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 firm's plants. These shared fixed costs create interdependencies between a firm's production and trade locations that generate third-market responses to policy changes.

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 the 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 by existing trade models.

Take as an example the anti-dumping duties placed on US washing machine imports from Korea in 2012. While standard trade models would have predicted an increase in the prices of washing machines in the US, prices instead fell as the Korean manufacturers relocated production to China. The higher bilateral trade costs between the US and Korea thus increased Chinese exports to the United States, as well as exports of washing machine parts from Korea to China, also 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' production location decisions and their extensive-margin trade choices. To do so, we 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 imports and exports by country from the Census Bureau with inward foreign direct investment (FDI) data on firms' foreign ownership by country and outward foreign affiliate activity by industry and 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.

A primary contribution of our paper is to show that US MNEs' extensive margin trade patterns are systematically related to their foreign manufacturing locations. Past work finds that importers are larger than non-importers, and that their relative size advantage is increasing in the number of countries from which they source (Antràs et al., 2017). In Figure 1, we extend this analysis by showing that the size premia associated with sourcing from more markets are *lower* when controlling for firms' MNE status. Indeed, controlling for the firm's MNE status reduces the US size premium associated with importing from over 25 countries by almost 100 log points. These 26+ country importers account for 71 percent of US manufacturers' imports, of which 93 percent are mediated by MNEs.

The size premia for exporting are lower than for importing, but Figure 1 shows that controlling for MNE status further reduces the US sales premium associated with exporting to 26+ markets by almost 100 log points. In fact, despite their lower premia, exports are even

Figure 1: Firms' US Sales Premia by Number of Source and Destination Countries
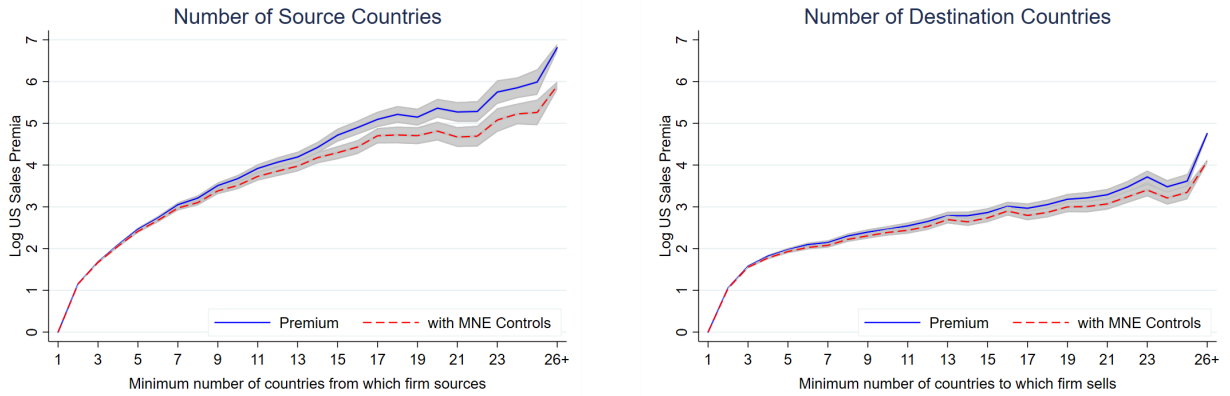
more skewed in that 83 percent are mediated by firms that export to over 25 countries. Among these firms' exports, 90 percent are sold by MNEs. These patterns align with models in which reaching additional import and export markets entails country-specific fixed costs, yet suggest either that MNEs' fixed costs are lower, or that their marginal benefit from activating a new input source or a new export market is higher.

Consistent with these explanations, the data also indicate that MNEs have larger extensive and intensive margins of trade than multi-country domestic traders, even after controlling for differences in their US size, number of establishments, number of distinct US manufacturing industries, firm age, and industry. While past work on multinationals emphasizes the empirical relevance of input shipments between an MNEs' headquarters and affiliates, we show that US MNEs' larger extensive and intensive margins of trade persist when limiting the data to arm's-length transactions. Since these trade flows are with unaffiliated parties, they cannot be explained by input shipments across plants. In addition, MNEs' larger trade margins are increasing in the number of foreign countries in which they manufacture goods, suggesting a potential complementarity between their trade and production decisions.

To analyze the geography of MNEs' trade and manufacturing decisions, we estimate the probability of importing from a particular country as a function of the firms' foreign manufacturing locations. We find that 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, we find that US MNEs are 7.4 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.

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). While those models feature a complementarity between vertical FDI and domestic trade, that complementarity only applies to intra-firm shipments of inputs between a firm's domestic plants and its affiliates. Vertical FDI 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 probabilities to import from and export to countries that are proximate to their affiliates by proposing 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), and a country-specific fixed cost to source inputs (as in Antràs et al., 2017). In our framework, however, the marketing fixed cost allows *all* of the firm's plants to sell in the country. Similarly, the sourcing 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. Since selling goods or sourcing inputs is also subject to iceberg trade costs, a firm enjoys higher marginal profits from activating markets that are close its affiliates. Given the shared fixed costs, the firm's domestic plants in turn also source from and sell to those markets.

The model generates new complementary forces between FDI and trade decisions with distinct implications for policy. We illustrate the policy-relevance of our framework with 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 such a bilateral 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) linked the 1987 Census of Manufactures to an indicator for 10 percent foreign ownership from the BEA and inferred outward FDI for firms with over 500 employees using the Census Large Firm Survey. They showed that US manufacturing plants are more productive when they are owned by MNEs, but had no information on US MNEs with less than 500 workers or on firm-level trade flows. More recent work linked Customs trade data to the LBD and identified multinational activity 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) merged the Census data to directories of international corporate structure, but similarly lacked information on US firms' foreign affiliate activity.

This paper and Kamal et al. (2022) are the first to merge Census and BEA outward FDI data.[1] 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 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.[2] Our contribution

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[1]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, which those authors led.

[2]The analysis in Garetto et al. (2019) is limited to affiliate sales to Canada, the UK, and Japan due to data

is to show that even under this same independence, a common fixed cost to sell in a market that is shared across all of the firm's plants results in a new complementary force between FDI and exporting. This complementarity interacts with bilateral trade costs to generate predictions in line with past firm-level evidence and the spatial correlations documented here, and implies that trade cost reductions will encourage, rather than discourage, FDI with third markets.[3]

Finally, the idea that firms may leverage key technologies across plants and countries has long provided a fundamental explanation for FDI (Helpman, 1985; Markusen, 1984). Fixed costs and selection are also well-established features of FDI (Yeaple, 2009; Ramondo, 2014). Bernard et al. (2018) show how 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. To our knowledge, ours is the first framework to feature firm-by-country rather than plant-by-country level fixed costs of sourcing or marketing, and to show that these fixed costs rationalize the domestic export and import patterns of US MNEs.

The rest of the paper is structured as follows. Section 2 describes the merged dataset and shows how MNEs differ from domestic traders. Section 3 exploits the novel firm-by-country details to provide three 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 offer some concluding remarks in Section 6.

2   New Data and Facts 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 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.

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restrictions.

[3]The firm-level fixed cost for MNEs 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 also more likely to start exporting the MNEs' headquarter country. Bernard et al. (2020) find that Danish offshoring import the same detailed goods that they produce domestically, though domestic varieties have higher unit values that rise after importing begins, in line with assumption that firms produce different varieties in each country.

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.[4] 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.[5]

We combine the Census data with the BE-11 survey that provides annual information on 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.[6] 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 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

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[4]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.

[5]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.

[6]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.

the Company Organization Survey, 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 it separates 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, assigning all activity at Census firms that contain a foreign BEA firm overstates the aggregate share of foreign ownership in the United States relative to published BEA totals. This overstatement is likely due to our use of the Census firmid, which combines EINs that BEA considers separate firms.[7] We therefore exploit BEA ultimate ownership information along with multinational activity data from the Census Bureau's Company Organization Survey 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

Table 1 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

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[7]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.[8] 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).

Table 1: Aggregate statistics for US-based firms in 2007, by MNE status

	Firms		Employment		Sales		Imports		Exports	
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 affiliate activity. 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 firms with one or more manufacturing plants in the United States (as in Fort et al., 2018). Table 2 shows that this sample of manufacturing 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 manufacture abroad, we divide US MNEs into those with and without foreign manufacturing affiliates. Table 2 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.[9]

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

Table 2: Manufacturing firms' share of aggregate activities, by MNE status

Firm Type	Firms	Emp	Sales	M Emp	M Sales	Imports	Exports
Domestic	242.00	0.10	0.09	0.58	0.35	0.09	0.12
Foreign MNEs	2.20	0.03	0.10	0.12	0.22	0.26	0.21
US MNEs							
No foreign manuf affiliates	0.35	0.04	0.05	0.03	0.03	0.03	0.02
With foreign manuf affiliates	1.20	0.06	0.14	0.27	0.40	0.29	0.44
Total	245.75	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 (000s) and shares of total and manufacturing (M) employment and sales, imports, and exports, for all firms with 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.

2.3 MNE versus Domestic Trader Size Premia

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.[10]

Table 3 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 3 shows that MNEs are substantially larger and more productive than all domestic firms, including those with related-party trade. Among U MNEs, those that manufacture both in the US and abroad are the largest. They are 477 log points bigger than domestic non-traders, and about three times the size of related-party importers or exporters.

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upper bound.

[9]We present comparable statistics for firms without US manufacturing plants in Appendix Table A.1. 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.

[10]All US MNEs trade and over 90 percent engage in related-party trade. See Appendix Table A.2.

Table 3: Size premia for domestic traders and multinationals

Dependent variable is the log of firm attribute in column header

Firm Type	All Sectors			Manufacturing	
	Emp	Sales	$\frac{Sales}{Emp}$	Sales	$\frac{Sales}{Emp}$
	(1)	(2)	(3)	(4)	(5)
Domestic Importers					
Arm's-length only	0.868***	0.979***	0.111***	0.972***	0.115***
	(0.006)	(0.007)	(0.003)	(0.007)	(0.003)
Related-party	1.461***	1.711***	0.250***	1.682***	0.260***
	(0.012)	(0.013)	(0.006)	(0.013)	(0.006)
Domestic Exporters					
Arm's-length only	0.695***	0.792***	0.097***	0.791***	0.097***
	(0.006)	(0.007)	(0.003)	(0.007)	(0.003)
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)
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.

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 systematically identifies much larger firms.

While US MNEs are the largest firms, they seem similarly productive to foreign MNEs. Both 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 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. Moreover, we estimate that US MNEs' average employment in management and professional services establishments (NAICS 54 and 55) is 8.9 percent higher than domestic firms' share, and almost 6 percentage points higher than foreign MNEs' share. Since these sectors comprise establishments that tend to provide support services for other establishments of the firm, they suggest that US MNEs' domestic employment may include fixed cost activities it leverages across its worldwide plants.

We conclude this section by showing how US MNEs' considerable US size premia are related to their foreign manufacturing locations. Figure 2 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 400 log points larger than firms that manufacture only in the United 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 600 log points larger than domestic manufacturers.

Figure 2: Firms' US Sales Premia by Number of Production Countries

3   New Facts on MNEs' Trade Patterns

In this section, we document three 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 shares of their sales, 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 margin of trade across countries. Prior work finds that firms trading with eleven or more countries account for the majority of trade flows (Bernard et al., 2018). We revisit the importance of the extensive margin by decomposing trade flows into more bins and by traders' multinational status.

Figure 3 illustrates the skewness in both imports (left panel) and exports (right panel). Firms that import from over 25 countries account for 72 percent of imports, while firms that export to more than 25 countries account for 84 percent of exports.[11]

Figure 3: US Exports and Imports by Traders' Extensive Margin of Countries
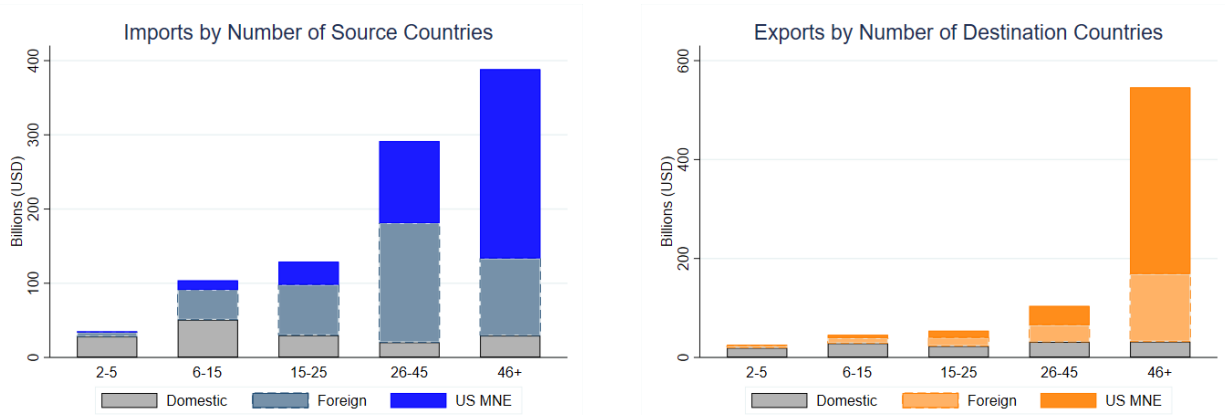
Sources: 2007 Economic censuses, LBD, LFTTD, and BEA inward and outward datasets. Figure presents US imports and exports by the number of countries with which the importer sources or the exporter sells and firm type. 'Foreign' are firms that are majority owned by a foreign firm. 'US MNEs' are majority owned by a US firm and have majority-owned foreign manufacturing affiliate activity. Sample consists of multi-country importers and exporters, which account for 99% of each trade type.

Past work on MNEs predicts their dominance of aggregate trade flows due to their significant size and productivity advantage (Bernard et al., 2009, 2018). To assess whether MNEs' larger extensive margins are solely attributable to their size, we estimate:

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[11]This figure is based on manufacturing firms that import from or export to at least two countries...these firms account for 99 percent of manufacturers' imports and exports, respectively. The single-country traders are essentially all domestic firms.

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

where sales_f^{US} are the firm's US sales, estabs_f^{US} is a count of the firms' US establishments, Foreign_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 MNE dummies) with the log count of the number of foreign countries in which the firm manufactures goods.

Table 4 presents the results from estimating equation (2) 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 more than double the number of countries of domestic multi-country importers.

A number of models predict that MNEs will source inputs from their foreign affiliates (e.g., Garetto, 2013). To assess whether affiliate input sourcing fully accounts for these patterns, we restrict the analysis to arm's-length transactions. Since the majority of foreign MNE trade is with related parties, this restriction restricts us to focusing on US firms. The coefficient on the US MNE indicator is slightly larger in column 3, while the estimate on interaction term is essentially unchanged. 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. 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.

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

13

Table 4: Extensive and intensive margin trade premia for multinationals

	All Imports		AL Imports	All Exports		AL Exports
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: dependent variable is the log(number of countries)						
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)
Log(affiliate countries)		0.115***	0.116***		0.072***	0.069***
		(0.012)	(0.013)		(0.017)	(0.019)
Panel B: dependent variable is the log(value of trade)						
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)
Log(affiliate countries)		0.256***	0.179***		0.203***	0.141***
		(0.041)	(0.044)		(0.034)	(0.038)
US industries	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. All regressions control for firm's primary 4-digit US NAICS, firm age, log of US sales, log number of US establishments. Import and export samples limited to firms that import from, or export to, 2+ countries, respectively.

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 3 and Table 4 in the following fact:

Fact 1. *US MNEs are more trade-intensive than domestic firms: they import and export more relative to their sales, and feature richer extensive margins of both imports and exports. These MNE trade premia are increasing in the number of foreign countries in which the firm manufactures goods.*

The data thus indicate that the disproportionate share of trade accounted for by MNEs cannot be explained solely by their size advantage. Instead, MNEs both import and export a

greater share of their US establishments' sales. Moreover, MNEs' larger extensive and intensive margins of trade are increasing in the number of countries in which they manufacture goods.

3.2   Relationship between FDI and Importing

We now study how firms' extensive and intensive margins of 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:

$$
\begin{aligned}
Pr(I_{fjr} = 1) = \quad & \beta_A Affiliate_{fjr} + \beta_{AR} AffiliateRegion_{fj' \neq jr} + \\
& \beta_F ForeignHQ_{fjr} + \beta_{FR} ForeignRegionHQ_{fj' \neq jr} + \gamma_f + \gamma_j,
\end{aligned}
\tag{2}
$$

where I_{fjr} is an indicator equal to one if firm f imports from country j in region r. The first row of equation (2) includes indicators for US MNEs' foreign manufacturing affiliate locations. $Affiliate_{fjr}$ is an indicator for whether the firm has a majority-owned manufacturing affiliate in country j and region r. $AffiliateRegion_{frj' \neq j}$ 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.[12] The second row in equation (2) includes similar indicators for foreign MNEs. $ForeignHQ_{fjr}$ is an indicator for whether the firm is majority owned by a firm headquartered in country j, and $ForeignRegionHQ_{frj' \neq j}$ 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 the geography of firms' MNE activity relates to their foreign sourcing behavior. We therefore include firm 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. The firm fixed effects control for all unobservable firm characteristics, so that the patterns we document cannot be explained by the relative size advantage of MNEs. We also include country fixed effects so that we focus 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.

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[12]We define the following regions: Africa, Central Asia, East Asia, Europe (excluding the New Member States), Middle East, New Member States of the European Union, North America, OWH, Oceania, South and Central America, South Asia, Southeast Asia, and Western Asia.

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

$$
\begin{aligned}
y_{fjr} = \quad & \beta_A Affiliate_{fjr} + \beta_{AR} AffiliateRegion_{fj' \neq jr} + \\
& \beta_F ForeignHQ_{fjr} + \beta_{FR} ForeignRegionHQ_{fj' \neq jr} + \gamma_f + \gamma_j + \varepsilon_{fjr}, \quad (3)
\end{aligned}
$$

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 and 2 present the extensive-margin estimates, while columns 3 and 4 present the intensive-margin results. The first of each of these regressions includes only the MNE and foreign headquarter indicators for the import country, while the second set of columns also includes the region indicators. Since the coefficients on the country indicators do not change significantly when including the region indicators, we focus on the second column for each margin. Examining the extensive-margin results in column 2, the estimates suggest that US firms are 53.6 percentage points more likely to import from a country in which they have a majority-owned foreign manufacturing affiliate, while foreign MNEs are 74 percentage points more likely to import from their headquarter country.

The most novel results in Table 5 are the positive correlations we estimate between the likelihood a firm will import from a country that is relatively proximate to its foreign manufacturing affiliates, or to its headquarter country. We find that US MNEs are 7.4 percentage points more likely to import from a country if they have an affiliate in the region. This estimate is over three times the size of the average share of countries from which a firm in the sample imports. Foreign MNEs are 9.0 points more likely to import from the same region as their headquarters. These estimates are economically large, since the average multi-country importers sources from only 2.8 percent of the 182 countries in the sample.

Columns 3 and 4 in Table 5 provide results on firms' intensive-margin import decisions. Focusing on column 4, the estimates suggest that US MNEs import 233 log points more from countries in which they have a foreign affiliate, while foreign MNEs import 367 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.[13]

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[13]Relatedly, Li (2021) finds that foreign-owned firms in China import more from their headquarters and countries close to their headquarters.

Table 5: MNE activity and the extensive and intensive margins of imports

	Extensive Margin		Intensive Margin	
	(1)	(2)	(3)	(4)
Affiliate$_{fjr}$	0.501***	0.536***	2.224***	2.331***
	(0.025)	(0.028)	(0.123)	(0.110)
Foreign HQ$_{fjr}$	0.669***	0.678***	3.617***	3.765***
	(0.047)	(0.047)	(0.227)	(0.223)
Affiliate in Region$_{fj'\neq jr}$		0.074***		0.181
		(0.015)		(0.113)
Foreign HQ in Region$_{fj'\neq jr}$		0.090***		0.480***
		(0.021)		(0.160)
Adj. R2	0.278	0.28	0.282	0.283
Observations (000s)	6,330	6,330	177	177
Firm & Country FEs	Yes	Yes	Yes	Yes

Source: 2007 Economic censuses, LBD, LFTTD, and BEA inward and outward datasets. Dependent variable for extensive margin regressions is an indicator for whether firm f imports from country j in region r. Dependent variable for intensive-margin regressions is the log of imports by firm f from 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. There are 182 countries in this sample. Standard errors two-way clustered by firm and by country. *,**, *** denote p<0.10, p<0.05, and p<0.01, respectively.

Past work focuses on a role for 'extended gravity' or for shared fixed costs of importing and exporting. We therefore re-estimate Equation equations (2) and (3) including 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. The results of these specifications are pending disclosure.

In sum, US MNEs are more likely to import from countries in which they have affiliates, and from proximate 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. 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. We incorporate this relationship in our theoretical framework in the next section.

We summarize these results 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, the amount a US MNE sources from a country in its sourcing set is not *higher if the MNE has 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 US MNEs' production locations and their export patterns. 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 46 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 mechanisms in past work (Irarrazabal et al., 2013; Keller and Yeaple, 2013; Ramondo and Rodríguez-Clare, 2013).[14]

Most notably, and similarly to the import results, the estimates also indicate that a US MNE is 8.7 points more likely to export to another country in the same region in which its affiliate is located. 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 such substitution forces are present, the data show that they are nevertheless dominated by complementary forces beyond those due to input shipments between affiliates and their headquarters.

As for importing, one possibility is that firm-level fixed costs to export are correlated across countries. To assess this possibility, we include indicators for whether the firm exports to other countries in the same region as j. We also construct export indicators that are analogous to the affiliate indicators. The results of these specifications are pending disclosure.

Columns 3 and 4 in Table 6 present results from estimating a variant of equation (3) in which the dependent variable is the log of firm exports to country j. The estimates indicate

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[14]We have tried using product and material trailer files on firms' US establishments inputs and production to distinguish imports of final goods versus inputs. In practice, a large share of US MNEs' imports are classified as both inputs and final goods using this approach.

that US MNEs export relatively more to countries in which their affiliates are located, and similarly, foreign MNEs export relatively more to their headquarter country. In contrast to the import regression estimates, we find that US MNEs also export about 16 percent more to other countries in the same region as their affiliate, whereas foreign MNEs have a negative, though insignificant, relationship between the amount they export to a country and its presence in the same region as its headquarters.

Table 6: MNE activity and the extensive and intensive margins of exports

	Extensive Margin		Intensive Margin	
	(1)	(2)	(3)	(4)
Affiliate$_{fc}$	0.423***	0.463***	1.906***	1.993***
	(0.032)	(0.035)	(0.108)	(0.102)
Foreign HQ$_{fc}$	0.518***	0.521***	1.306***	1.286***
	(0.043)	(0.043)	(0.140)	(0.155)
Affiliate in Region$_{fj' \neq jr}$		0.087***		0.163**
		(0.020)		(0.078)
Foreign HQ in Region$_{fj' \neq jr}$		0.035**		-0.112
		(0.014)		(0.122)
Adj. R2	0.266	0.267	0.42	0.42
Observations (000s)	7,230	7,230	350	350
Firm & Country FEs	Yes	Yes	Yes	Yes

Source: 2007 Economic censuses, LBD, LFTTD, and BEA inward and outward datasets. Dependent variable for extensive margin regressions is an indicator for whether firm f exports country j in region r. Dependent variable for intensive-margin regressions is the log of exports by firm f from 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. There are 182 countries in this sample. Standard errors two-way clustered by firm and by country. *,**, *** denote p<0.10, p<0.05, and p<0.01, respectively.

We summarize these results in our final fact:

Fact 3. *US MNEs are more likely to export, and conditional on exporting to a country to export more, both to countries in which they have an affiliate, and 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.*

These results are consistent with US MNEs shipping inputs to their foreign affiliates, and with them exporting final goods produced by their US establishments both to other customers

in the country of their affiliates, as well as to other proximate countries in the same region as their affiliates.

3.4   Summary of New Facts

The facts in this section provide new insights into MNEs' trade patterns. We show that MNEs import from and export to more countries than domestic traders, even after controlling for the size of their US operations. Conditional on positive imports, MNEs also import relatively more than domestic firms, again even after controlling for their size. US MNEs are also more export-intensive that domestic firms.

Most notably, we find that US MNEs' import and export flows are tilted not only towards countries in which they have affiliates, but also towards other countries in the same region as their affiliates. Current models on FDI do not predict these patterns. Indeed, the regional results for exports are not rationalized by the majority of horizontal or export-platform models of FDI in which foreign plant sales are a substitute that cannibalize from a firm's domestic exports. 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 standard gravity forces to create novel complementarities between firms' FDI and domestic import and export decisions. These complementarities arise because all of the firm's plants benefit from activating a particular final-good or input market, and the profitability of activating that market is decreasing in its variable trade costs from each of the firm's production locations.

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.[15]

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[15]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

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 nested CES structure for preferences 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:

$$U_{Mi} = \left(\int_{\varphi \in \Theta_i} \sum_{k \in \mathcal{K}(\varphi)} q_i(\varphi, k)^{(\sigma-1)/\sigma} \, \mathrm{d}\varphi \right)^{\sigma/(\sigma-1)}, \quad \sigma > 1, \tag{4}$$

where Θ_i is the endogenous measure of firms selling differentiated goods in country i, and where $\mathcal{K}(\varphi) \subseteq J$ 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

$$S_i(\varphi, k) = \left(\frac{p_i(\varphi, k)}{P_i} \right)^{1-\sigma} E_i \tag{5}$$

of their income on variety k produced by firm φ. In this expression, 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 given by:

$$P_i = \left(\int_{\varphi \in \Theta_i} \sum_{k \in \mathcal{K}(\varphi)} p_i(\varphi, k)^{1-\sigma} \mathrm{d}\varphi \right)^{\frac{1}{1-\sigma}}. \tag{6}$$

We assume that total manufacturing spending E_i and wages w_i in all countries are independent of the equilibrium in the manufacturing sector.

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 $\mathcal{K}(\varphi) \subseteq J$, and refer to it as the firm's *global*

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and Kortum (2002), as in Tintelnot (2017). See (Antràs et al., 2022) for details.

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.[16]

The first key assumption in the theory is that a firm must incur a country-specific fixed cost 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' 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 in the model 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

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

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 different subindices to denote countries: k denotes a country in the firm locates a final-good production plant; 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 baseline framework does not feature any *direct* dependence of the cost function in (7) on the country in which the firm is headquartered, so there is no need to include a subindex related to that headquarter country.

4.3   Firm Behavior Conditional on Extensive-Margin Strategies

We now 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

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

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. By contrast, input trade costs τ_{jk}^s vary bilaterally, such that source-country expenditure shares vary across plants within a firm. Although all of the firm's plants source inputs from the same set of countries, each plant's expenditure shares are oriented towards proximate countries.

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 (4) and spending function (5) imply that firm φ obtains sale revenue in country $i \in \Upsilon(\varphi)$ from varieties shipped from k equal to

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

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*.

Equation (9) illustrates how changes in source and assembly country characteristics affect firm sales from a particular location. Holding market demand $E_i P_i^{\sigma-1}$ and the firm's extensive-

23

margin strategies constant, 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.

Equation (9) also shows that changes in ξ_k^a, τ_{ki}^a, or τ_{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 common substitutability within and across a firm's 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).[17]

Given the assumption of Cobb-Douglas production technology in (7), a plant's total input purchases are a constant share of its sales $S_{ki}(\varphi)$ in equation (9) aggregated across activated sales markets $i \in \Upsilon(\varphi)$. Furthermore, imports from each country j correspond to a share $\chi_{jk}(\varphi)$ in equation (8) of the firm's total input purchases. As a result, imports by plants in k from a given sourcing location j are given by:

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

where κ_M is a constant.

Equation (10) shows how changes in assembly and sourcing potentials, and bilateral trade costs affect firm-level input flows. Holding market demand $E_i P_i^{\sigma-1}$ and a firm's extensive-margin strategies constant, 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 $j \in \mathcal{J}(\varphi)$. In addition, the lack of cannibalization effects across assembly plants implies that an increase in ξ_k^a or a reduction in τ_{ki}^a for any $i \in \Upsilon(\varphi)$ has no effect on the intensive margin sourcing decisions of plants located in *other* countries $k' \neq k$. The addition of a new country i' to the firm's marketing strategy 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 also affects firm sales and sourcing by a plant in k. Again, holding market demand and the firm's extensive-margin decisions constant, inspection of (10) shows that a decrease in 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.

Less trivially, 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. Sourcing from other countries may rise or fall,

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[17]In Antràs et al. (2022) we show that this special case in which a firm's sales are independent across countries arises when the standard *demand cannibalization* effect is exactly offset by a *demand complementarity* effect.

depending on the relative size of $\alpha(\sigma-1)$ and $(\rho-1)$. When inputs across countries are substitutable and demand is inelastic, the 'substitution effect' tends to dominate such that a reduction in sourcing costs from one country will lead not only to a decrease in expenditure shares from other countries, but also to a decrease in expenditure levels. By contrast, when demand is elastic and inputs are less substitutable, the marginal-cost reduction from lower trade costs translates to a relatively larger 'scale effect' in which the level of imports from all countries grows, even as expenditure shares shift towards the country with the trade-cost reduction.

Since 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:

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

where κ_π is a constant and where the indicators variables $\mathcal{I}_i^x$, $\mathcal{I}_k^a$, and $\mathcal{I}_j^s$ take a value of 1 when $i\in\Upsilon(\varphi)$, $k\in\mathcal{K}(\varphi)$ and $j\in\mathcal{J}(\varphi)$ (respectively), and 0 otherwise. Maximizing equation (11) is an NP-complex combinatorial problem that is infeasible to solve analytically, so we focus on characterizing its solution.[18]

We exploit three technical properties of the profit function in (11) to characterize its solution. 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

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[18]More formally, let $\pi_h(\varphi):\{0,1\}^{3J}\to\mathbb{R}_+$ be a variable profit function defined over the boolean hypercube. Let $\mathcal{I}=(\mathcal{I}^x,\mathcal{I}^a,\mathcal{I}^s)\in\{0,1\}^{3J}$ with $\mathcal{I}^x\in\{0,1\}^J$, $\mathcal{I}^a\in\{0,1\}^J$ and $\mathcal{I}^s\in\{0,1\}^J$. If the firm sells in market i then $\mathcal{I}_i^x=1$ and $\mathcal{I}_i^x=0$ otherwise; if the firm builds an assembly plant in location k then $\mathcal{I}_k^a=1$ and $\mathcal{I}_k^a=0$ otherwise; if the firm builds a sourcing plant in location j then $\mathcal{I}_j^s=1$ and $\mathcal{I}_j^s=0$ otherwise. The corresponding export, assembly, and sourcing strategies are defined as $\Upsilon_h(\varphi)\subseteq J=\{i\in J:\mathcal{I}_i^x=1\}$, $\mathcal{K}_h(\varphi)=\{k\in J:\mathcal{I}_k^a=1\}$, and $\mathcal{J}_h(\varphi)=\{j\in J:\mathcal{I}_j^s=1\}$, respectively.

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.[19] 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 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 plant in one location substitutes for a plant in other locations (Tintelnot, 2017; Arkolakis et al., 2021). Third, $(\mathcal{I}_j^s, \mathcal{I}_{j'}^s)$ 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 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 independence within each extensive margin are unlikely to hold in reality, they allow us to focus on the novel interdependencies across marketing, assembly, and sourcing strategies. We later discuss whether relaxing independence in each of these margins could provide an alternative explanation for the empirical patterns we document.

The two key 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) $(\mathcal{I}_i^x, \mathcal{I}_j^s)$ for any $i, j \in \{1, ..., J\}$; and (c) $(\mathcal{I}_k^a, \mathcal{I}_j^s)$ for $k, j \in \{1, ..., J\}$. As a result, the activation of a sales destination, an assembly location, or a sourcing location 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 capabilities, 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 firm-level heterogeneity in fixed costs, 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

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[19]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).

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.

4.5 Connection to Descriptive Evidence

We next employ our model to interpret the descriptive facts we developed earlier in the paper.

Selection into Exports, Imports and FDI Proposition 1 offers an immediate explanation for the patterns documented in Figures 1 and 2, in which the 'size premia' of firms is increasing in the firm's number of source countries, export markets, and assembly locations. More subtely, our model implies that US firms with foreign manufacturing plants should require a *lower* domestic size premium as domestic manufactures to overcome the additional fixed costs of adding more export destinations or input markets. Intuitively, properties (a) and (c) of the profit function imply that an MNE enjoys relatively larger benefits from activating a new export or input market, since that market will not only increase sales by its domestic plants, but also by its foreign affiliates. Consistent with these increasing differences, Figure 1 demonstrates that the size premia for firms as a function of the number of source or export countries flattens noticeably after controlling for a firm's multinational status. This flattening is particularly strong for importing, suggesting stronger complementarities between assembly and sourcing. Direct evidence for MNEs' larger extensive margins of trade is also shown in Table 4. US MNEs have larger extensive margins of imports and exports that are increasing in their number of foreign production locations, even after controlling for their US sales, number of US establishments, and number of distinct US manufacturing industries.

How unique is this prediction to our model? Obviously, other models of multinational activity predict that MNEs will tend to export to more countries and import from more countries, but this result tends to be driven solely by their productivity advantage or by their intrafirm trade flows. For instance, in Arkolakis et al. (2018) and Bernard et al. (2018), larger firms are more likely to be able to amortize *both* the fixed cost of marketing goods in foreign markets *and* the fixed cost of assembling goods in foreign markets. Similarly, in model with 'vertical' trade within MNEs (Ramondo and Rodríguez-Clare, 2013; Keller and Yeaple, 2013), parents are more likely to export inputs to or import inputs from their foreign affiliates, thus also generating disproportionately large extensive margins of exports and imports for MNEs.

Notice, however, that the patterns in Figure 1 indicate that MNEs have richer extensive margins of exports and imports relative to *comparable* non-MNEs with the same level of domestic sales. If what makes comparable firms have different MNE strategies is heterogeneity across

firms in the country-level fixed costs of assembly they face, our model indeed predicts that a multinational firm with the same domestic size than a non-MNE firm will have different extensive margins of trade, with the MNE importing from and exporting to more countries.

Conversely, previous models of export-platform FDI with cannibalization effects and plant-level fixed costs of exporting and importing would instead predict that US plants that are part of MNEs but have the same domestic profitability as non-MNE plants in the US should be *less* likely to export to foreign markets. Intuitively, as we show in Appendix B.1, under weak assumptions, the US operations of MNEs will face lower *within-firm* competition in the US than in foreign markets, and this will lead to a relatively lower profitability of foreign sales relative to US sales. This, in turn, would translate into lower incentives to export to those foreign markets (for given domestic sales), as well as to a lower ratio of worldwide sales to US sales by these US entities. With constant markups, a model with cannibalization effects thus predicts that the US operations of MNEs should feature lower operating profits than the US operations of a comparable non-MNE with the same level of US sales. Because in a model with plant-level fixed costs of sourcing selection into importing is driven purely by the profitability of the firm in the importing country, we can thus conclude that cannibalization effects would make MNEs be less likely import from foreign countries than non-MNEs with the same level of sales in the US (see Appendix B.1 for more details).

In sum, if what makes comparable US entities choose different global assembly strategies is cross-firm heterogeneity in the fixed cost of assembly, traditional models with cannibalization effects and plant-level fixed costs of exporting and sourcing cannot explain the patterns we have unveiled in the data. Although the above results were derived under heterogeneity in assembly costs is what leads firms with the same level of domestic sales to follow different MNE strategies, similar results are obtained when exploring heterogeneity in plant-level fixed costs of exporting or sourcing.[20]

As mentioned above, the prevalence of MNEs in trade flows is often times also related to the 'vertical' trade within these multinational firms, reflecting either exports by parent companies to their foreign affiliates, or imports by parents from their subsidiaries. Although we do not deny the empirical relevance of these flows, the patterns we unveil persist when we limit the analysis to arm's-length shipments, so they cannot be explained solely trade in inputs between the MNE and its affiliates.

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[20]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 higher fixed costs of sourcing), and thus will tend to be *less* likely to assemble abroad (using that lower core productivity).

Export and Import Intensity   The model's prediction on larger extensive margins of trade also implies that US MNEs will have higher ratios of imports and exports to their domestic sales. Combining equations (9) and (10), we show that the model predicts MNEs' import intensity will be higher and increasing in the number of countries from which they import goods. Similarly, we show that MNEs' export intensity is increasing in the number of countries in which they market goods (see Appendix B.2). The complementarities between the firm's global assembly strategy and both its input and marketing strategies thus imply that MNEs will have higher domestic import and export intensities that are increasing in the number of countries in which they manufacture. The evidence in Table 4 is exactly in line with this prediction, and as discussed above, 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 across plants predict that MNEs will export less intensively than domestic exporters, since their foreign manufacturing plant sales substitute for domestic sales. As for the extensive margin analysis, these results persist when we limit the analysis to arm's-length trade, which rules out intra-firm input shipments to or from affiliates as an explanation.

Extensive Margin of Exports   The model can also rationalize the fact that US MNEs are more likely to export to countries in the same region as their affiliates. Starting with profits in (11), and holding the firm's assembly and sourcing strategies fixed, the change in profits from adding destination market i to the set $\Upsilon(\varphi)$ can be expressed as

$$\Delta\pi\left(\varphi,\Upsilon\left(\varphi\right)\cup i,\mathcal{K}\left(\varphi\right),\mathcal{J}\left(\varphi\right)\right)=\kappa_\pi\varphi^{\sigma-1}E_iP_i^{\sigma-1}\sum_{k\in\mathcal{K}(\varphi)}\left[\xi_k^a\left(\tau_{ki}^a\right)^{1-\sigma}\left(\sum_{j\in\mathcal{J}(\varphi)}\xi_j^s\left(\tau_{jk}^s\right)^{1-\rho}\right)\right]-w_if_i^x.$$

(12)

This marginal benefit is increasing in the firm's core productivity φ and the level of demand in country i $(E_iP_i^{\sigma-1})$, while it is decreasing in the fixed cost $w_if_i^x$. 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 (12) is increasing in the number of activated assembly locations $k\in\mathcal{K}\left(\varphi\right)$, and disproportionately so if the set $\mathcal{K}\left(\varphi\right)$ includes production locations k with high assembly potentials and low bilateral trade costs with i. Similarly, the marginal benefit of activating any destination i is higher the larger the number of countries j in the sourcing strategy, and disproportionately so if $\mathcal{J}\left(\varphi\right)$ includes locations with high sourcing potentials and low bilateral trade costs with countries in which the firm assembles products.

To illustrate the role of firm-level fixed costs in this result, we solve for the same change

in profits from activating an additional export market, 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

$$\Delta \pi \left(\varphi, \Upsilon_k \left(\varphi\right) \cup i, \mathcal{K}\left(\varphi\right), \mathcal{J}_k\left(\varphi\right)\right) = \kappa_\pi \varphi^{\sigma-1} \xi_k^a \left(\tau_{ki}^a\right)^{1-\sigma} E_i P_i^{\sigma-1} \left(\sum_{j \in \mathcal{J}_k(\varphi)} \xi_j^s \left(\tau_{jk}^s\right)^{1-\rho}\right) - w_i f_i^{x,p}. \tag{13}$$

Unlike equation (12) 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 also 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. Lower bilateral trade costs between an affiliate in k and a market i increase the sales from k to i, such that the gains from activating that market are higher for firms with affiliates nearby. The shared fixed cost across plants further implies that an MNE's domestic plants will also sell to i, precisely in line with the results in Table 6.

Extensive Margin of Sourcing   We also analyze the change in firm profits from adding a new source country j to its global assembly strategy $\mathcal{J}\left(\varphi\right)$. Given equation (11), this change in profits is given by

$$\Delta \pi \left(\varphi, \mathcal{K}\left(\varphi\right), \mathcal{J}\left(\varphi\right) \cup j\right) = \kappa_\pi \varphi^{\sigma-1} \xi_j^s \sum_{k \in \mathcal{K}(\varphi)} \left[\left(\tau_{jk}^s\right)^{1-\rho} \xi_k^a \left(\sum_{i \in \Upsilon(\varphi)} \left(\tau_{ki}^a\right)^{1-\sigma} E_i P_i^{\sigma-1}\right)\right] - w_j f_j^s, \tag{14}$$

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. Crucially, that market potential is firm specific and, as explained above, depends on the firm's global marketing strategy. This interdependence arises from the complementarities between the firm's assembly capability and both its sourcing and marketing capabilities. Moreover, the term $\left(\tau_{jk}^s\right)^{1-\rho}$ in equation (14) 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.

As for exporting, this predicting on tilting is absent from models with plant-level fixed costs of sourcing. The change in profits from adding country j to the firm's sourcing strategy when doing so entails a plant-level fixed cost is given by

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

(15)

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 exporting and importing are incurred at the plant rather than firm level, MNEs' plants operate independently from each other, making import and export decisions that are indistinguishable from domestic firms with the same core productivity and fixed cost parameters. In the next section, we demonstrate how these interdependencies create new third market responses to changes in trade policy.

5   Policy Implications

We close our analysis with an example that illustrates how the new source of scale economies in our framework affects firm responses to changes in trade policy. To do so, we compare the effects of tariff changes on trade volumes in our framework with firm-level country-specific fixed costs of sourcing to those from a model with plant-level country-specific fixed costs (such as in 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.

As a result of our assumptions, the only extensive margin decisions the firm faces 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 these firms decisions and how they shape the firm's exports to North as a function of the bilateral trade costs between the South and the North. More specifically, we study how a reduction in bilateral trade costs for final goods (perhaps due to the gradual implementation of a free trade agreement between North and South) affects the firm's exports from the US to one of those countries (the North). When doing comparative statics for a single firm below, we hold constant the market demand level $E_N P_N^{\sigma-1}$ faced by the firm in the North and set $\kappa \varphi^{\sigma-1} E_N P_N^{\sigma-1} = 1$ (remember that wages are also kept unchanged).

We can write the extensive margin problem of the firm as choosing $(\mathcal{I}_N^x, \mathcal{I}_S^a, \mathcal{I}_S^s) \in \{0,1\}^3$ to maximize

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

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 exports from the US to the North. Nevertheless, given the complementarities between the different extensive margin decisions, 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 4 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, but reductions in intermediate input costs would generate similar effects (see Appendix B.3). Under our chosen parameter values, the US plant does not find it optimal to activate North as a destination of sales unless it can share the fixed costs of marketing with a Southern assembly.[21] 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

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[21]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 4: Third Market Effects of Trade Policy Shocks
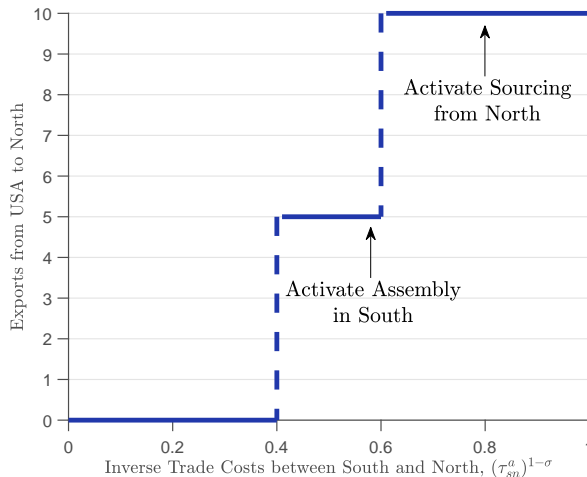
activate assembly in South and at the same time, it activates North as an export destination. The plant's exports thus increase on impact when it becomes a multinational firm. At even lower values of $\tau_{S,N}^a$, the overall sales of the firm are large enough to make sourcing in the North profitable, and the implied marginal-cost reduction benefits both the US and Southern plants of the firm. Thus, the US plant's exports to North again discontinuously jump up. 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.

It is straightforward to demonstrate the importance of the firm-level nature of marketing and of sourcing fixed costs for the patterns in Figure 4. If the fixed costs of marketing in the 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 4, the US plant's exports would remain flat at 0 for any value of $\tau_{S,N}^a$. Similarly, if the fixed costs of sourcing in the North had to be incurred by each plant independently, the decision of the US plant to source from the North would not be shaped by the decision of the Southern assembly plant to source from the North. Given the parameter values in Figure 4, 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 B.3 we demonstrate their generality within our framework, and we also compare them to those delivered by a model of FDI featuring plant-level fixed costs of marketing and of sourcing *and* cannibalization effects. In that model, bilateral trade liberalization between North and South would (weakly) *decrease* US plant exports to either North or South (holding constant the

33

market-demand level faced all firms in those markets).

6   Conclusion

Multinational firms are dominant players in domestic employment, output, and trade. Leveraging newly linked Bureau of Economic Analysis and US Census data, we confirm the quantitative importance of MNEs for the US economy, and document a large, positive, and statistically significant correlation between the countries with which they trade goods and locate their foreign affiliates. Even after controlling for firm and country fixed effects, US MNEs are significantly more likely to import not only from countries in which they have a majority-owned manufacturing affiliate, but also from other countries in their affiliate's region. Foreign MNEs are much more likely to import from their headquarter country, and from other countries in their headquarters region. We find similar extensive-margin patterns for US MNEs' exports.

We develop a multi-country model in which firms jointly decide on the location of their assembly plants (i.e., their assembly strategy) as well as the source of the inputs used in their plants worldwide (i.e., their global sourcing strategy). A key novel feature of our framework is the existence of firm-level economies of scale in firms' global sourcing strategies. A firm incurs a country-specific fixed cost to import inputs, which enables all of its assembly plants to source from that country. This firm-level fixed cost delivers rich complementarities between the global sourcing and global assembly choices of firms, and constitutes a plausible mechanism to explain the strong correlations between import and FDI locations we observe in the data. Our framework also delivers novel predictions on the effects of trade cost changes, for example due to tariff increases, on MNEs' imports and foreign affiliate sales. We show that firm-level fixed costs produce non-monotonic responses to bilateral trade cost changes in firms' imported input shares and affiliate sales. These non-monotonicities arise due to the interdependence in firms' extensive margin sourcing and assembly decisions, and differ from the predictions of a model with plant-level fixed costs.

The distinct responses in our firm-level fixed cost framework highlight the importance of incorporating this new source of firm-level scale economies when studying the effects of trade cost changes in a globalized world with complex supply chains. We hope our framework will prove useful for analyzing how tariff changes may 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. random.

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.[22] 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

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[22]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.

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 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 1.

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.1: 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 Data

MNEs' dominance of trade flows is also evident in the share of firms that engage in trade. Panel A in Table A.2 shows that essentially all US 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.2 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.2: 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.3: 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.

Table A.4 presents import and export statistics for the subset of firms that import from, or export to, *at least two* countries. Panel A of Table A.4 shows that these multi-country importers comprise just over half of all US importers, and an overwhelming 99 percent of total imports.[23]

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[23]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.

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. US MNEs have the most expansive sourcing strategies, importing from an average of 21 and a median of 17 foreign countries.[24]

Panel B of Table A.4 presents comparable statistics for 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.

Table A.4: Import and export statistics in 2007 for US manufacturing firms that import to, or export from, multiple countries, by firm type

Firm Type	Panel A: Import Statistics				Panel B: Export Statistics			
	Share of Aggregate		No. of Countries		Share of Aggregate		No. of Countries	
	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 non-multinationals. '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 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).

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[24]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.

B Theory Appendix

B.1 The Margins of Trade with Cannibalization Effects

In this Appendix we show that, in a version of our model with cannibalization effects, 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.

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 k to i of a firm with productivity φ and assembly and sourcing strategies $\mathcal{K}(\varphi)$ and $\mathcal{J}(\varphi)$ are given by

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

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

$$\Psi_i(\varphi) = \sum_{k'\in\mathcal{K}(\varphi)} \xi_{k'}^a (\tau_{k'i}^a)^{1-\sigma} \sum_{j\in\mathcal{J}(\varphi)} \xi_j^s (\tau_{jk'}^s)^{1-\rho}.$$

Notice that an increase in the sourcing potential of a location $k' \neq k$ belonging to the assembly strategy $\mathcal{K}(\varphi)$ has a *direct* negative impact on the level of sales from k to i.

Now 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 does have foreign assembly plants. We will now compute the ratio of firm sales from a Home market h (US in our empirical application) to any foreign destination market i relative to the firm's sales in its own market h, or domestic sales.

For the non-MNE firm, this ratio is given by

$$\frac{S_{hi}(\varphi_{NM})}{S_{hh}(\varphi_{NM})} = \frac{(\tau_{hi}^a)^{1-\sigma}}{(\tau_{hh}^a)^{1-\sigma}} \left(\frac{(\tau_{hi}^a)^{1-\sigma}}{(\tau_{hh}^a)^{1-\sigma}}\right)^{\theta-1} \frac{E_i(P_i)^{\sigma-1}}{E_h(P_h)^{\sigma-1}},$$

while for the MNE, this ratio is given by

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

The latter ratio will be lower than the former whenever

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

or

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

A sufficient condition for this inequality to hold is

$$\frac{\tau_{ki}^a}{\tau_{hi}^a} < \frac{\tau_{kh}^a}{\tau_{hh}^a} \text{ for all } k,$$

which will hold as long as location k is 'closer' to i than h is, or $\tau_{ki}^a < \tau_{hi}^a$ (since naturally $\tau_{hh}^a < \tau_{kh}^a$).

It is in fact possible to express this condition in a somewhat more intuitive fashion. In particular, consider 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. This condition is

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

but can be written as

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

which simplifies to

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

which is of course identical to (B.1).

We have thus established that it will typically be the case that

$$\frac{S_{hi}(\varphi_M)}{S_{hh}(\varphi_M)} < \frac{S_{hi}(\varphi_{NM})}{S_{hh}(\varphi_{NM})},$$

and thus, holding constant domestic sales – or $S_{hh}(\varphi_M) = S_{hh}(\varphi_{NM})$, the multinational firm will feature lower levels of exports, which will in turn reduce the operating profits associated with exporting, and thus a lower probability of exporting. Furthermore, these lower export flows will translate into lower total sales from the US establishments of these firms, which will in turn lead to lower operating profits, and a lower profitability of selecting into import sources

(given our assumption of independence across input sources). In sum, a US establishment of a MNE will be less likely to export and to import than a non-MNE establishment featuring the same level of domestic sales.

B.2 Export Intensity

In this Appendix we 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

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

and thus it 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

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

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.3 Details on Section 5

[IN CONSTRUCTION]