEs than for establishment that are *not* part of MNEs, even when we compare firms with a common domestic size.

As we show in Antràs et al. (2022), in a model in which the elasticity of substitution across varieties is higher within firms than across firms, the potential sales from h to i of a firm with productivity φ and assembly and sourcing strategies $\mathcal{K}(\varphi)$ and $\mathcal{J}_h(\varphi)$ are given by

$$S_{hi}(\varphi) = \kappa_S \varphi^{\sigma-1} \xi_h^a (\tau_{hi}^a)^{1-\sigma} \sum_{j\in\mathcal{J}_h(\varphi)} \xi_j^s \left(\tau_{jh}^s\right)^{1-\rho} (\Psi_i(\varphi))^{\theta-1} E_i (P_i)^{\sigma-1}, \tag{B.5}$$

where $0<\theta<1$, and where $\Psi_i(\varphi)$ is defined as

$$\Psi_i(\varphi) \equiv \sum_{k\in\mathcal{K}(\varphi)} \xi_k^a (\tau_{ki}^a)^{1-\sigma} \sum_{j\in\mathcal{J}_k(\varphi)} \xi_j^s \left(\tau_{jk}^s\right)^{1-\rho}. \tag{B.6}$$

The subindex h in $\mathcal{J}_h(\varphi)$ reflects the fact that the sourcing strategy is now a *plant-level* strategy. Notice from these expressions that an increase in the sourcing potential of a location $k \neq h$ belonging to the assembly strategy $\mathcal{K}(\varphi)$ has a *direct* negative impact on the level of sales from h to i. This reflects the existence of cannibalization effects, which are absent in our framework.

Consider now the problem of solving for the optimal assembly strategy of the firm $\mathcal{K}(\varphi)$, as well as the plant-specific marketing and sourcing strategies $\Upsilon_k(\varphi)$ and $\mathcal{J}_k(\varphi)$, respectively, for each assembly location $k \in \mathcal{K}(\varphi)$. Starting from equation (B.5) and invoking the constant markup rule, firm profits

can be expressed as:

$$\begin{aligned}\pi(\varphi) &= \kappa\varphi^{\sigma-1}\sum_{i\in J}\mathcal{I}_{ki}^{x}\cdot\left(\Psi_i(\varphi)\right)^{\theta-1}\cdot E_i P_i^{\sigma-1}\left[\sum_{k\in J}\mathcal{I}_{k}^{a}\cdot\xi_k^a\left(\tau_{ki}^a\right)^{1-\sigma}\left(\sum_{j\in J}\mathcal{I}_{kj}^{s}\cdot\xi_j^s\left(\tau_{jk}^s\right)^{1-\rho}\right)\right] \\ &\quad -\sum_{k\in J}\sum_{i\in J}\mathcal{I}_{ki}^{x}\cdot w_i f_i^{x,p}-\sum_{k\in J}\sum_{j\in J}\mathcal{I}_{kj}^{s}\cdot w_j f_j^{s,p}-\sum_{k\in J}\mathcal{I}_{k}^{a}\cdot w_k f_k^{a}, \qquad \text{(B.7)}\end{aligned}$$

where κ_π is a constant and the indicators $\mathcal{I}_{ki}^x$, $\mathcal{I}_k^a$, and $\mathcal{I}_{kj}^s$ take a value of 1 when $i\in\Upsilon_k(\varphi)$, $k\in\mathcal{K}(\varphi)$ and $j\in\mathcal{J}_k(\varphi)$ (respectively), and 0 otherwise.

Note that when $\theta=1$, the cannibalization effects disappear and profits are additively separable in the operating profits of the various assembly plants in $\mathcal{K}(\varphi)$, just as in our baseline model. In that case, firm profits feature complementarity between assembly, exporting and sourcing, but only at the assembly-location level. More specifically, the profit function in (B.7) features increasing differences in $(\mathcal{I}_{ki}^x,\mathcal{I}_k^a)$, $\left(\mathcal{I}_{ki}^x,\mathcal{I}_{kj}^s\right)$, and $\left(\mathcal{I}_k^a,\mathcal{I}_{kj}^s\right)$ for a given k, and any i and j; but there are no complementarities between $(\mathcal{I}_{ki}^x,\mathcal{I}_{k'}^a)$, $\left(\mathcal{I}_{ki}^x,\mathcal{I}_{k'j}^s\right)$, and $\left(\mathcal{I}_{k'}^a,\mathcal{I}_{kj}^s\right)$ for $k\neq k'$.

In the presence of cannibalization effects, profits feature *decreasing* differences in two candidate assembly locations k and k' (or $\mathcal{I}_k^a$ and $\mathcal{I}_{k'}^a$), and also in $(\mathcal{I}_{ki}^x,\mathcal{I}_{k'}^a)$, $\left(\mathcal{I}_{ki}^x,\mathcal{I}_{k'j}^s\right)$, and $\left(\mathcal{I}_{k'}^a,\mathcal{I}_{kj}^s\right)$ for $k\neq k'$. We can illustrate this for the case of exporting by computing the change in profits from activating country i as a destination of sales from a given assembly location k

$$\Delta\pi\left(\varphi,\Upsilon_k(\varphi)\cup i,\mathcal{K}(\varphi),\mathcal{J}_k(\varphi)\right)=\kappa\varphi^{\sigma-1}\cdot\left(\Psi_i(\varphi)\right)^{\theta-1}\cdot E_i P_i^{\sigma-1}\cdot\xi_k^a\left(\tau_{ki}^a\right)^{1-\sigma}\left(\sum_{j\in J}\mathcal{I}_{kj}^{s}\cdot\xi_j^s\left(\tau_{jk}^s\right)^{1-\rho}\right),$$

where remember that

$$\Psi_i(\varphi)\equiv\sum_{k\in J}\mathcal{I}_k^a\cdot\xi_k^a\left(\tau_{ki}^a\right)^{1-\sigma}\sum_{j\in J}\mathcal{I}_{kj}^s\cdot\xi_j^s\left(\tau_{jk}^s\right)^{1-\rho}.$$

With $\theta<1$, we thus have that this change in profits is decreasing in $\mathcal{I}_{k'}^a$ and $\mathcal{I}_{k'j}^s$ for $k'=k$. Intuitively, the presence of other foreign affiliates in countries k' (as well as richer sourcing strategies in those other assembly locations) reduces the profitability of exporting to country i. Relative to a domestic firm with the same core productivity φ, a MNE with foreign affiliates is thus less likely to export.

Similarly, for the case of importing, the change in profits associated with adding location j to the sourcing strategy of a given plant k is given by

$$\Delta\pi\left(\varphi,\Upsilon_k(\varphi),\mathcal{K}(\varphi),\mathcal{J}_k(\varphi)\cup j\right)=\kappa_\pi\varphi^{\sigma-1}\cdot\xi_j^s\left(\tau_{jh}^s\right)^{1-\rho}\left(\sum_{i\in J}\mathcal{I}_{ki}^{x}\cdot\xi_h^a\left(\tau_{hi}^a\right)^{1-\sigma}\left(\Psi_i(\varphi)\right)^{\theta-1}E_i P_i^{\sigma-1}\right)-w_j f_j^{s,p}.$$

For $\theta<1$, this change in profits is decreasing in $\mathcal{I}_{k'}^a$ and $\mathcal{I}_{k'i}^x$ for $k'=k$. Intuitively, the presence of other foreign affiliates in countries k' (as well as richer export strategies in those other assembly locations) reduces the profitability of sourcing from country j. Relative to a domestic firm with the same core productivity φ, an MNE with foreign affiliates is thus less likely to import.

In our empirical results, we present results showing that MNEs have larger extensive margins of imports and exports even after controlling for their domestic size. We next show that this is also (typically) inconsistent with models with cannibalization effects and plant-level fixed costs of exporting and of sourcing.

To prove this, take two firms with core productivity levels φ_{NM} and φ_M. Suppose that due to heterogeneous fixed costs of foreign assembly, firm φ_{NM} is not a MNE, while firm φ_M has foreign assembly plants. Given equation (B.5), for firm φ_{NM} and φ_M to have the same level of sales by their establishments in the Home market, it needs to be the case that

$$\left(\frac{\varphi_M}{\varphi_{NM}}\right)^{\sigma-1}\frac{\left(\sum_{i\in\Upsilon_h(\varphi_M)}\left(\tau_{hi}^a\right)^{1-\sigma}\left(\Psi_i\left(\varphi_M\right)\right)^{\theta-1}E_i\left(P_i\right)^{\sigma-1}\right)\left(\sum_{j\in\mathcal{J}_h(\varphi_M)}\xi_j^s\left(\tau_{jh}^s\right)^{1-\rho}\right)}{\left(\sum_{i\in\Upsilon_h(\varphi_{NM})}\left(\tau_{hi}^a\right)^{1-\sigma}\left(\Psi_i\left(\varphi_{NM}\right)\right)^{\theta-1}E_i\left(P_i\right)^{\sigma-1}\right)\left(\sum_{j\in\mathcal{J}_h(\varphi_{NM})}\xi_j^s\left(\tau_{jh}^s\right)^{1-\rho}\right)}=1, \quad \text{(B.8)}$$

which is identical to (B.2) except for the terms $\Psi_i\left(\varphi_M\right)$ and $\Psi_i\left(\varphi_{NM}\right)$.

We next demonstrate that if the two firms have the same domestic size, they will necessarily choose the same sourcing strategy at home, or $\mathcal{J}_h\left(\varphi_M\right)=\mathcal{J}_h\left(\varphi_{NM}\right)$. The extensive margin of sourcing is governed by

$$\Delta\pi\left(\varphi,\Upsilon_h\left(\varphi\right),\mathcal{K}\left(\varphi\right),\mathcal{J}_h\left(\varphi\right)\cup j\right)=\kappa_\pi\varphi^{\sigma-1}\xi_j^s\left(\tau_{jh}^s\right)^{1-\rho}\left(\sum_{i\in\Upsilon_h(\varphi)}\xi_h^a\left(\tau_{hi}^a\right)^{1-\sigma}\left(\Psi_i\left(\varphi\right)\right)^{\theta-1}E_iP_i^{\sigma-1}\right)-w_jf_j^{s,p},$$

which is analogous to (13) except for the term $\left(\Psi_i\left(\varphi\right)\right)^{\theta-1}$. For common fixed costs of sourcing, the relative incentive to import from country j is given by

$$\left(\frac{\varphi_M}{\varphi_{NM}}\right)^{\sigma-1}\frac{\sum_{i\in\Upsilon_h(\varphi_M)}\xi_h^a\left(\tau_{hi}^a\right)^{1-\sigma}\left(\Psi_i\left(\varphi_M\right)\right)^{\theta-1}E_iP_i^{\sigma-1}}{\sum_{i\in\Upsilon_h(\varphi_{NM})}\xi_h^a\left(\tau_{hi}^a\right)^{1-\sigma}\left(\Psi_i\left(\varphi_{NM}\right)\right)^{\theta-1}E_iP_i^{\sigma-1}},$$

which plugging in (B.8) reduces to

$$\frac{\sum_{j\in\mathcal{J}_h(\varphi_{NM})}\xi_j^s\left(\tau_{jh}^s\right)^{1-\rho}}{\sum_{j\in\mathcal{J}_h(\varphi_M)}\xi_j^s\left(\tau_{jh}^s\right)^{1-\rho}}.$$

If this ratio was higher than one, φ_M would have a higher incentive to import from all countries, but then $\mathcal{J}_h\left(\varphi_{NM}\right)\subset\mathcal{J}_h\left(\varphi_M\right)$, which would contradict this ratio being higher than one. Similarly, if the ratio was lower than one, φ_{NM} would have a higher incentive to import from all countries, but then $\mathcal{J}_h\left(\varphi_M\right)\subset\mathcal{J}_h\left(\varphi_{NM}\right)$, which would contradict this ratio being lower than one. Thus, this ratio must be equal to one, and $\mathcal{J}_h\left(\varphi_M\right)=\mathcal{J}_h\left(\varphi_{NM}\right)$.

The equal-domestic-size condition (B.8) thus simplifies to

$$\left(\frac{\varphi_M}{\varphi_{NM}}\right)^{\sigma-1}\frac{\sum\limits_{i\in\Upsilon_h(\varphi_M)}\left(\tau_{hi}^a\right)^{1-\sigma}\left(\Psi_i\left(\varphi_M\right)\right)^{\theta-1}E_i\left(P_i\right)^{\sigma-1}}{\sum\limits_{i\in\Upsilon_h(\varphi_{NM})}\left(\tau_{hi}^a\right)^{1-\sigma}\left(\Psi_i\left(\varphi_{NM}\right)\right)^{\theta-1}E_i\left(P_i\right)^{\sigma-1}}=1. \tag{B.9}$$

From the definition of $\Psi_i(\varphi)$ in (B.12), it is clear that $\Psi_i(\varphi_M)>\Psi_i(\varphi_{NM})$ since $\mathcal{K}(\varphi_{NM})=\{h\}\subset\mathcal{K}(\varphi_M)$, and $\mathcal{J}_h(\varphi_{NM})=\mathcal{J}_h(\varphi_M)$.

Consider then the extensive margin of exporting, which in analogy to (15), is governed by

$$\Delta\pi\left(\varphi,\Upsilon_h\left(\varphi\right)\cup i,\mathcal{K}\left(\varphi\right),\mathcal{J}_h\left(\varphi\right)\right)=\kappa_\pi\varphi^{\sigma-1}\xi_h^a\left(\tau_{hi}^a\right)^{1-\sigma}\left(\Psi_i\left(\varphi\right)\right)^{\theta-1}E_iP_i^{\sigma-1}\left(\sum_{j\in\mathcal{J}_h(\varphi)}\xi_j^s\left(\tau_{jh}^s\right)^{1-\rho}\right)-w_if_i^{x,p}.$$

We seek to show that, under plausible assumptions, the MNE will be less likely to export to country i, which would result in MNEs featuring (weakly) less rich export strategies. For common fixed costs of exporting, the MNE will be less likely to export to country i if

$$\left(\frac{\varphi_M}{\varphi_{NM}}\right)^{\sigma-1}\left(\frac{\Psi_i\left(\varphi_M\right)}{\Psi_i\left(\varphi_{NM}\right)}\right)^{\theta-1}<1.$$

Plugging in (B.9), we can express this condition as

$$\frac{\sum\limits_{i'\in\Upsilon(\varphi_{NM})}\left(\tau_{hi'}^a\right)^{1-\sigma}\left(\Psi_{i'}\left(\varphi_{NM}\right)\right)^{\theta-1}E_{i'}\left(P_{i'}\right)^{\sigma-1}}{\sum\limits_{i'\in\Upsilon(\varphi_M)}\left(\tau_{hi'}^a\right)^{1-\sigma}\left(\Psi_{i'}\left(\varphi_M\right)\right)^{\theta-1}E_{i'}\left(P_{i'}\right)^{\sigma-1}}\left(\frac{\Psi_i\left(\varphi_M\right)}{\Psi_i\left(\varphi_{NM}\right)}\right)^{\theta-1}<1.$$

It is helpful to decompose this expression as

$$\frac{\left(\tau_{hh}^a\right)^{1-\sigma}\left(\left(\frac{\tau_{hh}^a}{\tau_{hi}^a}\right)^{1-\sigma}\right)^{\theta-1}E_h\left(P_h\right)^{\sigma-1}+\sum\limits_{i'\in\Upsilon(\varphi_{NM})}\left(\tau_{hi'}^a\right)^{1-\sigma}\left(\left(\frac{\tau_{hi'}^a}{\tau_{hi}^a}\right)^{1-\sigma}\right)^{\theta-1}E_{i'}\left(P_{i'}\right)^{\sigma-1}+\left(\tau_{hi}^a\right)^{1-\sigma}E_i\left(P_i\right)^{\sigma-1}}{\left(\tau_{hh}^a\right)^{1-\sigma}\left(\frac{\Psi_h(\varphi_M)}{\Psi_i(\varphi_M)}\right)^{\theta-1}E_h\left(P_h\right)^{\sigma-1}+\sum\limits_{i'\in\Upsilon(\varphi_M)}\left(\tau_{hi'}^a\right)^{1-\sigma}\left(\frac{\Psi_{i'}(\varphi_M)}{\Psi_i(\varphi_M)}\right)^{\theta-1}E_{i'}\left(P_{i'}\right)^{\sigma-1}+\left(\tau_{hi}^a\right)^{1-\sigma}E_i\left(P_i\right)^{\sigma-1}}<1. \tag{B.10}$$

Note that the third term in the denominator of the left-hand-side term is identical in the numerator and in the denominator. As for the first term, notice that in the plausible scenario in which the operations in h of the MNE firm φ_M capture a higher market share of the firm's sales in the 'domestic' market h than in the foreign market i (reflecting higher competition from foreign establishments in foreign markets than in this domestic market h), we have

$$\frac{S_{hh}\left(\varphi_M\right)}{\sum\limits_{k\in\mathcal{K}(\varphi_M)}S_{kh}\left(\varphi_M\right)}>\frac{S_{hi}\left(\varphi_M\right)}{\sum\limits_{k\in\mathcal{K}(\varphi_M)}S_{ki}\left(\varphi_M\right)},$$

which can be written as

$$\frac{\xi_h^a \left(\tau_{hh}^a\right)^{1-\sigma} \sum\limits_{j \in \mathcal{J}(\varphi_M)} \xi_j^s \left(\tau_{jh}^s\right)^{1-\rho}}{\Psi_h\left(\varphi_M\right)} > \frac{\xi_h^a \left(\tau_{hi}^a\right)^{1-\sigma} \sum\limits_{j \in \mathcal{J}(\varphi_M)} \xi_j^s \left(\tau_{jh}^s\right)^{1-\rho}}{\Psi_i\left(\varphi_M\right)},$$

which simplifies to

$$\frac{\Psi_i\left(\varphi_M\right)}{\Psi_h\left(\varphi_M\right)} > \frac{\left(\tau_{hi}^a\right)^{1-\sigma}}{\left(\tau_{hh}^a\right)^{1-\sigma}}.$$

Thus, under the plausible assumption that MNEs face tougher competition abroad than at Home, the first term is the numerator is lower than the first term in the denominator.

These results imply that if only one of the two firms is an exporter, it must necessarily be the non-MNE. To see this, note that if initially both firms only sell domestically, and are both considering including a single export location i to their marketing strategy, equation (B.10) reduces to

$$\frac{\left(\tau_{hh}^a\right)^{1-\sigma} \left(\left(\frac{\tau_{hh}^a}{\tau_{hi}^a}\right)^{1-\sigma}\right)^{\theta-1} E_h \left(P_h\right)^{\sigma-1} + \left(\tau_{hi}^a\right)^{1-\sigma} E_i \left(P_i\right)^{\sigma-1}}{\left(\tau_{hh}^a\right)^{1-\sigma} \left(\frac{\Psi_h(\varphi_M)}{\Psi_i(\varphi_M)}\right)^{\theta-1} E_h \left(P_h\right)^{\sigma-1} + \left(\tau_{hi}^a\right)^{1-\sigma} E_i \left(P_i\right)^{\sigma-1}} < 1,$$

which we know holds in the plausible case $\Psi_i\left(\varphi_M\right)/\Psi_h\left(\varphi_M\right) > \left(\tau_{hi}^a\right)^{1-\sigma}/\left(\tau_{hh}^a\right)^{1-\sigma}$.

When considering a richer extensive margin of exports, we can use the same arguments to show that if two firms have the same level of domestic sales in the Home market – or $S_{hh}\left(\varphi_M\right) = S_{hh}\left(\varphi_{NM}\right)$, the multinational firm will feature lower levels of exports for any destination market i, which will in turn reduce the operating profits associated with exporting, and thus a lower probability of exporting for the MNE. When comparing firms with the same level of sales of their domestic establishments, such a comparison is a bit more complex, but as equation (B.10) indicates, the same conclusions will arise as long as

$$\left(\frac{\Psi_{i'}\left(\varphi_M\right)}{\Psi_i\left(\varphi_M\right)}\right)^{\theta-1} \simeq \left(\frac{\tau_{hi'}^a}{\tau_{hi}^a}\right)^{1-\sigma},$$

which corresponds to the condition

$$\frac{S_{hi'}\left(\varphi_M\right)}{\sum\limits_{k \in \mathcal{K}(\varphi_M)} S_{ki'}\left(\varphi_M\right)} \simeq \frac{S_{hi}\left(\varphi_M\right)}{\sum\limits_{k \in \mathcal{K}(\varphi_M)} S_{ki}\left(\varphi_M\right)},$$

which in turn requires the market share of the MNE in its existing export destinations i' not to be too different than the one in the candidate location i.

Although the results above depend on heterogeneous fixed costs of assembly to obtain firms with the same level of domestic sales but with different MNE strategies, similar results can be obtained with heterogeneous plant-level fixed costs of exporting or sourcing. US plants with disproportionately low fixed costs of exporting, will export more but will tend to be *less* likely to open foreign affiliates due to the competition these foreign affiliates face from the exports from the Home market. Similarly,

US plants with disproportionately low fixed costs of sourcing will feature lower core productivity than US plants with the same domestic sales, and thus will tend to be *less* likely to assemble abroad (due to their lower core productivity and assuming homogeneous fixed costs of assembly).

B.5 Headquarter Gravity

In our baseline model, we abstract from direct headquarter gravity forces (Arkolakis et al., 2018; Head and Mayer, 2019). In this Appendix, we show that, whenever the fixed costs of exporting and importing are at the plant- rather than the firm-level, including an additional cost of production for an affiliate in country k owned by a firm headquartered in h does not increase that firm's domestic imports and exports from countries that are more proximate to its affiliates.

In particular, for a firm φ headquartered in country h, we let sale revenue in country $i \in \Upsilon(\varphi)$ from varieties shipped from k be equal to

$$S_{hki}(\varphi) = \kappa_S \varphi^{\sigma-1} \xi_k^a (\tau_{ki}^a)^{1-\sigma} (\gamma_{hk}^a)^{1-\sigma} \left(\sum_{j \in \mathcal{J}(\varphi)} \xi_j^s (\tau_{jk}^s)^{1-\rho} \right)^{\alpha(\sigma-1)/(\rho-1)} E_i (P_i)^{\sigma-1},$$

which is identical to (9) except for the term $(\gamma_{hk}^a)^{1-\sigma} < 1$. A higher value of γ_{hk}^a denotes a larger cost of the spatial separation between headquarters and assembly.

This headquarter gravity term also affects equation (8) characterizing imports by plants in k from a given sourcing location j, which are now given by

$$M_{hjk}(\varphi) = \kappa_M \varphi^{\sigma-1} \xi_j^s (\tau_{jk}^s)^{1-\rho} \left(\sum_{j' \in \mathcal{J}(\varphi)} \xi_{j'}^s (\tau_{j'k}^s)^{1-\rho} \right)^{\frac{\alpha(\sigma-1)}{(\rho-1)}-1} (\gamma_{hk}^a)^{1-\sigma} \sum_{i \in \Upsilon(\varphi)} \xi_k^a (\tau_{ki}^a)^{1-\sigma} E_i (P_i)^{\sigma-1}.$$

Consider now the the change in profits from activating an additional input source, which with headquarter gravity is governed by (see equation (13))

$$\Delta\pi(\varphi, \Upsilon_k(\varphi), \mathcal{K}(\varphi), \mathcal{J}_k(\varphi) \cup j) = \kappa_\pi \varphi^{\sigma-1} \xi_j^s (\tau_{jk}^s)^{1-\rho} (\gamma_{hk}^a)^{1-\sigma} \sum_{i \in \Upsilon_k(\varphi)} \xi_k^a (\tau_{ki}^a)^{1-\sigma} E_i P_i^{\sigma-1} - w_j f_j^{s,p}.$$

Other things equal, the term $(\gamma_{hk}^a)^{1-\sigma}$ implies that source countries that are closer to the headquarter country will be relatively more appealing to all plants $k \in \mathcal{K}(\varphi)$. But note that from the point of view of the establishments of the headquarter country (US in our empirical application), this choice is governed by

$$\Delta\pi(\varphi, \Upsilon_h(\varphi), \mathcal{K}(\varphi), \mathcal{J}_h(\varphi) \cup j) = \kappa_\pi \varphi^{\sigma-1} \xi_j^s (\tau_{jh}^s)^{1-\rho} (\gamma_{hh}^a)^{1-\sigma} \sum_{i \in \Upsilon_h(\varphi)} \xi_h^a (\tau_{hi}^a)^{1-\sigma} E_i P_i^{\sigma-1} - w_j f_j^{s,p},$$

and thus only depends on the distance between h and j, and *not* the distance between j and the other

assembly locations of the firm $k \in \mathcal{K}(\varphi) - \{h\}$.

Similarly, the choice of whether to activate an additional export destination from the headquarter country is governed by (see equation (15))

$$\Delta\pi\left(\varphi, \Upsilon_h(\varphi) \cup i, \mathcal{K}(\varphi), \mathcal{J}_h(\varphi)\right) = \kappa_\pi \varphi^{\sigma-1} \xi_h^a \left(\tau_{hi}^a\right)^{1-\sigma} \left(\gamma_{hh}^a\right)^{1-\sigma} E_i P_i^{\sigma-1} \left(\sum_{j \in \mathcal{J}_h(\varphi)} \xi_j^s \left(\tau_{jh}^s\right)^{1-\rho} \right) - w_i f_i^{x,p},$$

and thus only depends on the distance between h and i, and *not* the distance between i and the other assembly locations of the firm $k \in \mathcal{K}(\varphi) - \{h\}$.

B.6 Details on Section 5

In section 5, we develop a low-dimensional example to illustrate the effects of changes in bilateral trade costs on a third country's exports. At the end of the section, we state the following result, which we prove here:

Proposition B.1. Holding constant the market demand levels $E_i P_i^{\sigma-1}$ in all countries i, a decrease in bilateral trade costs $\tau_{N,S}^a$ and $\tau_{N,S}^s$ between countries N and S weakly increases final good sales $S_{hi}(\varphi)$ by plants in a third country h (with $h \neq N$ and $h \neq S$) to any market i and also weakly increases imports $M_{jh}(\varphi)$ by plants in h from any source country j.

The first step in the proof is to notice from equations (9) and (10) that changes in trade costs involving countries other than k have no direct impact on either final good sales $S_{ki}(\varphi)$ or intermediate input imports $M_{jk}(\varphi)$. This is in contrast to a model with cannibalization effects, as discussed below. For reference, it is useful to reproduce these two equations, while assuming $\alpha(\sigma-1) = \rho - 1$, as we have done in the main text.

$$\begin{aligned} S_{ki}(\varphi) &= \kappa_S \varphi^{\sigma-1} \xi_k^a \left(\tau_{ki}^a\right)^{1-\sigma} \sum_{j \in \mathcal{J}(\varphi)} \xi_j^s \left(\tau_{jk}^s\right)^{1-\rho} E_i \left(P_i\right)^{\sigma-1}; \\ M_{jk}(\varphi) &= \kappa_M \varphi^{\sigma-1} \xi_j^s \left(\tau_{jk}^s\right)^{1-\rho} \sum_{i \in \Upsilon(\varphi)} \xi_k^a \left(\tau_{ki}^a\right)^{1-\sigma} E_i \left(P_i\right)^{\sigma-1}. \end{aligned}$$

This first result implies that the only manner in which decreases in $\tau_{N,S}^a$ or $\tau_{N,S}^s$ will affect exports and imports is via changes in the firm's sourcing strategy $\mathcal{J}(\varphi)$ or its marketing strategy $\Upsilon(\varphi)$. More precisely, it is clear from the expressions above that, if we prove that decreases in $\tau_{N,S}^a$ or $\tau_{N,S}^s$ lead to a (weakly) richer sourcing $\mathcal{J}(\varphi)$ and to a (weakly) richer marketing strategy $\Upsilon(\varphi)$, we will also have proved the result in the Proposition above.

We now turn to determining the firm's extensive margins of sourcing and marketing, which are associated with the maximization of firm profits in equation (11), which we again reproduce for ease of

reference:

$$\pi\left(\Upsilon\left(\varphi\right),\mathcal{K}\left(\varphi\right),\mathcal{J}\left(\varphi\right)\right) = \kappa\varphi^{\sigma-1}\sum_{i\in J}\mathcal{I}_i^x\cdot E_i P_i^{\sigma-1}\left[\sum_{k\in J}\mathcal{I}_k^a\cdot\xi_k^a\left(\tau_{ki}^a\right)^{1-\sigma}\left(\sum_{j\in J}\mathcal{I}_j^s\cdot\xi_j^s\left(\tau_{jk}^s\right)^{1-\rho}\right)\right] - \sum_{i\in J}\mathcal{I}_i^x\cdot w_i f_i^x - \sum_{j\in J}\mathcal{I}_j^s\cdot w_j f_j^s - \sum_{k\in J}\mathcal{I}_k^a\cdot w_k f_k^a.$$

Let us focus on the effects of trade costs for the choices of $\mathcal{I}_i^x$, $\mathcal{I}_k^a$, and $\mathcal{I}_j^s$. If a firm only has an assembly plant in its home country, say h, its sourcing and marketing strategies are only shaped by the vectors of bilateral trade costs τ_{hi}^a and τ_{jh}^s, and trade policy changes involving two countries other than h would not affect a firm's choices. Nevertheless, when the firm has plants in other locations $k\neq h$, notice that bilateral trade costs not involving country h are relevant for its sourcing and marketing strategies. Furthermore, it is clear from inspection that the profit function is supermodular in both $\left(\tau_{ki}^a\right)^{1-\sigma}$ and $\left(\tau_{jk}^s\right)^{1-\rho}$ and the firm's marketing, assembly, and sourcing strategies, as captured by $\mathcal{I}_i^x$, $\mathcal{I}_k^a$, and $\mathcal{I}_j^s$, respectively. We can then invoke Topkis's monotonicity theorem to demonstrate that the solution for these indicator variables capturing the various extensive margin decisions of the firm are all (weakly) decreasing in any trade cost τ_{ki}^a and τ_{jk}^s involving countries other than h. This completes the proof of the result.

In the remainder of this Appendix, we consider the implications of changes in trade policy in a variant of our model featuring plant-level fixed costs of marketing and of sourcing *and* cannibalization effects. The following result applies in that framework:

Proposition B.2. Consider a variant of our model with plant-level fixed costs of marketing and of sourcing and cannibalization effects. Holding constant the market demand levels $E_i P_i^{\sigma-1}$ in all countries i, a decrease in bilateral trade costs $\tau_{N,S}^a$ and $\tau_{N,S}^s$ between countries N and S weakly decreases final-good sales $S_{hi}\left(\varphi\right)$ by plants in a third country h (with $h\neq N$ and $h\neq S$) to any market i and also weakly decreases intermediate-input imports $M_{jh}\left(\varphi\right)$ by plants in h from any source country j.

In words, in that variant of the model, holding constant the market-demand level faced all firms in all markets, bilateral trade liberalization between North and South would (weakly) *decrease* exports to and imports from either North, South or any other market by plants in h.

To prove this result formally, we first state the assumptions of this variant of our model. As we show in Antràs et al. (2022), whenever the assumption of a common elasticity of substitution across all varieties is relaxed, and one allows the elasticity of substitution across varieties within firms to differ from that of varieties produced by different firms, firm sales from some assembly location k to some destination market i can be expressed as

$$S_{ki}\left(\varphi\right) = \kappa_S\varphi^{\sigma-1}\xi_k^a\left(\tau_{ki}^a\right)^{1-\sigma}\sum_{j\in\mathcal{J}_k(\varphi)}\xi_j^s\left(\tau_{jk}^s\right)^{1-\rho}\left(\Psi_i\left(\varphi\right)\right)^{\theta-1}E_i\left(P_i\right)^{\sigma-1}, \tag{B.11}$$

where $\theta \neq 1$, and where $\Psi_i(\varphi)$ is defined as

$$\Psi_i(\varphi) = \sum_{k' \in \mathcal{K}(\varphi)} \xi^a_{k'} \left(\tau^a_{k'i}\right)^{1-\sigma} \sum_{j \in \mathcal{J}_k(\varphi)} \xi^s_j \left(\tau^s_{jk'}\right)^{1-\rho}. \tag{B.12}$$

Note that beyond the term $(\Psi_i(\varphi))^{\theta-1}$, the above revenue function also differs from (9) in that we allow for assembly-plant-specific sourcing strategies, reflecting the fact that fixed costs of sourcing are now incurred at the plant rather than the firm level. Although θ can in principle be larger or smaller than one, we shall focus on the case in which $\theta < 1$, which is associated with the cannibalization effects that are standard in the horizontal FDI literature. To obtain $\theta < 1$, Antràs et al. (2022) assume that the elasticity of substitution across varieties is higher within firms than across firms.

Given these firm revenues, it is easy to verify that we can express overall firm profits, as a function of its various extensive margin decisions as

$$\begin{aligned}\pi\left(\Upsilon(\varphi), \mathcal{K}(\varphi), \mathcal{J}(\varphi)\right) &= \kappa\varphi^{\sigma-1}\left[\sum_{k\in J} \mathcal{I}^a_k \cdot \xi^a_k \left(\tau^a_{ki}\right)^{1-\sigma}\left(\sum_{j\in J} \mathcal{I}^s_{kj} \cdot \xi^s_j \left(\tau^s_{jk}\right)^{1-\rho} \left(\Psi_i(\varphi)\right)^{\theta-1}\right) \sum_{i\in J} \mathcal{I}^x_{ki} \cdot E_i P_i^{\sigma-1}\right] \\ &\quad - \sum_{i\in J} \mathcal{I}^x_{ki} \cdot w_i f^x_i - \sum_{j\in J} \mathcal{I}^s_{jk} \cdot w_j f^s_j - \sum_{k\in J} \mathcal{I}^a_k \cdot w_k f^a_k. \end{aligned} \tag{B.13}$$

Note that this program now considers assembly-plant-specific sourcing and marketing strategies $\mathcal{I}^s_{kj}$ and $\mathcal{I}^x_{ki}$.

A first observation is that if we set $\theta = 1$, this profit function features increasing differences in (a) $(\mathcal{I}^x_{ki}, \mathcal{I}^a_k)$ for any i; (b) $\left(\mathcal{I}^x_{ki}, \mathcal{I}^s_{jk}\right)$ for any $i, j \in \{1, ..., J\}$; and (c) $\left(\mathcal{I}^a_{ki}, \mathcal{I}^s_{jk}\right)$ for any $j \in \{1, ..., J\}$. These may appear to be the same properties as those associated with the profit function (11) in the main text, but there is a crucial difference. The complementarity between assembly, sourcing and exporting now only holds at the plant level, not at the firm level. In other words, if changes in parameters (say a reduction in bilateral trade cost between two countries) increases the profitability of plant k sourcing from country j, this will have no impact on the firm's intensive and extensive margin decisions in plants located in countries k' other than k. More formally, for $k \neq k'$, when $\theta = 1$, profits in (B.13) are additively separable in (a) $(\mathcal{I}^x_{k'i}, \mathcal{I}^a_k)$ for any i, (b) $\left(\mathcal{I}^x_{ki}, \mathcal{I}^s_{jk'}\right)$ for any $i, j \in \{1, ..., J\}$; and (c) $\left(\mathcal{I}^a_{ki}, \mathcal{I}^s_{jk'}\right)$ for any $j \in \{1, ..., J\}$.

An implication of this additive separability is that decreases in bilateral trade costs $\tau^a_{N,S}$ or $\tau^s_{N,S}$ between two countries N and S can only affect exports and imports of plants located in N or S. This is because neither the intensive nor the extensive margin decisions of plants located in third countries $k \neq N$ and $k \neq S$ are affected by such bilateral trade costs. It is worth stating this result as a Proposition:

Proposition B.3. Consider a variant of our model with plant-level fixed costs of marketing and of sourcing, but *no* cannibalization effects. Holding constant the market demand levels $E_i P_i^{\sigma-1}$ in all countries i, a decrease in bilateral trade costs $\tau^a_{N,S}$ and $\tau^s_{N,S}$ between countries N and S has no effect on either final-good sales $S_{hi}(\varphi)$ by plants in a third country h (with $h \neq N$ and $h \neq S$) to any market

i or on intermediate-input imports $M_{jh}(\varphi)$ by plants in h from any source country j.

We now turn to the case in which $\theta < 1$, which introduces cannibalization effects into the framework.

Consider first the intensive margin of exports. From equations (B.11) and (B.12), a reduction in $\tau^a_{N,S}$ and $\tau^s_{N,S}$ can only affect sales from a home country h to any market i if a firm has a plant in either N or S. Notice also that in those cases, a reduction in $\tau^a_{N,S}$ and $\tau^s_{N,S}$ increases the term $\Psi_i(\varphi)$ in (B.12) for $i = N$ or $i = S$, and therefore (weakly) reduces $S_{hN}(\varphi)$ and $S_{hS}(\varphi)$ whenever $\theta < 1$. The intuition is straightforward: the reduction in $\tau^a_{N,S}$ and $\tau^s_{N,S}$ can only affect the operations in h via increased competition from the firm's affiliates in N or S, which now have an advantage in selling to each other's markets. Because $S_{hN}(\varphi)$ and $S_{hS}(\varphi)$ weakly decrease and $S_{hi}(\varphi)$ does not increase for any i, it is also clear that holding the extensive margins of trade constant, the size of the plant in h will necessarily (weakly) decrease, and intermediate input purchases by this plant will also (weakly) decrease.

Consider now the extensive margins of trade. Reductions in $\tau^a_{N,S}$ and $\tau^s_{N,S}$ naturally increase the profitability of assembling in either N or S, so $\mathcal{I}^a_N$ and $\mathcal{I}^a_S$ weakly increase when $\tau^a_{N,S}$ or $\tau^s_{N,S}$ fall. In addition, whenever the firm has an assembly plant in either N or S, the extensive margins of exports and imports of that plant will also be enhanced, or more formally, $\mathcal{I}^s_{Nj}$, $\mathcal{I}^s_{Sj}$, $\mathcal{I}^x_{Ni}$, and $\mathcal{I}^x_{Si}$ are all weakly decreasing in $\tau^a_{N,S}$ or $\tau^s_{N,S}$. It is then straightforward to see from equations (B.11) and (B.12) that as the extensive margins of exports and imports by plants in N or S become richer, this further reduces sales by the plant in the third-market h. Importantly, this fall in sales not only affects sales in N or S, but also sales in other countries i where the plants in N and S already sold to or started selling to following the fall in $\tau^a_{N,S}$ or $\tau^s_{N,S}$. Finally, the fact that, holding all extensive margin decisions fixed, $S_{hi}(\varphi)$ weakly decreases for all markets i in response to reductions in $\tau^a_{N,S}$ and $\tau^s_{N,S}$ implies that, if the extensive margin decisions of the plant in h change at all, it must be in a manner that weakly decreases $\mathcal{I}^s_{hj}$ and $\mathcal{I}^x_{hi}$.

In sum, on account of both the intensive and extensive margins of trade, under cannibalization, we have that a decrease in bilateral trade costs $\tau^a_{N,S}$ and $\tau^s_{N,S}$ between countries N and S weakly decreases final-good sales $S_{hi}(\varphi)$ by plants in a third country h (with $h \neq N$ and $h \neq S$) to any market i and also weakly decreases intermediate-input imports $M_{jh}(\varphi)$ by plants in h from any source country j.