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Discussion Paper No. 55

November 6, 2017

Collaborative Research Center Transregio 190 | www.rationality-and-competition.de
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November 2, 2017

Abstract

This paper studies the life-cycle dynamics of exporters and multinational enterprises (MNEs). We present a dynamic model of trade and MNE activity in which the mode of serving a market depends on the well-known proximity-concentration tradeoff. We show that the option of performing MNE activities in the model produces life-cycle patterns for exporters that differ from those in an export-only model. Calibrating our model to rich firm-level data from France and Norway, our main quantitative finding is that a reduction in trade costs triggers much larger responses in growth rates and exit rates, for young exporters, in the model with MNEs than in the model without MNEs. We also show that the model is largely consistent with a set of new facts on the joint life-cycle dynamic behavior of exporters and MNEs.

JEL Codes: F1; F2. Key Words: international trade; exporters; multinational firm; Markov process; sunk cost; proximity-concentration tradeoff; trade liberalization.

*We benefited from comments at various seminars. We would like to specially thank Jonathan Vogel for his insightful comments on an early version of the paper, as well as Costas Arkolakis, Kerem Cosar, Javier Cravino, Stefania Garetto, Pinelopi Goldberg, Eduardo Morales, Veronica Rappoport, Andrés Rodríguez-Clare, and Mu-Jeung Yang for their comments and suggestions. We greatly thank Julien Martin for his help with the French data. Haishi Li, as well as Zhida Gui and Xiao Ma, provided outstanding research assistance. This work is supported by a public grant overseen by the French National Research Agency (ANR) as part of the "Investissements d'avenir" program (reference: ANR-10-EQPX-17—Centre d'accès sécurisé aux données—CASD). The empirical analysis with the German data was conducted during visits to the research center of the Deutsche Bundesbank. We gratefully acknowledge the hospitality of the Bundesbank and the access to its Micro-database Direct investment (MiDi). Anna Gumpert gratefully acknowledges the financial support from the Deutsche Forschungsgemeinscheft through CRC TR 190. All errors are our own.

1 Introduction

The analysis of firms' life-cycle dynamics has been crucial to understanding the effects of economic shocks. While the life-cycle dynamics of exporters and domestic firms have been extensively studied and documented, the behavior of multinational enterprises (henceforth, MNEs) over their life cycle has been relatively unexplored. Yet foreign production by MNEs is firms' most frequently chosen mode of serving foreign markets: According to UNCTAD (2013), global sales of MNEs' affiliates are twice as large as global exports, while comprehensive micro-level evidence shows that MNEs account for disproportionally large shares of aggregate output and employment in many countries (Antrás and Yeaple, 2014).

In this paper, we study the life-cycle dynamics of MNEs and exporters in the context of the well-known proximity-concentration tradeoff. In particular, we evaluate the role played by the firm's option to become an MNE in exporters' behavior. We find that including MNEs in an otherwise standard dynamic trade model is quantitatively important to understanding the effects of trade shocks on new exporters dynamics: The life-cycle responses of exports, regarding exit and growth rates, are much larger in a model that allows for the option to serve foreign markets through Foreign Direct Investment (FDI) than in a model in which that option is not present.

We start by documenting new facts on the life-cycle dynamics of MNEs and exporters. We exploit the unique characteristics of firm-level data on domestic firms, exporters, and MNEs from France and Norway and complement them with firm-level data on MNEs from Germany. We uncover three new facts. First, new exporters in a foreign market have two to three times higher exit rates than new affiliates of MNEs in the same market. Second, sales growth profiles are similar between the two groups. Finally, young exporters' exit rates exhibit gravity—that is, they are strongly correlated with foreign market size and distance—whereas those of young MNE affiliates are uncorrelated with these foreign country characteristics. Our findings are strikingly very similar across the three economies under study, despite their different structures.

To capture the patterns observed in the data, we build a model of the dynamics of the proximity-concentration tradeoff, based on the static model of trade and FDI in Helpman et al. (2004, henceforth, HMY). We introduce dynamics by assuming that firm productivity evolves according to a Markov process. The model preserves the ranking on the export and MNE choice from the static model: The most productive firms become MNEs; the middle ones become exporters; and the least productive firms serve only their home market. We compare our dynamic version of HMY to the model without MNEs—that is, a dynamic Melitz-type model. Without the option of becoming MNEs, the most productive firms in this model are exporters. The comparison between the two models reveals that the truncation to the right in the exporters' productivity distribution created by the MNE option modifies the average dynamic behavior of exporters. In particular, new exporters in our model with MNEs can have lower growth—and lower exit—rates than in the model in which firms do not have the option of becoming MNEs simply because the fastest-growing exporters leave the export status and become MNEs. In the long run, the comparison between exporters in the model with and without MNEs boils down to a comparison of the characteristics of exporters in Melitz (2003) and exporters in HMY: Melitz's exporters are larger, on average—and have lower exit rates—than exporters in a world in which the upper right tail becomes MNE.

The effect is quantitatively relevant. Using a calibrated version of our model with MNEs extended to include sunk entry costs both for export and MNE activities and one without the option of performing MNE activities, we show that while the two models do about equally as well in capturing the exit profile of new exporters observed in the data, the model of the proximity-concentration tradeoff captures the sales profile observed for exporters much better.[1] The inclusion of an additional way of serving foreign markets slows down exporters' growth, on average, by 35 percent by age four, according to our calibration based on moments for France. Importantly, new exporters' life-cycle dynamics after a trade shock are starkly different between the dynamic model of the proximity-concentration tradeoff and a dynamic Melitz-type model. In the model with MNEs, moving from a high to a low trade cost environment would drastically increase sales—and drastically decrease exit rates—of exporters, by age four. In contrast, the same trade costs' decrease would barely change exporters' life-cycle behavior in the model without MNEs.

Our mechanism hinges on firms substituting between exports and FDI. Using detailed firm-level, trade, and product data, the literature has documented that FDI substitutes for trade when the cost of trade increases.[2] We complement this evidence with new facts on the life-cycle dynamics of the proximity-concentration tradeoff. When firms open a new affiliate in a foreign country, exports from the parent firm to that country sharply decline relative to foreign affiliate sales. Simultaneously, some of the firms discontinue exporting to the destination market altogether. In further support of the mechanism of the model, we document that exporters that eventually become MNEs already grow much faster

[1] The inclusion of sunk entry costs for MNEs is necessary to match the lower exit rates of MNEs with respect to those of exporters, as well as to capture the fact that young exporters' exit rates follow gravity, while MNEs' do not. Following the literature, we also include sunk entry costs for exporters, but we calibrate them to be virtually zero.

[2] See Gruber and Mutti (1991), Belderbos and Sleuwaegen (1998), Bloningen (2001), Head and Ries (2001), and Amiti and Wakelin (2003), among others.

before MNE entry than do exporters that never become MNEs. This evidence also highlights the importance of distinguishing among different types of exporters when taking trade models to the data.

Our paper contributes to several strands of the literature. First, we contribute to the nascent literature that studies the behavior of exporters and MNEs using dynamic models. Ramondo et al. (2013), Yalcin and Sala (2014), Fillat and Garetto (2015), and Conconi et al. (2016) study the proximity-concentration tradeoff in dynamic setups, but none of them focuses on its consequences for the firm life-cycle behavior.[3] Fillat et al. (2015) and Garetto et al. (2017) do study the life-cycle dynamics of MNEs with a view to their risk-premium implications and the specialization patterns of affiliates over their life-cycle, respectively. Both papers restrict their attention to MNEs and do not include exporting as a mode of entering foreign markets.

Second, we contribute to the extensive literature that studies the dynamics of exporters. Early work by Baldwin (1989), Baldwin and Krugman (1989), and Dixit (1989), followed by more recent work by Ghironi and Melitz (2005), Das et al. (2007), Alessandria and Choi (2007), and Impullitti et al. (2013), point to the importance of the hysteresis created by sunk investments for understanding the effects of temporary and permanent shocks on aggregate trade flows and exchange rate movements. Using data for Colombia, Ruhl and Willis (2017) document facts similar to ours regarding the life-cycle dynamics of exporters, and show that matching the observed new exporters' sales growth entails lower estimates of the sunk entry cost than the ones in the previous literature. All of this literature, in contrast to a recent literature that uses static quantitative models, has been silent on the role played by MNEs. Our findings suggest that MNEs are important for understanding the life-cycle dynamics of exporters and for predicting their responses to trade shocks, such as a trade liberalization episode.

More generally, there is an extensive literature, summarized by Davis and Haltiwanger (1999) and, more recently, by Haltiwanger et al. (2013), that has been long concerned with the life-cycle dynamics of firms, with a particular emphasis on job creation and destruction. This literature has been devoted to closed-economy setups and has barely included in its analysis the different modes of internationalization available to the firm. Our find-

[3] While Ramondo et al. (2013) include aggregate uncertainty to analyze how the properties of the international business cycle affect the choice of the entry mode into foreign markets, Fillat and Garetto (2015) include aggregate uncertainty and sunk entry cost to study the consequences for asset pricing. Conconi et al. (2016) include a learning mechanism to explain the fact that most firms enter foreign markets as exporters before opening an affiliate there. Yalcin and Sala (2014) study the effects of uncertainty on the optimal timing and mode of foreign market entry. Early work by Rob and Vettas (2003) features demand uncertainty together with capacity constraints to study the mechanism behind the choice of firms to export to—and open affiliates in—the same market.

ings suggest that not including options that create selection patterns "to-the-right" in the productivity distribution (i.e., the most productive firms choose to internationalize) may bias the quantitative implications of the closed-economy dynamic models. According to our calibration, the inclusion of MNEs entails young exporters that are, on average, three percent more productive—and 18 percent larger—in their domestic market than young exporters when the MNE option is not available. This result suggests that even including only the export option in those closed-economy models has the potential to quantitatively change the predicted dynamic patterns of the average firm in the domestic market.

The literatures on the life-cycle of both domestic firms and exporters find that models with heterogeneous firms and idiosyncratic Markov productivity process, as in Hopenhayn (1992), deliver new firms that grow too large too fast. Both literatures have resorted to demand frictions to slow down firm growth (see Ruhl and Willis (2017) for exporters and Foster et al. (2016) for domestic firms).[4] We show that it is important to consider the full set of options available to firms to better account for their life-cycle dynamics: Giving exporters the possibility of becoming an MNE, a first-order feature of the data, slows down their life-cycle growth. This finding complements the literature on demand-side factors.

Finally, the creation of superstar firms linked to the rapid increase in globalization and its consequences for aggregate outcomes, such as the decline in manufacturing employment (Boehm et al., 2017) and increasing inequality (Autor et al., 2017), puts selection patterns "to-the-right" at a central stage and gives them the potential to be quantitatively extremely relevant. Indeed, the dynamic effects arising from selection "to-the-right" may come not only from including the different modes of accessing foreign markets to gain customers, but also from the different modes of accessing foreign markets to gain suppliers, such as offshoring, licensing, and other global sourcing strategies. This is an important topic for future research, and its omission has the potential to bias the quantitative implications of closed-economy dynamic models.

The paper proceeds as follows: Section 2 describes the data; Section 3 documents the facts; Section 4 describes the model; Section 5 presents the calibration; Section 6 presents the counterfactual exercises and further evidence; and Section 7 concludes.

[4] See, among others, Cabral and Mata (2003), Atkenson and Kehoe (2005), Arkolakis (2010), Luttmer (2011), Drozd and Nosal (2012), and Gourio and Rudanko (2014). See Syverson (2011) for a survey on productivity-based studies. In relation to exporters' growth driven by demand factors, papers such as Eaton et al. (2014), Albornoz et al. (2012), and Morales et al. (2017) focus on the dynamics of trade associated with learning. Arkolakis (2016) includes the cost of building a customer base in a dynamic model of trade and shows that his model matches several facts on growth, size, and survival observed in the data. Fitzgerald et al. (2017) evaluate the importance of demand learning versus costumer-based firm growth.

2 Data

Our empirical analysis is based on rich firm-level panel datasets from France, Norway, and Germany. Both the French and the Norwegian data contain information on domestic firms, exporters, and MNEs in varying levels of detail. In contrast, the German data contain extremely detailed information on the foreign affiliates of German MNEs, but do not provide any information on exporters and domestic firms. Our analysis exploits the strengths of each of the three data sources, all of which cover a period of more than ten years.

France. The data, which span the years 1999-2011, combine information from several sources. Information on a firm's domestic sales is from FICUS (1999-2007) and FARE (2008-2011); the export data are from the French customs; information on ownership links between firms in France and between firms in France and abroad are from LiFi; and information on foreign affiliate sales is from OFATs (2007, 2009-2011). We restrict the sample to firms that are subject to the BRN-taxation regime and, for some of the analysis, to the sub-period 1999-2007.[5]

The data contain information on each firm's domestic sales and export sales by destination, as well as the location of foreign affiliates of French MNEs. Information on foreign affiliate sales is available only for a subset of large MNEs and for some (non-consecutive) years.[6] While affiliate sales are recorded annually, exports are recorded monthly.

Following Kleinert et al. (2015), we consolidate the information on domestic activities, exports and foreign affiliates to the level of the French group (i.e., if firms A and B belong to firm C, we consolidate all three firms). We keep a consolidated firm in the sample if at least one of its domestic members is active in the manufacturing sector in at least one year.[7] For independent firms, we focus on those that operate in the manufacturing sector in at least one year. Our sample contains only firms headquartered in France and excludes French affiliates of foreign MNEs.

We consider MNE-country pairs and exporter-country pairs with multiple entry and exit

[5] The FICUS/FARE databases provide balance sheet data on virtually all French firms. The principal data source is firms' tax statements. The BRN regime applies to larger firms. We conducted our analysis also including all firms. As small firms rarely export or conduct FDI, results are very similar. The period restriction is made in order to avoid structural breaks in the time series, as both the industry classification and the definition of the domestic sales variable changed in 2008.

[6] OFATS is a survey of French MNEs with affiliates outside of the European Union. The sample is biased towards large MNEs, as a comparison of domestic sales for MNEs in OFATs and the other sources reveals.

[7] This consolidation implies that wholesale firms in France may be part of our sample, which is important because large French groups often channel exports through wholesale affiliates.

over the sample period.[8] We restrict our attention to majority-owned affiliates of French MNEs, which account for around 80 percent of all affiliates of French MNEs. We aggregate both exports and FDI at the parent firm-foreign destination-year level. We end up with a sample of 963,375 firm-year observations. The upper panel of Table D.1 shows that 1.6 percent of firms in our sample are MNEs and 28.7 percent are non-MNE exporters. French MNEs account for almost 60 percent of employment in our sample, while non-MNE exporters account for more than 30 percent. The median (mean) French MNE operates in two (five) markets, with a handful of MNEs serving more than 81 markets, while the median (mean) exporter serves four (ten) markets, with some exporters serving more than 178 markets.[9]

Norway. The data, which span the years 1996-2006, include information on each firm's domestic sales, as well as export and foreign affiliate sales by destination country. The data nest balance sheet information on firms in the Norwegian manufacturing sector from Statistics Norway's Capital Database; information on exporters from customs declarations; and data on firms' foreign operations from the Directorate of Taxes' Foreign Company Report. The coverage is comprehensive: All foreign affiliates of Norwegian firms in the manufacturing sector, as well as 90 percent of Norwegian manufacturing revenues, are included; firms in the oil sector are excluded.

We consider MNE-country pairs and exporter-country pairs with multiple entry and exit over the sample period. We include both majority- and minority-owned foreign affiliates of Norwegian parents and adjust the affiliate sales by the parent's ownership share.[10] Our sample consists of almost 89,018 firm-year observations. As the lower panel of Table D.1 shows, only 1.5 percent of Norwegian firms have affiliates abroad, and 36.4 percent are non-MNE exporters. Norwegian MNEs represent more than 13 percent of total manufacturing employment in Norway, while exporters represent 63 percent. The median (mean) Norwegian MNE operates in two (four) markets, with a maximum at 37 markets, while the median (mean) exporter serves three (seven) markets, with a maximum of 122 markets.

Germany. The data, which span the years 1999-2011, contain detailed balance sheet information about foreign affiliates of German MNEs. The main data source is the Microdatabase Direct investment (MiDi). Information about parent firms is limited; for instance, it is not possible to distinguish between domestic and export sales of the parent.

[8] Restricting the sample to MNE-country and exporter-country pairs with a single entry and exit over the sample period yields very similar results.

[9] To preserve confidentiality, the maximum number of markets cannot be reported.

[10] A 20 percent ownership threshold, not ten percent, is used to distinguish direct from portfolio investment. The ownership shares considered for Norway are lower than the ones for France (20 versus 50 percent) in order to gain observations.

We consolidate the information on direct and indirect ownership shares and restrict our attention to majority-owned affiliates, which represent 95 percent of foreign affiliates of German MNEs, and affiliates whose parent operates in the manufacturing sector, or whose parent is a holding company belonging to a corporate group in the manufacturing sector, in at least one year.[11] We consolidate affiliates at the parent firm-foreign destination-year level, and end up with a sample of 37,843 parent-year observations. Only 0.21 percent of German firms have affiliates abroad, but they account for 27 percent of total sales in Germany (Buch et al., 2005). The median (mean) German MNE operates in one (three) country(ies), with some parents operating in more than 27 markets.[12]

3 Facts on the life-cycle dynamics of exporters and MNEs

We document three novel facts about the life-cycle dynamics of MNEs and exporters related to exit rates, sales growth rates, and the relation between life-cycle variables and the foreign country characteristics. We focus on new firms that start exporting to—or open an affiliate in—a foreign country. We further concentrate on non-MNE exporters and MNEs. That is, we focus on the firm's main mode of international operation: Only firms that are not MNEs are considered exporters to a foreign destination, while firms belonging to the group of MNEs may or may not export contemporaneously to the same foreign destination.

For both France and Norway, 75 percent of MNEs are exporters to the foreign market in which they have an affiliate, and about a third of new affiliates in a foreign market start exports to that market from their headquarter in the year of MNE entry. Observing firms that export and conduct FDI in the same foreign country at the same time could be due to, for example, the shipment of intermediate inputs from the parent to the affiliate (Keller and Yeaple, 2013; Irarrazabal et al., 2013; Ramondo and Rodríguez-Clare, 2013). Unfortunately, data that distinguish between intrafirm and arm's length trade are not systematically available, making the study of the behavior of these flows over the life-cycle of firms impossible. Nonetheless, data from a survey of French MNEs that distinguishes shipments to related parties from shipments to unrelated parties, for the year 1999, reveal

[11] Reporting foreign investments to the German central bank is compulsory, but the reporting requirements change over time. We adjust the sample to unify thresholds: We include only affiliates with either a participation of ten percent and revenues of at least ten million DM (Euro equivalent), or with participation of at least 50 percent and revenues of at least three million Euro. We consolidate ownership shares and restrict the sample to majority-owned affiliates only after unifying the reporting threshold. Additionally, parents change sectors over time: About a fifth of parents in manufacturing in some years switch to a non-manufacturing sector, mainly holding sector, in some other years.

[12] To preserve confidentiality, the maximum number of markets cannot be reported.

that, of the set of firm-destination pairs with a positive amount of intrafirm trade (which indicates that the firm has an affiliate in the foreign market), the average (median) share of intrafirm exports is 71 (98) percent.[13] More than half of firms with intrafirm trade to a foreign destination also export to that destination arm's length, suggesting the presence of shipments from the parent to unrelated parties in a different product than the one produced by the foreign affiliate in the foreign market.[14] Those magnitudes, however, entail arm's length flows that are small for the median parent, almost 30 percent for the mean parent, and concentrated in a few firms.

3.1 Exit rates

We first study the exit patterns of young exporters and young MNEs. We focus on exit from the current mode of international operation (i.e., exporter or MNE) in a given foreign country. Our finding is that:

Fact 1. New MNEs in a foreign destination have lower exit rates than new exporters to that destination.

Figure 1 plots the exit rates for exporters and MNEs, at the firm-destination level, by age. Exit rates are calculated as the number of MNEs (exporters) that exit a given destination relative to the number of active MNEs (exporters) in that destination at each age. Age refers to the number of years after entry in a given market and mode, with age in the entry year equal to zero. The figure presents an average across all firm-destination pairs.

On average, MNEs in a foreign market have half or one third of the exit rates of exporters in the same foreign country in their first year of life. For both modes of internationalization, exit rates are declining with age, though more drastically for exporters.

It is remarkable that the exit patterns are not only qualitatively, but also quantitatively, similar for France and Norway.[15] The exit patterns for young MNEs at the firm-destination level are also remarkably similar to the patterns found for MNEs for Germany (Appendix Figure C.5).

A formal test confirms that French exporters are around 15 percentage points more likely

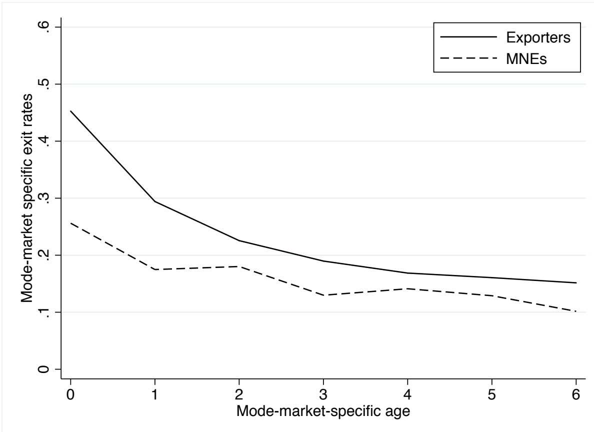
[13] Data for the United States, from the Bureau of Economic Analysis (2004), further reveal that goods for further processing represent more than 90 percent of total intrafirm trade from the U.S. parent to affiliates abroad; the remaining ten percent include goods for resale and capital goods. This evidence suggests that shipments from the parent to the affiliate are mostly related to production sharing.

[14] We are extremely thankful to Julien Martin, who graciously calculated these statistics for us.

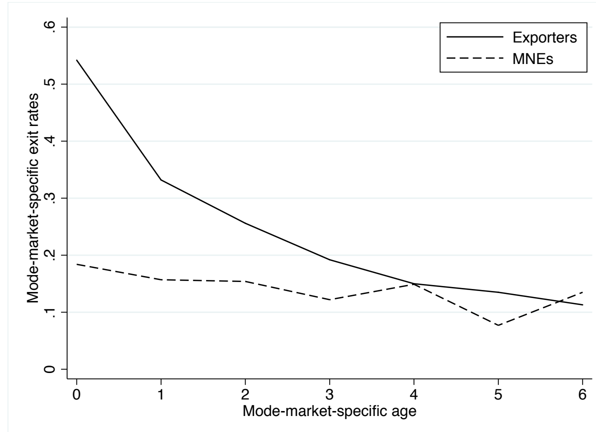
[15] Eaton et al. (2008) document similar exit rates for new Colombian exporters, at the firm-destination level.

Figure 1: Exit rates by age.

(a) France



(b) Norway



Notes: Number of exits from a mode-market relative to the number of firms active in a mode-market, by mode-market-specific age, for exporters and MNEs. Averages across destinations weighted by each destination's share of export (MNE) firms. Exporters refers to non-MNE exporters only.

to exit than foreign affiliates of French MNEs in the first two years after entry, but the difference disappears later in life. For Norway, the difference in exit rates between exporters and MNEs is 30 percentage points at entry, but, after two years, the difference is not statistically different from zero. This finding is summarized in Appendix Figure C.1.

Robustness. One may be concerned that the differences in exit rates documented in Figure 1 are not due to differences between the two modes of internationalization, but that they are artifacts of definitions of age and exit. Firms may switch between modes so that exporters become MNEs, and MNEs become exporters, for example. To exclude such patterns from driving our results, we present two robustness results using the French data. First, we recompute age as the number of years that the firm is active in a market, regardless of its international mode of operation; that is, we compute market-specific, rather than market-mode specific, age. Baseline results still hold, as shown in Appendix Figure C.2a. Second,we redefine exit as complete exit from the market rather than as exit from either exporting or MNE activities in a market. Baseline results still hold, as Appendix Figure C.2b shows.[16] Finally, one may be concerned that the entry mode of FDI plays a role: If MNEs enter a market through Merger and Acquisition (M&A), they take over pre-existing domestic firms, whereas Greenfield affiliates are, by definition, brand-new firms. The German data allow us to explore this distinction. Appendix Figure C.6a shows

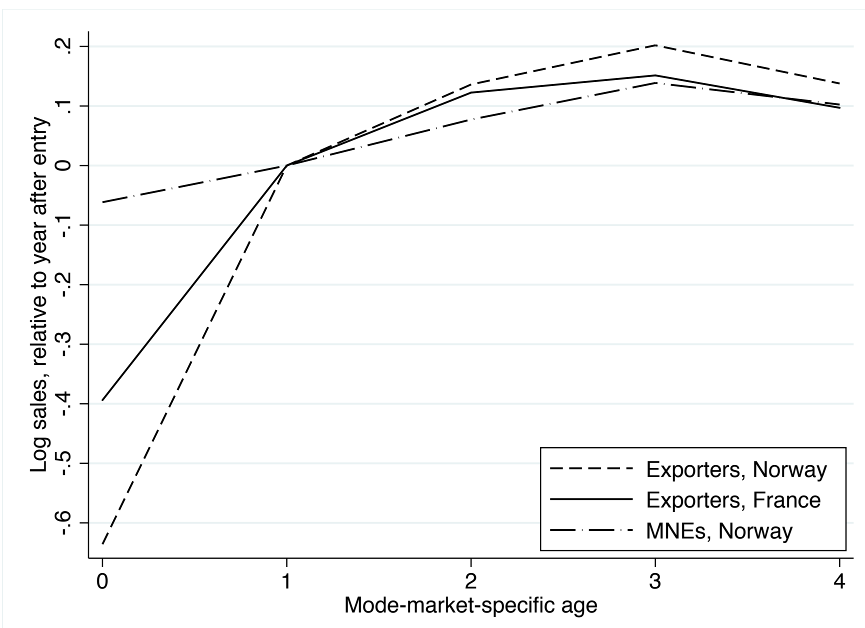
[16] In unreported results for France, we find that our baseline results are robust to: splitting the sample into European Single Market (ESM) and non-ESM countries to address concerns about the different reporting thresholds for exports to EU and non-EU members; using the unconsolidated rather than the consolidated data; and splitting the sample into the 1999-2005 and 2006-2011 periods. Additionally, results at the firm level are very similar to results at the firm-destination level.

that there is no difference in exit rates between the two modes of entry of new affiliates of German MNEs abroad.

3.2 Growth rates

We now analyze the life-cycle sales growth profiles of new MNEs and exporters. Figure 2 shows the sales growth of exporters and MNE affiliates by age. We focus on firms that survive for at least four years in a market-mode to attenuate possible bias created by including low-growth firms that exit the destination immediately upon entry. We demean the firm-destination observations by industry, year, and destination fixed effects. We normalize sales with respect to one year after entry because the entry year may be contaminated, particularly for exporters, by the so-called "partial-year effects"—i.e., artificially high first-year growth rates because of firms that started operations in the middle of the entry year (see Bernard et al., 2017).

Figure 2: Sales growth by age.



Notes: Log of firm-destination export (affiliate) sales with respect to firm-destination export (affiliate) sales in the year after entry, for firms with five or more years in the market, in each mode. Averages across destinations weighted by each destination's share of export (MNE) firms. Log of sales are first demeaned by industry, year, and destination fixed effects. Exporters refers to non-MNE exporters only.

The figure shows that foreign sales grow at similar rates for French exporters, Norwegian exporters, and Norwegian MNEs. Growth rates are markedly different only between age zero and age one, but as outlined above, this difference is likely attributable to partial-year effects. We conclude that:

Fact 2. Life-cycle sales growth for exporters is similar to life-cycle sales growth for MNEs.

Appendix Figure C.5b further shows the comparison between Norway and Germany: Sales profiles for MNEs are quite similar across the two data sources.

Robustness. One may be concerned that normalizing sales growth by the year after entry is not sufficient to adequately account for partial-year effects. As the French data contain monthly export sales, we can correct for partial-year effects using the methodology proposed by Bernard et al. (2017). Appendix Figure C.3a confirms that the entry year does seem contaminated by these effects: Growth at age one is much higher for the calendar-year data than for the adjusted data; for subsequent ages, growth rates are quite similar, which gives confidence in the age-one normalization in Figure 2.

To explore whether affiliate-specific or parent-specific effects drive growth patterns, we show the life-cycle behavior of the ratio of foreign to domestic sales. We find that the ratio of foreign to domestic sales is rather flat and similar for exporters and MNEs, except for the entry year, which, again,may be contaminated for exporters by partial-year effects (Appendix Figure C.3b). This result suggests that factors related to the parent firm are an important driver of sales growth.

To document the selection induced by non-random survival, Appendix Figure C.4 shows growth profiles by tenure in the market. As expected, firms that survive longer grow faster. Notably, the differences are less pronounced for MNEs. Importantly, for all tenure lengths, exports from age one onwards grow at a similar pace as MNE sales.

Finally, one may be rightly concerned that sales growth rates of new MNEs differ between new MNE affiliates that enter the market through M&A versus Greenfield FDI. One may expect that, as brand-new firms, affiliates created through Greenfield FDI grow faster than affiliates created through M&As. Using the German data, Appendix Figure C.6b shows that, as expected, MNEs that enter through M&A grow less than MNEs that enter a market with a Greenfield project. Nonetheless, the differences are not large if one disregards the entry year, again supporting our normalization choice in Figure 2.

3.3 Gravity

The previous two facts pool firms across different destination countries. Country characteristics, however, may be an important determinant of firms' life-cycle decisions. To explore this issue, we study the correlation between the first-year exit rates (i.e., exit rates at age zero) of exporters and MNEs, respectively, and two country characteristics that are prominent in the international trade literature: the size of the receiving country, as measured by GDP; and the distance of the receiving country from the firm's home country. Our finding is that:

Fact 3. Young exporters' exit rates exhibit gravity, whereas MNEs' do not.

Figure 3 shows scatter plots of the first-year exit rate against market size (upper panels), and distance (lower panel). We restrict the sample to countries with at least ten firm-destination observations. We show results for French exporters and MNEs and relegate results for Norway, which are extremely similar, to Appendix Figure C.7.

The cross-country patterns of first-year exit between the two modes of international operation are strikingly different: While exporters operating in smaller and more distant markets are more likely to stop operations right after entry, it is not clear that affiliates of MNEs do. In fact, an Ordinary-Least- Square (OLS) regression shows that the exit probability increases by almost seven percentage points when distance doubles, and it decreases by 3.4 percentage points when GDP doubles, with both coefficients significant at one percent. In contrast, the effects of GDP and distance on the exit rates of MNE affiliates are insignificant.[17]

Robustness. As Figure 3 shows, exporters and MNEs are active in different countries: French firms penetrate many more countries as exporters than as MNEs. To exclude that the difference in country coverage drives the results, we replicate our analysis for only those countries with both exporting and multinational activity. As Appendix Figure C.8 shows, results are robust to considering the same set of countries for exporters and MNEs; the pattern for exporters is less pronounced than in the full sample but is still clearly correlated with country characteristics.[18]

4 The dynamics of the proximity-concentration tradeoff

In this section, we present a dynamic model of exports and MNE activities that builds on the model of the proximity-concentration tradeoff with heterogeneous firms in HMY. As in the original framework, when firms decide to serve foreign markets through exports or FDI, they trade off the magnitude of trade costs versus the magnitude of plant-level fixed costs. Additionally, as in the original framework, the model is exclusively about

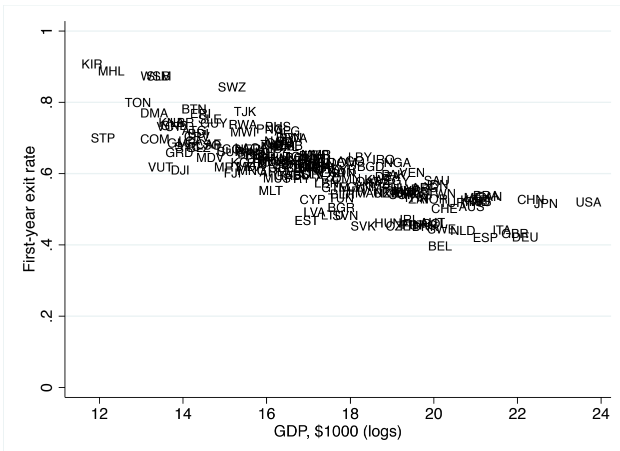
[17] In unreported results, we also find that country characteristics do not significantly affect first-year exit rates of German MNEs.

[18] OLS coefficients for (log) GDP and (log) distance are, respectively, -0.023 (s.e. 0.003) and 0.046 (s.e. 0.005).

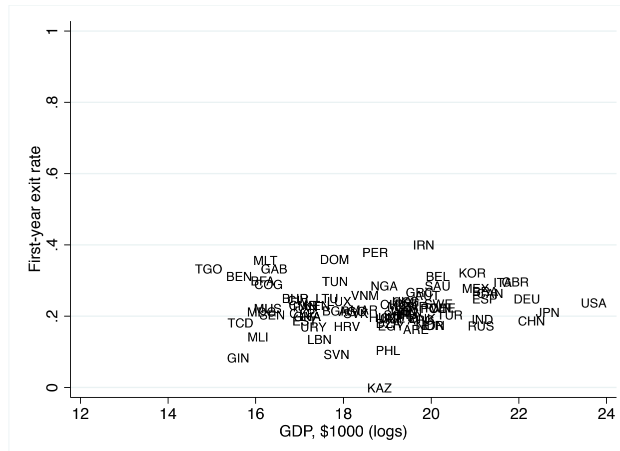
Figure 3: First-year exit rates and market characteristics, France.

Market size

(a) Exporters

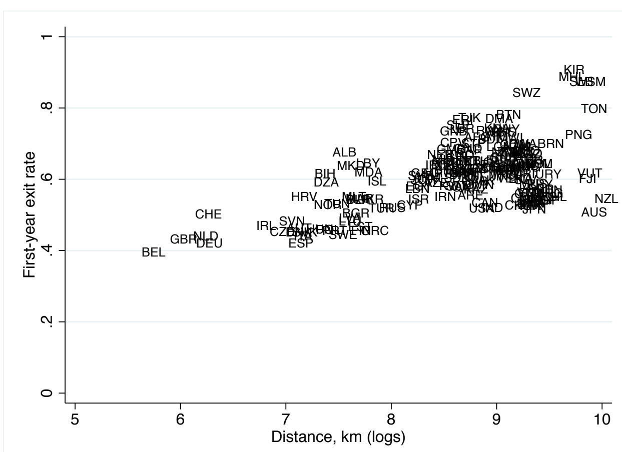


(b) MNEs

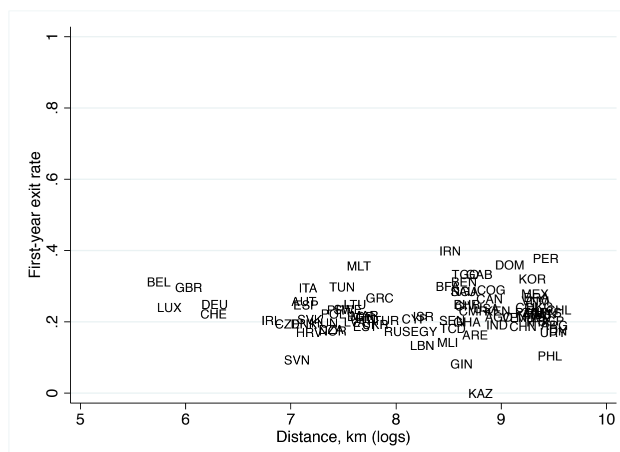


Distance

(c) Exporters



(d) MNEs



Notes: Number of exits from a mode-market relative to the number of firms active in a mode-market, for exporters and MNEs, in the first year upon market-mode entry (i.e., age zero). Destinations with ten or more firm-year observations and with available GDP data. Exporters refers to non-MNE exporters only. GDP data from *International Financial Statistics* (IMF). Distance data from *CEPII* (Mayer and Zignago, 2011).

"horizontal" FDI—i.e., FDI destined to serve the foreign market; export-platforms (i.e., locating production in market l and serving a third market n through exports from l) and production-sharing considerations (i.e., intrafirm trade) are excluded.[19]

We proceed in two steps. First, to better isolate the role played by MNEs, we add a Markov process for firm-level productivity to the model in HMY and show how the option to become an MNE affects the dynamic behavior of exporters. Second, we enrich the model with a sunk entry cost for MNE activities to capture the differences in the exit behavior of MNEs and exporters documented in Facts 1 and 3 in Section 3.

One remark is in place. Being exclusively about substitution forces, our model does not capture simultaneous trade and FDI flows to a given market. Our dynamic model, however, can easily accommodate trade flows in intermediate inputs from the parent to the affiliate: Without aggregate shocks, the way that these flows are introduced in the static models, such as in Irarrazabal et al. (2013) and Ramondo and Rodríguez-Clare (2013), carries over the dynamic setup. We do not incorporate intrafirm flows into the model since data on related-party trade along the life-cycle of the MNE are not available, and, more importantly, these flows do not affect the main mechanism presented below. An additional way of incorporating simultaneous exports and FDI in the same market by the same firm is to consider multi-product firms, as in Tintelnot (2017). We leave multi-product considerations outside of the model for two reasons. First, the evidence presented at the beginning of Section 3 suggests that these flows are small for most of the firm-destination pairs, even though they are concentrated in large firms. And, second, data at the product level for both exports and MNE activities are not available.

4.1 Baseline model

We construct a partial equilibrium model with two countries, Home and Foreign. Time is discrete. Labor is the only factor of production and is supplied in fixed quantity. The wage in each country is pinned down by a constant-return-to-scale freely tradable homogeneous good sector, and normalized to one, $w = 1$.

Goods that are exported to the foreign country are subject to an iceberg-type trade cost, $\tau \geq 1$, while production in foreign affiliates is subject to an efficiency loss given by $\gamma \geq 1$, with $\tau > \gamma$, consistent with the empirical evidence (Antrás and Yeaple, 2014). A firm that exports incurs a per-period fixed cost, f^x, and a firm that operates an affiliate in the

[19] The empirical evidence indicates that most FDI is horizontal: Ramondo et al. (2016) document that the median foreign affiliate of U.S. MNEs ships zero goods to its parent; 66 percent of its sales are devoted to unaffiliated parties in the host market of operations.

foreign country incurs a per-period fixed cost f^m, with $f^m/f^x > (\gamma/\tau)^{\sigma-1}$, as in HMY. Fixed costs are paid in units of labor.

A firm is characterized by a core efficiency level, $\phi \equiv \exp(z)$, that evolves over time following a first-order autoregressive AR(1) process,

$$z' = \rho z + \sigma_\epsilon \epsilon',$$

where $0 \leq \rho < 1$ and $\epsilon' \sim N(0,1)$. If a firm from the Home country opens an affiliate in the Foreign country, that affiliate inherits its parent's productivity process.

There exists a continuum of firms that compete monopolistically, and have access to a continuum of differentiated products. The mass of Home firms, M, is fixed and normalized to one. We assume Constant-Elasticity-of-Substitution (CES) preferences, with the elasticity of substitution denoted by σ. Firms optimally charge a constant mark-up, $\kappa \equiv \sigma/(\sigma-1)$, over marginal costs, so that sales follow the standard CES formula. Let $E \equiv \kappa^{1-\sigma} X/P^{1-\sigma}$ be the size of demand in Foreign. We normalize $E_{home} = 1$ so that E is the size of Foreign relative to Home.

Static profit maximization implies that domestic sales are given by

$$X^d(\phi) = \phi^{\sigma-1}, \tag{1}$$

while exports from Home are

$$X^x(\phi) = E\phi^{\sigma-1}\tau^{1-\sigma}, \tag{2}$$

and sales of Home affiliates in Foreign are

$$X^m(\phi) = E\phi^{\sigma-1}\gamma^{1-\sigma}. \tag{3}$$

Each period, firms decide whether to be domestic and produce in the domestic market for domestic consumers only; or to export and produce in the domestic market for domestic and foreign consumers; or to become an MNE and produce in the domestic market for domestic consumers and in the foreign market for foreign consumers. As there are no sunk costs of entry, these decisions are static: Given their productivity draw, each period, firms decide whether they become MNEs or exporters or stay domestic.

The value of being a firm with productivity ϕ is given by

$$V(\phi) = \frac{X^d(\phi)}{\sigma} + \max\left\{\frac{X^m(\phi)}{\sigma} - f^m, \frac{X^x(\phi)}{\sigma} - f^x, 0\right\} + \beta EV(\phi' \mid \phi). \tag{4}$$

A firm exports whenever $\phi > \bar{\phi}^x$, where the export cutoff is defined by

$$\frac{1}{\sigma} X^x(\bar{\phi}^x) - f^x = 0, \tag{5}$$

while a firm does FDI in the foreign market whenever $\phi > \bar{\phi}^m$, with the MNE cutoff is defined by

$$\frac{1}{\sigma} X^x(\bar{\phi}^m) - f^x = \frac{1}{\sigma} X^m(\bar{\phi}^m) - f^m. \tag{6}$$

Solving for both cutoffs, we get:

$$\bar{\phi}^x = \sigma^{\frac{1}{\sigma-1}} \left(\frac{f^x}{E\tau^{1-\sigma}} \right)^{\frac{1}{\sigma-1}}, \tag{7}$$

and

$$\bar{\phi}^m = \sigma^{\frac{1}{\sigma-1}} \left(\frac{f^x - f^m}{E(\tau^{1-\sigma} - \gamma^{1-\sigma})} \right)^{\frac{1}{\sigma-1}}. \tag{8}$$

As $\tau > \gamma$, foreign affiliate sales are higher than export sales for a given level of productivity. Additionally, the assumption on variable and fixed costs implies that $\bar{\phi}^m > \bar{\phi}^x$, as in HMY, so that MNEs are more productive than exporters. Finally, with symmetric wages, that same assumption ensures that export-platforms are never the preferred option.

The effects of the MNE option on exporters' life-cycle behavior. We now compare a dynamic model with MNEs and exporters to a model with exporters but no MNEs. This amounts to comparing a dynamic HMY model of the proximity-concentration tradeoff with a dynamic Melitz model in which dynamics are introduced as a Markov process for firm-level productivity. The dynamic Melitz model is obtained by simply setting γ (or f^m) to infinity.

In the static setup, comparing the two models would amount to comparing the model in HMY with Melitz (2003). This comparison is useful because the corresponding dynamic models have the same properties in the steady state (across firms of different ages). It is straightforward that, under the same value of parameters, exporters in the Melitz model are, on average, more productive than exporters in a model of the proximity-concentration tradeoff: The most productive firms choose to serve foreign markets through FDI when they are given that additional option and abandon exports. Even in the static model, adding options to the firm's choice set changes the size distribution of exporters. The effect hinges on having the distribution of productivity for exporters truncated to the left and right, rather than just to the left.

As in the static setup, in our baseline dynamic setup, the model without MNEs delivers the same productivity cutoff for export activities as the one in (7). Differences between the two models come from the truncation-to-the-right in the productivity distribution created by the MNE option, given by the cutoff in (8).

The first difference is that the value of the firm in the dynamic model with MNEs is higher than in the dynamic model with only exporters: The maximum operator in the middle term of (4) is over three, rather than two, terms.

The second difference refers to growth rates. Importantly, the model with MNEs delivers the possibility that exporters have lower (geometric) *average* growth rates of productivity than exporters in the model without MNEs. Proposition 1 proves the result for an AR(1) productivity process with enough persistence.

Proposition 1. Assume that firm productivity follows a first-order autoregressive process, $z_{t+1} = \rho z_t + \sigma_\epsilon \epsilon_{t+1}$, with $\epsilon_{t+1} \sim N(0,1)$, and $0 \leq \rho < 1$. For a firm that exports in t and $t-1$, expected productivity growth in a model with only left truncation in the productivity distribution is defined by $\Delta Z_t^L \equiv \mathbb{E}\left(z_t - z_{t-1} \mid z_t > \underline{z}, z_{t-1} > \underline{z}\right)$, while in a model with left and right truncation, $\Delta Z_t^{LR} \equiv \mathbb{E}\left(z_t - z_{t-1} \mid z_t > \underline{z}, z_{t-1} > \underline{z}, z_t < \bar{z}, z_{t-1} < \bar{z}\right)$, with $\underline{z}$ and $\bar{z}$ denoting the left and right truncation points, respectively. Then, there exists ρ^* such that for $\rho > \max(\rho^*, 0)$, $\Delta Z_t^L > \Delta Z_t^{LR}$, and for $\rho = \rho^*$, $\Delta Z_t^L = \Delta Z_t^{LR}$.

Proof. See Appendix A.

Intuitively, the option of becoming an MNE not only truncates the distribution of productivities, but also induces a truncation to-the-right of the export sales growth distribution. Only firms with productivity above the export—but below the MNE—productivity threshold, in two consecutive periods, contribute to export sales growth. For each exporter productivity level z, there is a maximum possible increase in productivity such that the exporter remains an exporter. Exporters that receive a higher productivity shock turn into MNEs when the MNE option is allowed. Those exporters with the highest productivity shocks and, thus, the highest sales growth do not contribute to the average growth rate of exporters in the model with MNEs, but they do so in the model without MNEs. Furthermore, because the maximum possible growth in productivity decreases with productivity levels, smaller exporters that turn into MNEs are the ones contributing to average productivity in the model without MNEs, but they do not contribute to it in the model with MNEs. This effect results in a higher average productivity early in life—and, in turn, lower exit rates—for exporters in the model for which the MNE option is present.

Finally, the effects of changing trade costs on the exporters' dynamic behavior are also different across the model with and without MNEs. Examining the export productivity cutoff in (7) reveals that it increases with τ. In contrast, the MNE productivity cutoff in (8) decreases with τ. Hence, a lower τ increases the MNE productivity cutoff and decreases the export productivity cutoff, decreasing the likelihood of becoming an MNE. In the extreme, for $\tau = 1$, MNEs disappear and the model collapses to the one without MNEs. These effects imply that, on average, exporters' life-cycle profiles are less similar in the models with and without MNEs for high values of trade costs, and become more similar as τ decreases toward one. Additionally, it is worth noting that a change in trade costs produces a much more drastic change in the average life-cycle profiles of exporters in the model with MNEs. This is due, again, simply to changes to the truncation to the right: While the model without MNEs has only one (left) margin moving, the model with MNEs has two (left and right) margins changing at the same time. These changes in cutoffs translate into more pronounced changes in the average growth rate and exit rates along the life cycle of exporters.

Summing up, exporters in the model with MNEs have different life-cycle characteristics from those in the model without MNEs due to the additional truncation-to-the-right created by the option of serving markets through FDI. The mechanism has the potential to better reconcile the canonical model with the data, and to complement other demand-side mechanisms proposed in the literature that have been included in models to bring them closer to the data (see Footnote 4 in the introduction).

The effects created by a problem with additional choices that truncate the distribution of productivity to the right are not specific to the problem of choosing how to serve a foreign market. For instance, firms can be given the option of choosing to source inputs from only the domestic market or from the domestic and foreign markets; firms can be given the option of operating one technology or of choosing from different vintages of a technology; or, households can be given the option of choosing from one occupation or from many occupations.

The relevant question becomes whether, *quantitatively*, the differences created by an additional truncation point are large enough to change the results of the counterfactual exercises. In our context, we are interested in measuring whether a model with MNEs delivers exporters' life-cycle patterns that respond differently to trade shocks—such as a trade liberalization episode—than in a model without MNEs. Sections 5 and 6 are devoted to answering that question.

4.2 Extended model: sunk MNE costs

The dynamic HMY model qualitatively captures some, but not all, of the facts documented in Section 3. In particular, the baseline model is able to capture Fact 2: Conditional on entry, the model predicts equal growth rates for exporters and MNEs. This result arises simply from assuming the same productivity process for domestic, exporting, and MNE firms. The baseline model, however, cannot reproduce Fact 3 that states that exit rates for exporters vary negatively with size and positively with transport costs, while exit rates for MNEs do not; both MNE and exporter exit rates vary systematically with country characteristics. Regarding Fact 1, the baseline model may be able to capture the lower exit rates of new MNEs relative to the ones of new exporters, but most likely, will not reproduce the large difference observed in those exit rates, particularly upon entry.

We extend the baseline model by adding sunk costs for MNE entry. Adding sunk costs turns the MNE problem in a fully dynamic problem. Firms have two possible states: producing in the home market for domestic consumers only and, potentially, for foreign consumers (D); or producing in the home market for domestic consumers and in the foreign market for foreign consumers (M).

The value functions are modified to reflect the presence of sunk MNE costs, $F^m > 0$, which are also paid in units of labor. The value of being a multinational firm with core productivity ϕ is given by

$$V(\phi, M) = \frac{X^d(\phi)}{\sigma} + \max\left\{\frac{X^m(\phi)}{\sigma} - f^m + \beta EV(\phi', M \mid \phi),\right.$$
$$\left.\max(0, \frac{X^x(\phi)}{\sigma} - f^x) + \beta EV(\phi', D \mid \phi)\right\}; \tag{9}$$

and the value of being a domestic firm with core productivity ϕ is given by

$$V(\phi, D) = \frac{X^d(\phi)}{\sigma} + \max\left\{\frac{X^m(\phi)}{\sigma} - f^m - F^m_e + \beta EV(\phi', M \mid \phi),\right.$$
$$\left.\max(0, \frac{X^x(\phi)}{\sigma} - f^x) + \beta EV(\phi', D \mid \phi)\right\}. \tag{10}$$

As is well-known from the literature, a sunk entry cost creates persistence in firms' status. The optimal policy for an MNE is to discontinue the foreign investment if being domestic (state D) entails larger discounted expected profits than being MNE (state M). This policy is characterized by a cutoff value of productivity $\bar{\phi}^m$. If productivity falls below $\bar{\phi}^m$, a current MNE exits the foreign market and produces only in the domestic market. If productivity exceeds $\bar{\phi}^m$, the firm remains an MNE (state M). Similarly, the optimal policy for a domestic firm is characterized by a productivity cutoff level, $\bar{\phi}^m_e$. Once the productivity level of the domestic firm exceeds $\bar{\phi}^m_e$, it becomes an MNE. It is possible to rank the two productivity cut-offs. Since the second terms in the outer maximization problem in (9) and (10), respectively, are identical, and X^m and V are increasing in ϕ, as the expectation operator preserves monotonicity, it follows that $\bar{\phi}^m < \bar{\phi}^m_e$. This implies that the model delivers an "inaction" zone that exists by virtue of the sunk cost of doing FDI. Domestic firms with productivity $\phi \in [\bar{\phi}^m, \bar{\phi}^m_e]$ remain domestic, while MNEs with productivity $\phi \in [\bar{\phi}^m, \bar{\phi}^m_e]$ remain MNEs. The inaction zone, thus, creates persistence in the MNE status.

In the dynamic setup without sunk MNE costs, it suffices to have $f^m/f^x > (\gamma/\tau)^{1-\sigma}$ for MNEs to have a higher exit cutoff than exporters, $\bar{\phi}^m > \bar{\phi}^x$. In the dynamic setup with sunk MNE costs, that assumption is not enough. We proceed by simply assuming that the MNE exit cutoff is higher than the exporter exit cutoff. Nonetheless, we preserve the assumption on parameters made in the static and dynamic setups without sunk costs.[20]

The model with MNE sunk costs gives rise to the possibility that exit rates for MNEs are much lower than for exporters: The presence of sunk costs creates a non-entry/non-exit zone, as shown in Baldwin (1989), that makes MNE exit less likely than in the setup with no sunk costs. This result, however, depends on the values of the model's parameters.

The inclusion of sunk MNE costs allows the model to qualitatively replicate Fact 3: Exit rates of young exporters are correlated with country characteristics, while for MNEs, they are not. The following proposition shows the result.

Proposition 2. Let $\bar{z}$ be the productivity exit cutoff from a mode of international operation. The increase in the first-year exit probability when $\bar{z}$ increases is larger when sunk costs of entry into the mode are zero than when sunk costs are positive.

Proof. See Appendix A.

Because of MNE sunk costs, the productivity level required for MNE entry exceeds the productivity level at exit, $\bar{\phi}^m_e > \bar{\phi}^m$. Conditional on entry, the higher the sunk costs, F^m, the higher the option value of being MNE and, hence, the larger the zone of inaction and the less sensitive the exit behavior to differences in variable profits.

4.3 Additional predictions

The model's mechanism is based on selection on productivity; that is, all new MNEs have received a sufficiently good productivity shock that induces entry. Under the AR(1) assumption for productivity, the firm status before entry plays a role in subsequent life-cycle

[20] The assumption that $\bar{\phi}^m > \bar{\phi}^x$ is implicit in the way we wrote the value functions: It rules out that, for the marginal MNE, the value of producing at home for the domestic market only is higher than the value of producing at home for the domestic and foreign market. In our calibrations and simulations below, this ranking of cutoffs is never violated.

dynamics. In particular, firms that enter MNE status from exporting have, due to their higher productivity, a different life-cycle than firms that enter from domestic activities only.

In this section, we first formally show that firm status matters for the exit behavior of firms, and then we look for support in the data. We show the result for the case with sunk MNE costs, but the result does not hinge on them.

Proposition 3. Assume that a firm switches from exporting to MNE activity. The probability that the new MNE exits upon entry is lower than if the firm had switched from domestic to MNE activity.

Proof. See Appendix A.

The proposition shows, essentially, that if two firms, one with high and one with low productivity, enter the MNE status, the one with lower productivity is more likely to exit upon entry. As long as exporters are more productive than domestic firms, firms that have export experience enter MNE status with a productivity level that is higher than that of a firm with no export experience. Given that productivity follows a Markov process with log-normal distributed shocks, and the exit cutoffs are the same for MNEs with and without export experience, larger firms at the time of entry are less likely to have a productivity draw that falls below the exit cutoff in the subsequent period.

Naturally, Proposition 3 predicts that experienced MNEs should have lower exit rates than non-experienced MNEs upon entry. The data support this prediction. As shown in Appendix Figure C.9, for France, new MNE affiliates with previous export experience in a given foreign market have around ten-percentage-point lower exit rate in the first year after entry than do new MNE affiliates without such experience. The difference disappears as firms grow older.[21] Additionally, it is worth mentioning that new MNEs that have exported to a foreign market before MNE entry represent almost 60 percent of new MNEs for France (47 percent for Norway).[22]

The selection on productivity, together with the sunk MNE costs, leads to additional predictions on the size of MNEs and exporters, respectively, at entry and exit. The presence of sunk MNE costs predicts that MNEs that are larger at entry than at exit, while the lack of sunk export costs predicts that exporters should be of roughly equal size at entry and exit. Table D.2 in the appendix shows the average size at entry and exit for exporters and

[21] Unreported evidence for Norway results in a significant difference in exit rates between experienced and non-experienced MNEs only for the first year after MNE entry.

[22] Most MNEs have one to two years of export experience in a given foreign market. In contrast, it is worth noting that firms that enter a market as exporters after MNE entry represent less than 0.2 percent of new exporters in a market.

MNEs, in their different transitions (e.g., domestic to MNE status). Size is given by (log) domestic sales. MNEs are larger at entry than at exit, clearly supporting our inclusion of sunk MNE costs in the model; exporters are also larger at entry than at exit, but the result is not significant for Norway. Given the mixed evidence, we include sunk export costs in the calibrated version of the model. They will turn out to be virtually zero.

5 Calibration

We next calibrate the model with sunk costs of both MNE and export entry and analyze how well the calibrated model *quantitatively* captures the patterns observed in the data. Appendix B presents the setup and main equations of the full model with export and MNE sunk costs.

We perform two calibrations using moments from France and Norway, alternately, to calibrate the parameters of the model.[23] We quantitatively assess the model by comparing the facts in Section 3 with the ones constructed from the simulated data.

We calibrate the model using the top 15 destination markets for exports and MNEs, plus a sixteenth country constructed as a weighted average of the rest of the world (RoW), both for France and Norway. The top 15 destinations represent more than 75 percent of export and MNE sales.[24]

For each destination, we calibrate the values of the iceberg trade and MNE costs, the per-period export and MNE fixed costs, the sunk costs of MNE and export entry, and the relative market size. Consistent with the model presented in the previous section, the original HMY framework, and the empirical evidence, we focus exclusively on horizontal sales of affiliates and proceed under the assumption that there are no export-platforms sales, so that entry into each destination country can be solved independently from the rest.

Finally, as in the model, we restrict the analysis to a partial equilibrium setting since we are interested in the properties of firm-level dynamics.

[23] We present the calibration for Norway because the information on MNE sales in the French data to construct a life-cycle sales profile is very limited. We are interested, however, in comparing the model with the data in this dimension.

[24] In the French data, it is not possible to distinguish exports to Belgium from exports to Luxembourg. Therefore, we aggregate Belgium-Luxembourg and the Netherlands into one country (Benelux). Due to its increasing importance, we add China to the list of French foreign sales' destination.

5.1 Calibration procedure

We set $\sigma = 4$, which implies a mark-up over unit cost of 33 percent and is the common value estimated for the trade elasticity. The discount factor for firms, captured by the parameter β, is set to 0.95, which is consistent with an interest rate of five percent. The measure of firms M is normalized to one in each country.

The parameters characterizing the Markov process for firm-level productivity, ρ and σ_ϵ, come from estimating a first-order autoregressive process on domestic sales, by OLS, using all French and Norwegian firms (i.e., unbalanced panel). We set $\rho = \rho_{sales}$ and $\sigma_\epsilon = \sigma_{sales}/(\sigma - 1)$. The regression includes year and industry fixed effects, with standard errors clustered at the industry level. For France, $\rho = 0.960$ and $\sigma_\epsilon = 0.197$, while for Norway, our estimates imply that $\rho = 0.957$ and $\sigma_\epsilon = 0.133$.[25]

Given σ, we use the ratio of export to domestic sales, $r_n^x \equiv (X_n^x(\phi)/X^d(\phi))^{\frac{1}{1-\sigma}} = E_n \tau_n^{1-\sigma}$, for firms serving market n, to get an estimate of trade-cost-adjusted market n's size. Analogously, we use the average ratio of MNE to domestic sales, $r_n^m \equiv (X_n^m(\phi)/X^d(\phi))^{\frac{1}{1-\sigma}} = E_n \gamma_n^{1-\sigma}$, for MNE affiliates operating in market n, to get an estimate of MNE-cost-adjusted market n's size.[26] We calculate r_n^x and r_n^m, respectively, as a weighted average across firms serving market n in each mode, with weights given by the firm's domestic sales. For exports, we restrict attention to firms that served market n at least three years in a row. For MNEs, we do not limit the number of years in a market (given the low number of observations on sales for France). Appendix Table D.3 shows the values for r_n^x and r_n^m, for each destination market.

The remaining four parameters of the model are jointly calibrated, for each market: the per-period fixed cost of exporting, f_n^x; the per-period fixed cost of MNE, f_n^m; the MNE sunk cost, F_n^m; and the export sunk cost, F_n^x. We target four moments, for each market: the fraction of non-MNE exporters serving market n; the fraction of French MNEs serving market n; the probability of MNE exit at age zero (i.e., entry year) from market n; and the probability of export exit at age zero from market n. Appendix Table D.4 shows averages across destinations for the four targeted moments, in the model and in the data, as well as the correlation coefficient between data and model, for France and Norway, respectively. Appendix Table D.5 shows the four targeted moments by destination, in the model and data, while Appendix Table D.6 presents the calibrated parameters, for France and Norway, respectively.

[25] Results are very similar if we estimate a Tobit model rather than a linear model.

[26] For France, to gain observations, for some destinations, we impute missing MNE sales using as covariates (log) domestic sales, (log) domestic employment, an interaction of the two previous variables, year and sector fixed effects, for firms surviving at least five years in a foreign destination.

5.2 Calibration results

We find that the calibrated model does well at quantitatively capturing the facts presented in Section 3. We first compare the exit rates of exporters and MNEs, by age, in the data and the model. Our calibration procedure targets exit rates of MNEs and exporters, respectively, *only* at entry. Second, we show that the export sales and affiliate sales (relative to the year after entry), by age, are very similar in the data and the model. Third, we assess the model's ability to capture the observed elasticities of exit rates at entry with respect to country characteristics, for MNEs and exporters, respectively. Finally, we assess the model's ability to capture other non-targeted moments.

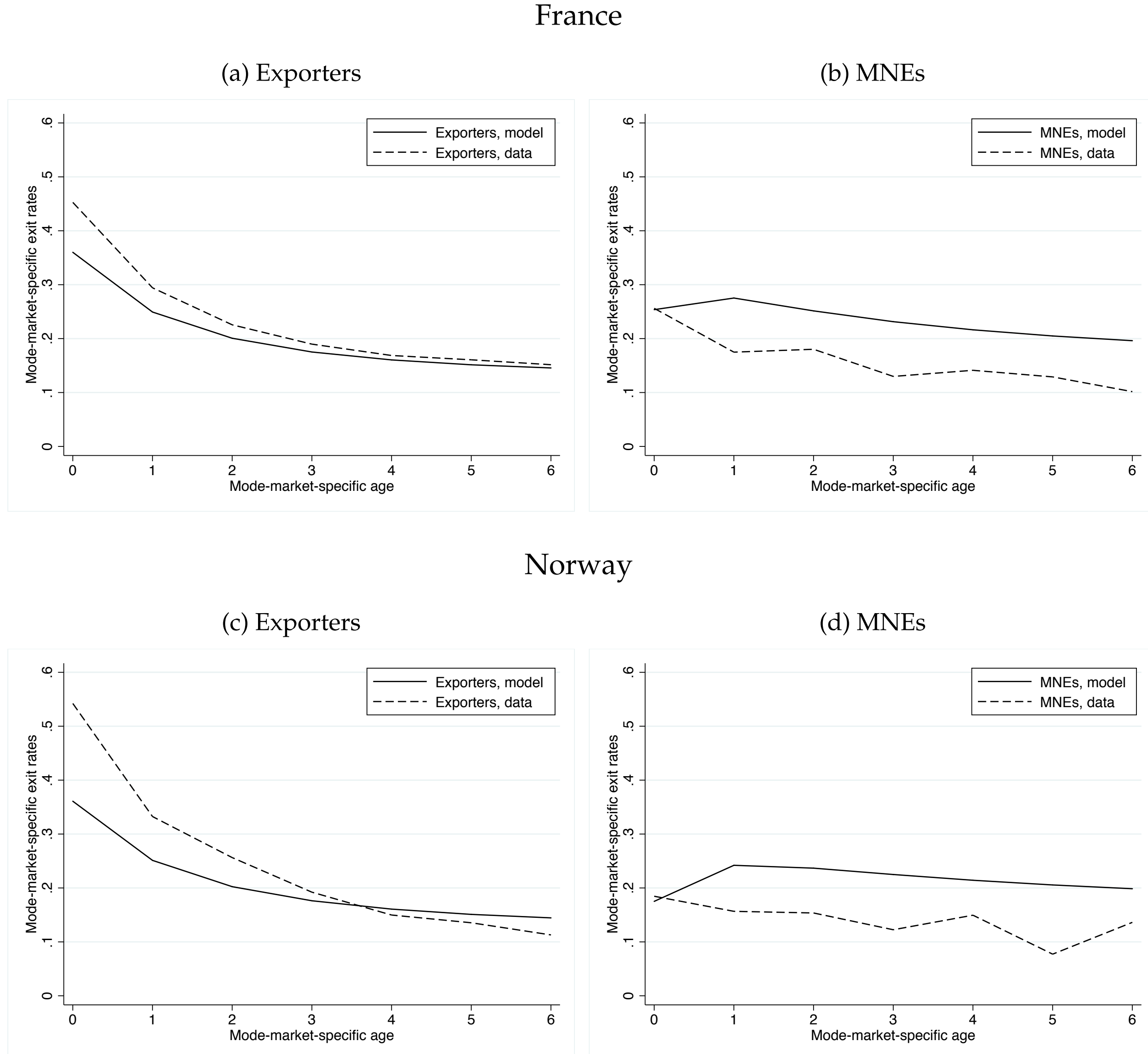
Figure 4 shows that the quantitative model captures fairly well, on average, the exit patterns of young exporters and MNEs. Even with zero calibrated export sunk costs, the model falls short in capturing the high exit rates for exporters at entry. At later ages, the calibrated model closely mimics the data. For MNEs, the calibrated model captures the decline in exit rates with age, except for age one; however, it delivers exit rates that tend to be higher than in the data.

Figure 5 shows the ability of the model to capture the growth profiles for new MNEs and new exporters. We show a geometric average across destination markets and normalize sales with respect to age one (i.e., one year after entry). The model matches the sales profile for exporters remarkably well, even though exporters, by age four, grow faster in the model than in the data. As we will show in the next section, the calibrated model with MNEs improves the fit to the data with respect to a model with only exporters (i.e., a dynamic version of the Melitz model). Additionally, the calibrated model does a fairly good job at picking growth profiles for new MNEs; the smooth growth observed in the data is also present in the model.

To evaluate the model's ability to quantitatively capture Fact 3 in Section 3, we calculate, in the data and in the model, by OLS, the elasticity of exit rates at age zero for exporters (MNEs) on geography-adjusted country size, $r_n^x \equiv E_n \tau_n^{1-\sigma}$ ($r_n^m \equiv E_n \gamma_n^{1-\sigma}$), across the destinations included in our calibration, for Norway and France, respectively. Results are presented in the first rows of Table 1.[27] One has to keep in mind that these regressions have only 16 observations, so they are only suggestive. Still, the model delivers sharper results for exporters than for MNEs, as the theory predicts and our third fact shows: New exporters' exit rates decrease with geography-adjusted country size, while new MNEs'

[27] We evaluate the ability of the calibrated model to replicate those elasticities because, even though we target first-year exit rates in the calibration procedure, the match, particularly for exporters, is not perfect.

Figure 4: Exit rates by age, model and data.



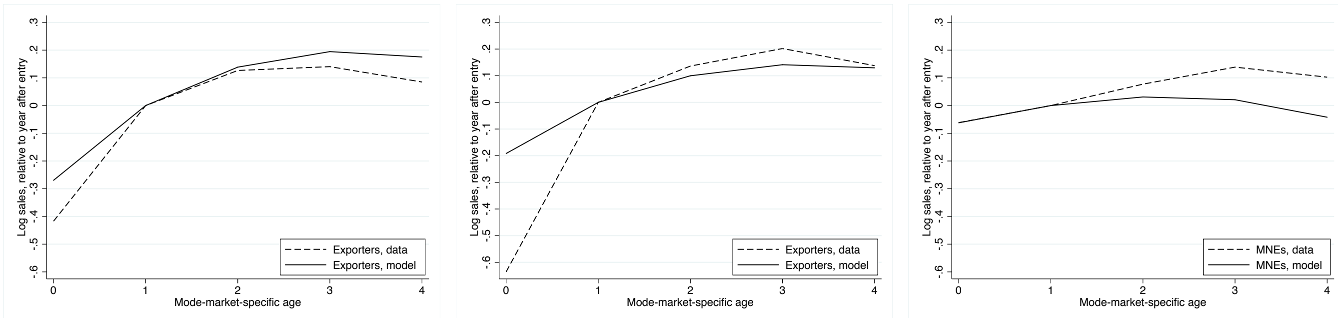
Notes: Number of exits from a mode-market relative to the number of firms active in a mode-market, by mode-market-specific age, for exporters and MNEs. Averages across destinations included in the calibration, weighted by each destination's share of export (MNE) firms. Weights are data-based and model-based, for data and model variables, respectively. Exporters in the data refers to non-MNE exporters only.

exit rates do not have a clear pattern.

Regarding other non-targeted moments in Table 1, as shown in Proposition 3, the calibrated model correctly captures the fact that new experienced MNEs have lower exit rates than non-experienced MNEs. Yet the calibrated model delivers virtually zero new MNEs that were not previously exporters. Additionally, in the data, the share of exporters (MNEs) that start and stop exporting (MNE activity) are very similar. The model captures this fact because, in the stationary equilibrium, these two rates are equal. The calibrated

Figure 5: Sales growth by age, model and data.

(a) Exporters, France (b) Exporters, Norway (c) MNEs, Norway



Notes: Log of firm-destination export (affiliate) sales with respect to firm-destination export (affiliate) sales in the year after entry, for firms with five or more years in the market, in each mode. Averages across destinations included in the calibration, weighted by each destination's share of export (MNE) firms. Weights are data-based and model-based, for data and model variables, respectively. In the data, log of sales are first demeaned by industry, year, and destination fixed effects. Exporters in the data refers to non-MNE exporters only.

model, however, does not capture the higher rates observed for exporters vis-á-vis MNEs. Finally, the model captures rather accurately the transitions from export and domestic status, particularly for France. The model over-predicts the transition from MNE to export status and under-predicts the transition from MNE to domestic status.

Overall, given its parsimony in terms of shocks and number of parameters, the calibrated model does a rather good job of matching the patterns observed in the data.

5.2.1 The size of export and MNE costs

We now evaluate the size of the calibrated per-period fixed costs and sunk entry costs, for exports and MNE activities. We first calculate theses costs in terms of a year of firm sales, and then, we translate them into a monetary value.

Sunk costs, particularly for exports, do not seem to be a heavy burden on firms deciding to internationalize.[28] Fixed operating costs, however, are relatively much larger. Our calibrated per-period and sunk costs for MNEs correspond to an average ratio of productivity, between the marginal firm that enters and the marginal firm that exits MNE status, of 1.14, both for France and Norway, whereas for exporters the analogous ratio is one.

The middle panel of Table 2 shows that, for MNEs, sunk costs represent more than ten percent of year sales for smaller firms and around five percent for larger firms, according

[28] Our estimates are even smaller than the ones in Ruhl and Willis (2017) for Colombian exporters. They use a model like the one we present here, but without MNEs, that they extend to accommodate demand frictions. Their estimate of sunk export costs is of 12,000 U.S. dollars.

Table 1: Additional non-targeted moments, data and model.

	Data		Model	
	France	**Norway**	**France**	**Norway**
Elasticity of first-year exit rates to size-adjusted iceberg costs				
exporters	-0.048*	-0.023	-0.036***	-0.085***
MNEs	0.038	0.063	0.037	0.061
Share of experienced MNEs	0.60	0.47	0.99	0.99
Exit rates at age zero, experienced MNEs	0.21	0.16	0.25	0.18
Exit rates at age zero, non-experienced MNEs	0.29	0.21	0.33	0.24
Stopper rates				
exporters	0.316	0.313	0.210	0.209
MNEs	0.182	0.149	0.231	0.208
Starter rate				
exporters	0.389	0.334	0.210	0.209
MNEs	0.169	0.180	0.231	0.208
Probability of:				
exporter to MNE	0.003	0.002	0.009	0.007
exporter to domestic	0.188	0.275	0.202	0.203
domestic to MNE	2.0e-05	5.0e-04	1.3e-08	3.4e-09
domestic to exporter	0.019	0.102	0.020	0.019
MNE to exporter	0.059	0.069	0.231	0.208
MNE to domestic	0.043	0.049	3e-05	3e-05

Notes: The elasticity of first-year exit rates to geography-adjusted country size (r_n^x and r_n^m, respectively, for exporters and MNEs) is the OLS coefficient of a bivariate regression (with a constant), using the16 countries included in the calibration, for France and Norway, alternately (levels of significance denoted by *** $p < 0.01$, ** $p < 0.05$, and * $p < 0.1$). The fraction of experienced MNEs is calculated as the number of new MNEs of age zero with previous export experience in a market, relative to all new MNEs of age zero entering that market. Stopper (starter) rates are calculated as the share of all exporters (MNEs) that exit (enter) relative to *all* exporters (MNEs), a given destination. The transition probabilities are calculated for *all* firms, a weighted average across destinations: exporter to MNE (domestic) is relative to the number of non-MNE exporters; domestic to MNE (exporter) is relative to the number of domestic firms; and MNE to exporter (domestic) is relative to the number of MNEs. Averages across destinations included in the calibration, weighted by each destination's share of export (MNE) firms. Weights are data-based and model-based, for data and model variables, respectively. Exporters in the data refers to non-MNE exporters only.

Table 2: The size of calibrated costs.

	Norway				France			
	f_n^x	f_n^m	F_n^x	F_n^m	f_n^x	f_n^m	F_n^x	F_n^m
Calibrated values								
average	0.067	3.514	0.0003	2.159	0.119	5.42	0.0001	2.849
Values as % of sales								
25th sales pc	23.5	18.6	0.10	11.4	17.7	13.0	0.014	6.8
50th sales pc	17.8	15.3	0.07	9.4	11.6	9.8	0.009	5.2
75th sales pc	11.8	11.4	0.05	7.0	6.2	6.3	0.005	3.3
90th sales pc	7.6	8.0	0.03	4.9	3.2	3.6	0.002	1.9
Values in U.S. dollars								
25th sales pc	1,309	386,324	5	237,429	2,054	561,672*	2	295,217*
50th sales pc	5,991	1,107,230	24	680,488	7,632	1,401,336*	6	736,548*
75th sales pc	26,981	2,995,292	110	1,840,863	22,486	2,624,685*	17	1,379,545*
90th sales pc	87,376	7,160,481	356	4,400,728	54,575	4,808,348*	42	2,527,287*

Notes: f_n^x are per-period fixed export costs; f_n^m are per-period fixed MNE costs; F_n^x are sunk export costs; and F_n^m are sunk MNE costs. Sales percentiles are with respect to the export sales distribution, for the case of costs related to exports, and for the MNE sales distribution, for the case of costs related to MNEs. The values in U.S. dollars for different percentiles are calculated using the values of sales in the data, transformed to U.S. dollars using an average of the annual exchange rate observed over our sample period, from Penn World Tables 9.0 (Feenstra et al., 2015). (*) estimated values assuming that the xth pc of the MNE sales distribution is proportional to the xth pc of the export sale distribution, with the proportionality factor calculated using the ratio of export to MNE sales for each percentile, for Norway. Averages across destinations included in the calibration, weighted by each destination's share of export (MNE) firms. Weights are data-based and model-based, for data and model variables, respectively.

to our calibration for Norway. For French MNEs, in terms of sales, our calibration suggests that these sunk costs are half those faced by Norwegian MNEs. In monetary terms, for Norwegian MNEs, sunk costs range from less than 300,000 to almost five million U.S. dollars. In contrast, the calibrated sunk export costs are very small, around 0.1 percent of export sales in a given year. Per-period costs represent around six percent of foreign sales for large Norwegian exporters and reach almost 20 percent for small exporters; per-period MNEs costs are slightly larger. Our calibrated values for French exporters and MNEs entail lower per-period costs, in terms of year sales, than for Norwegian firms. In monetary terms, given the difference in size between MNEs and exporters, per-period fixed costs for exporters are only 70,000 U.S. dollars for the 90th percentile of Norwegian exporters, but reach almost eight million U.S. dollars for the largest MNEs. Appendix Table D.7 presents results by destination market for the median exporter (MNE) in terms of sales in each destination.

6 The role of MNEs in new exporters' dynamics

Armed with the calibrated model, we *quantitatively* analyze the role of MNEs in the life-cycle dynamics of exporters. This is analogous to saying that we evaluate the importance of the dynamics of the proximity-concentration tradeoff. To this end, we compare our calibrated model with a calibrated version of the model with only exporters. We first show that the calibrated model with MNEs matches the data on exporters' life-cycle sales profiles better than the calibrated model without MNEs. More importantly, having both calibrated models, we show that not including FDI as an option to serve foreign markets has consequences for the counterfactual exercises. That is, we show the importance of including "truncation to the right" in the productivity distribution of exporters. In particular, our exercises show that the properties of the (steady-state) life-cycle dynamics for exporters before and after a trade-liberalization episode differ greatly between the model with only exporters and the model with both exporters and MNEs. Finally, we also analyze whether exporters have a role in MNE dynamics; the answer is negative, reinforcing the powerful effects of having both-sided truncation problems.

The model with only exporters is calibrated to match the share and the exit probability of exporters at age zero, in each market n, observed in the data. In this way, we pin down the per-period fixed cost of exporting, f_n^x and the sunk export cost, F_n^x; all remaining parameters are calibrated as in the baseline calibration. The calibrated model with only exporters matches the export-related targeted and non-targeted moments in Tables D.4 and 1, respectively, equally well as the baseline model with MNEs (not shown). Appendix Table D.6 shows the calibrated values for f_n^x and F_n^x for the model without MNEs. As expected, the calibrated values for the fixed costs of exporting are larger in the model without MNEs than in the model with MNEs, whereas the sunk costs of export entry are virtually zero in both models.

Next, we turn to the two key facts on exporters' life-cycle dynamics: exit rates and sales growth.

Figure 6a compares exit rates for exporters, averaged across destination markets, in the data and in the calibrated model with and without MNEs, for France. Appendix Figure C.10 shows results by destination market. There is barely any difference in the pattern of exit for young exporters across the two models. Both models fail to capture the high exit rates of exporters at age one, but improve substantially in matching exit rates for older ages. Results for Norway are in Appendix Figure C.13a.

In contrast, there are substantial differences between the two calibrated models for the export sales profile shown in Figure 6b: The model with MNEs produces sales profiles for exporters that are flatter and closer to the data. This finding reflects Proposition 1, which predicts that a model with left and right truncation yields exporters that grow more slowly than exporters in a model with only left truncation, given an AR(1) productivity process with enough persistence. Notably, our calibrations suggest that, *quantitatively*, the effect is large: We obtain a difference of almost ten percentage points by age four, on average, for France.[29] Differences are even larger when we consider some popular destinations for French exports: Inspecting Appendix Figure C.11 reveals, for instance, that when we consider the United States as the destination for French exports, the model without MNEs delivers sales, relative to age one, that are 15 percentage points higher than in the model with MNEs. Results for Norway are in Appendix Figure C.13b.[30]

Additionally, as Appendix Figure C.12 shows, differences between the two models increase with years of tenure in the market. That is, for exporters that survive at least two years in a market, by age two, average exports (relative to the year after entry) are only one percentage point lower in the model with MNEs. But for exporters that survive at least seven years in a market, the difference between the two models reaches ten percentage points by age two and twenty percentage points by age seven.

One remark is in order. In the theory, we showed comparative statics results; that is, we compared the model with and without exporters for the same set of parameters. We did not consider the case in which the two models deliver the same share of exporters which entails to adjust parameters accordingly. This readjustment is what the calibration does. In the model of Section 4 without sunk costs, it is easy to compute the parameters' change needed to get the same share of exporters in both models. Simply, one needs to equate $1 - G(\bar{\phi}^{x'}) = G(\bar{\phi}^m) - G(\bar{\phi}^x)$, where the productivity cutoffs are given by (7) and (8), respectively, and the "prime" denotes the equilibrium with only exporters. Given the values for γ and τ, f^x has to be larger in the model without MNEs than in the model with MNEs to keep the exporters' share constant. As a consequence, exit rates (to domestic status) are larger—and growth rates are lower—in the recalibrated model than in the model without the recalibration because it delivers exporters that are, on average, more productive.

Perhaps not surprisingly, the calibrated models show more similar growth patterns when we compare new exporters that eventually become MNEs in the model with MNEs, with

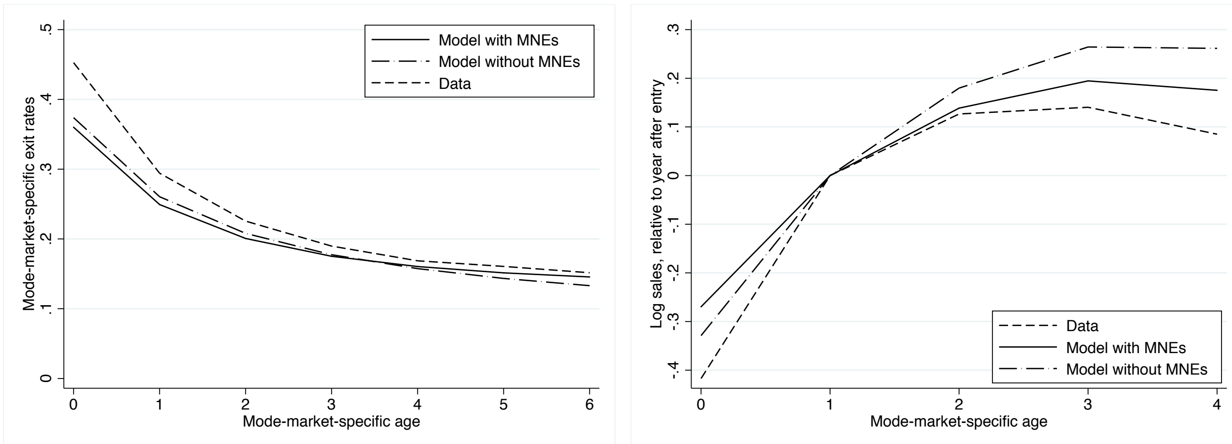
[29] Differences would be even more dramatic if averages across export sales were weighed by firm size at entry.

[30] For Norway, differences between the two calibrated models are, on average, less pronounced, but for some popular destinations, such as Great Britain and France, differences reached almost ten percentage points (not shown).

Figure 6: The role of MNEs in new exporters' dynamics.

(a) New exporters' exit rates

(b) New exporters' sales growth

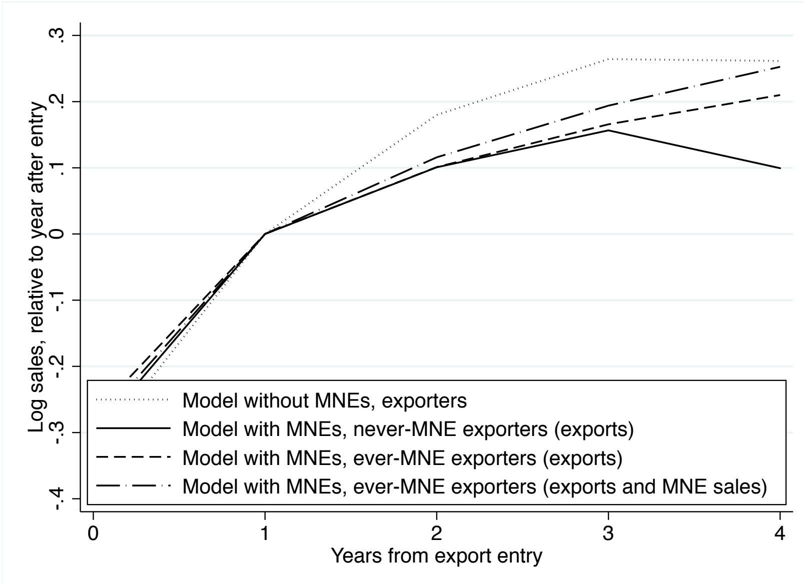


Notes: Models calibrated to French data. (6a): number of exits from a mode-market relative to the number of firms active in a mode-market, by mode-market-specific age. (6b): log of firm-destination export sales with respect to firm-destination export sales in the year after entry, an average over firms with five or more years in the market. In the data, log of sales are first demeaned by industry, year, and destination fixed effects.
Averages across destinations included in the calibration, weighted by each destination's share of export firms. Weights are data-based and model-based, for data and model variables, respectively. Exporters in the data refers to non-MNE exporters only.

exporters in the model without MNEs. The ever-MNE exporters exhibit a sales growth profile along their life cycle that is steeper than that of new exporters that never change to MNE status (i.e., the bulk of exporters). We observe this pattern not only for the part of their life in which they serve the foreign market as exporters, but also for the period in which they become MNEs, as indicated by the dashed and long-dashed lines, respectively, in Figure 7 (Appendix Figure C.14 reports results for Norway). The sales profiles for these ever-MNE exporters are closer to those in the model without MNEs (i.e., the model without "truncation to the right"), particularly for older ages. In the next section, we provide empirical evidence on this prediction of the model.

The presence of an additional option to serve foreign markets has consequences for the average productivity of young exporters in the domestic market. For France, a comparison of our calibrated models with and without exporters suggests that, while in the entry year, exporters in the model with MNEs are, on average, three percent more productive—and almost 20 percent larger—than in the model without MNEs, by age ten, as a consequence of their slower growth rate, they are eight percent less productive—and two thirds their size. This result implies that, by not including MNEs, dynamic trade models may be biased in their results regarding the productivity distribution of firms in the domestic

Figure 7: Exporters' sales growth by age and type, calibrated models.



Notes: Models calibrated to French data. Log of firm-destination export (export and MNE) sales with respect to firm-destination export sales in the year after export entry, an average over firms with five or more years in the market as exporters. Averages across destinations included in the calibration, weighted by each destination's share of export firms. Weights are model-based. Never-MNE exporters are exporters that, in our sample period, do not change to MNE status. Ever-MNE exporters are exporters that become MNEs after export entry. Exports for ever-MNE exporters are computed for the years before MNE entry. Exporters in the data refers to non-MNE exporters only.

market. The argument is more general, as it can be extended to closed-economy life-cycle dynamic models. Our quantitative results suggest that adding "truncation-to-the-right" to the firms' problem has the potential of changing the quantitative implications of the closed-economy models.

In conclusion, adding the option of serving foreign markets through FDI slows down exporters' growth in a calibrated version of the canonical model of trade. This result is achieved without resorting to demand-side frictions which, naturally, may complement our mechanism. Crucially, as we show next, the differences between the two calibrated models are quantitatively large enough to change the results of some common counterfactual exercises in the trade literature.

6.1 The effects of trade liberalization

The differences in the life-cycle patterns of exporters between the model with and without MNEs have important consequences for the life-cycle responses of these groups of firms to a (permanent) trade-liberalization episode. To evaluate the effects, we perform two related exercises.

In our first exercise, we simulate the calibrated models with and without MNEs for an increase–and a decrease—of 30 percent in iceberg trade costs, τ_n, for all destinations n. We then compute the steady-state exit rates and sales profiles, by age, for exporters, in both models. Figure 8 shows the results using the models calibrated to French moments; Appendix Figure C.15 shows the results using the models calibrated to the Norwegian data.

The first result to note is that differences between the two models are larger in an environment with high iceberg trade costs, as also suggested by the theory. Second, if one were to move from an environment with high trade costs to one with low trade costs, a model without MNEs would predict that new exporters have similar life-cycle patterns. In the model with MNEs, however, new exporters would drastically change their life-cycle patterns: Exit rates by age would be greatly reduced and sales growth greatly increased.

The results in Figure 8 also show the effects of liberalizing MNE activities on exporters' life-cycle dynamics. In particular, moving from the model without MNEs to the one with MNEs would imply a small decrease in the exit rates of young exporters but a drastic decrease in their growth rates: by age five, a 20-percentage-point decrease for an environment with low trade costs, and an almost 40-percentage-point decrease for an environment with high trade costs. Relatedly, one can ask how much exporters' life-cycle patterns would change if one liberalized only trade or trade and MNEs activities together. The answer is: for the former case, not much; for the latter, a lot.

Our second exercise compares exporters' behavior in their first and tenth year of export activity in the models with and without MNEs, as a function of the export-to-domestic sales ratio, which, in the model, equals $E_n\tau_n^{1-\sigma}$. This exercise is equivalent to computing exporters' exit and growth rates, respectively, at age zero and ten, for different values of variable trade costs, ranging from frictionless trade to high trade cost values. Figure 9 shows the results for France. Results for Norway, which are very similar, are relegated to Appendix Figure C.16.[31]

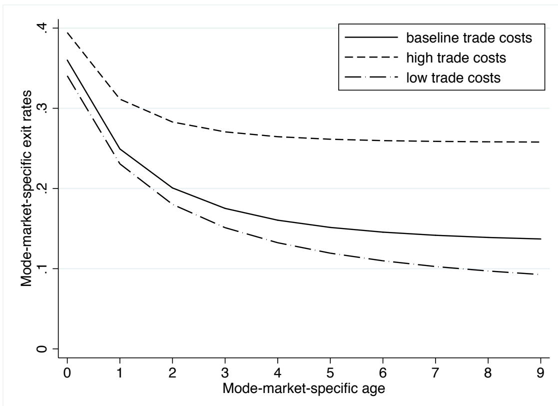
At entry, exporters' exit rates are very similar across the two models, regardless of the level of the variable trade costs. In contrast, growth rates are higher in the model without MNEs, and do not change as much with changes in the trade regime. Ten years after entry, exit rates are five percentage points higher in the model with MNEs for environments with high trade costs, while sales, relative to entry, are ten percentage points lower. The message is similar to the one in Figure 8: In the model with MNEs, moving from autarky

[31] Because the transition to MNE status is not very common, the models with and without MNEs deliver very similar exporters' participation rates.

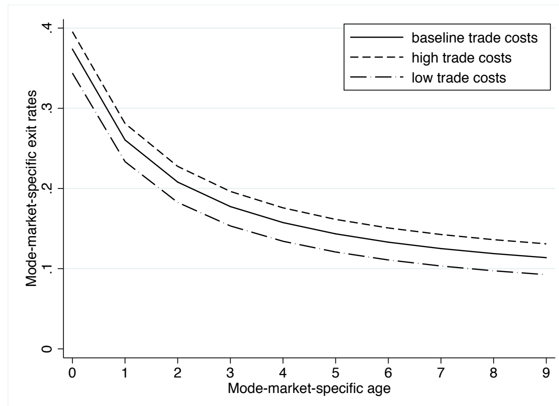
Figure 8: New exporters' dynamics, high and low iceberg trade costs.

New exporters' exit rates

(a) Model with MNEs

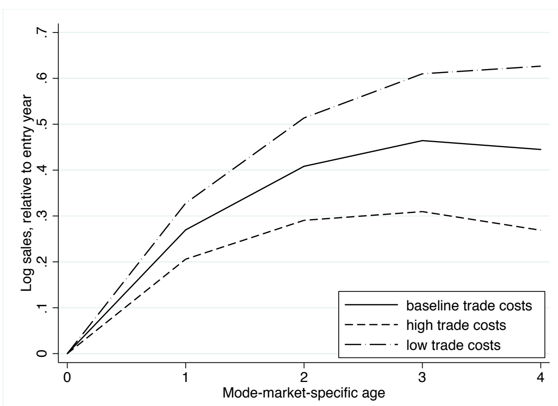


(b) Model without MNEs

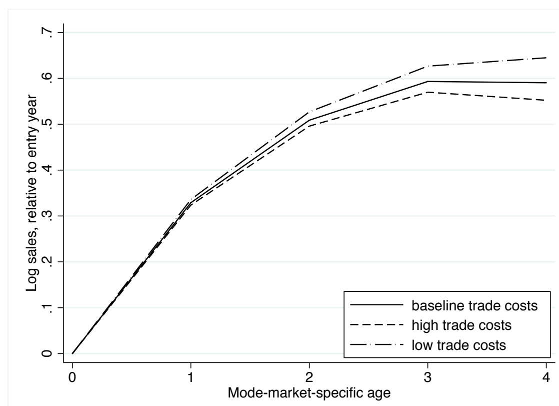


New exporters' sales growth

(c) Model with MNEs



(d) Model without MNEs



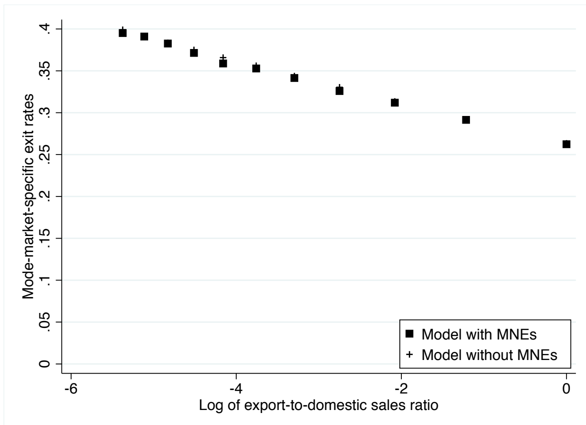
Notes: Models calibrated to French data. Upper panels: number of exits from a mode-market relative to the number of firms active in a mode-market, by mode-market-specific age. Lower panels: log of firm-destination export sales with respect to firm-destination export (affiliate) sales in the year after entry, an average over firms with five or more years in the market.
Averages across destinations included in the calibration, weighted by each destination's share of export firms. Weights are model-based. High, low, and baseline trade costs refer, respectively, to iceberg trade costs, τ_n, which are 30 percent higher, 30 percent lower, and equal to the baseline calibrated values, for each destination n.

to frictionless trade will drastically change the life-cycle dynamics of young exporters, while the model without MNEs predicts much smaller changes.

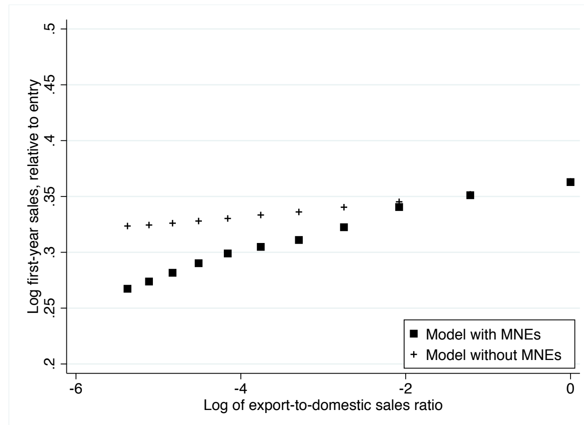
Figure 9: New exporters' dynamics, comparative statics.

First year after export entry

(a) Exporters' exit rates

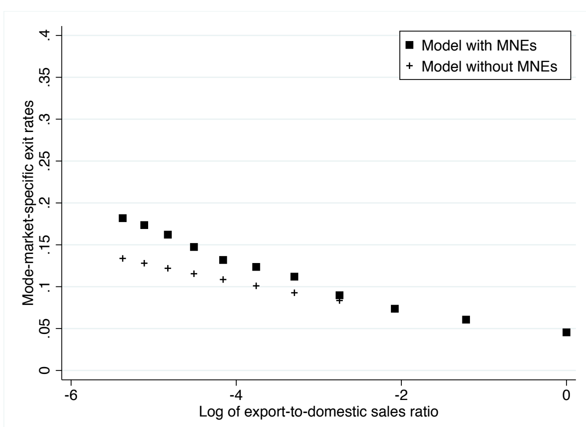


(b) Exporters' sales, relative to entry

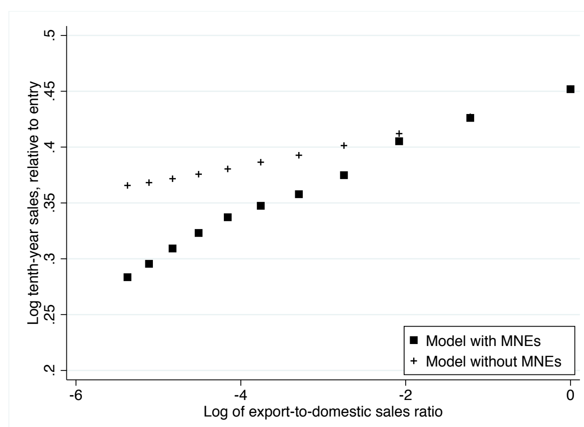


Tenth year after export entry

(c) Exporters' exit rates



(d) Exporters' sales, relative to entry



Notes: Models calibrated to French data. (9a) and (9c): number of exits from a mode-market relative to the number of firms active in a mode-market, at age zero. (9b) and (9d): log of firm-destination export sales with respect to firm-destination export sales at age zero, an average over firms with five or more years in the market.
Averages across destinations included in the calibration, weighted by each destination's share of export firms. Weights are model-based.

Finally, we show a comparison between our calibrated model with exporters and MNEs and a calibrated model with only MNEs. We recalibrate the parameters of the only-MNE model in order to match the MNE shares and first-year exit rates observed in the data, and we compare MNEs' life-cycle exit and growth rates across the two models. Not surprisingly, Appendix Figure C.17 shows that, in terms of the dynamic behavior of young MNEs, there is no difference between the model with exporters and MNEs and the model without exporters: MNEs are not subject to truncation-to-the-right in either model.[32]

6.2 Evidence on the dynamics of the proximity-concentration tradeoff

The effects of adding the option of becoming an MNE on exporter sales growth hinges on the assumption that giving the firms the additional choice of serving foreign markets through FDI induces truncation to the right of the export productivity distribution. In this section, we present evidence on the substitution forces between export and MNE activities that are behind the proximity-concentration tradeoff. While the existence of this tradeoff has been documented in static setups, as referenced in Footnote 2, there is no equivalent evidence for dynamic setups.[33] We present evidence related to the life-cycle dynamics of the proximity-concentration tradeoff, which are new to the literature.

The dynamic model of the proximity-concentration tradeoff predicts that exporters that become MNEs substitute away from exporting and sell to the foreign market by setting up local production facilities. Using data on life-cycle export and MNE sales, which is available only for Norway, we explore the behavior of the export-to-foreign affiliate sales ratio after MNE entry. Figure 10a shows that, on average, firms that enter a market through FDI reduce export sales from the parent to that market, relative to MNE sales, by almost 15 percentage points. The median MNE shows a reduction in the ratio of export to MNE sales of more than 25 percentage points. Additionally, as Figure 10b shows, some new MNEs discontinue exporting altogether: Around ten percent of firms that enter a market through FDI and were exporting in the period before entry discontinue exporting.[34]

At the core of the model's mechanism is the self-selection of fast-growing exporters into MNE activities. Essentially, the average sales growth rates of exporters in the dynamic HMY-type model are lower than the average sales growth rates of exporters in a dynamic Melitz (2003)-type model because the fastest-growing exporters become MNEs. To

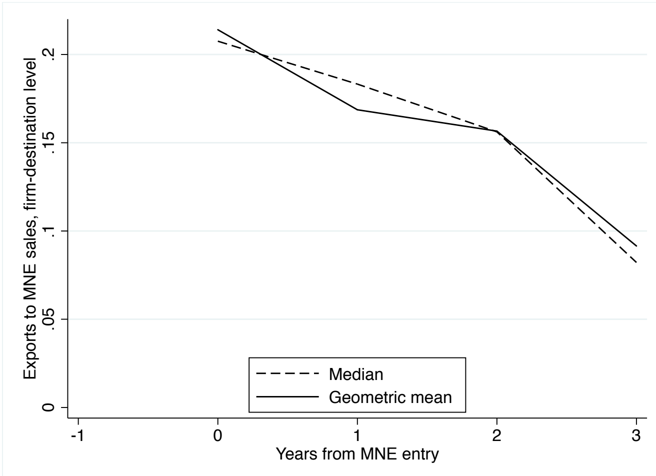
[32] Unreported results for Norway are extremely similar.

[33] In the aggregate data, trade and multinational activity across country pairs, are positively and strongly correlated. However, as Head and Ries (2004) notice, in static models, this is not at odds with the presence of substitution forces. The effect is difficult to disentangle in the aggregate data, mainly due to the presence of multiple products and vertical production chains. In fact, papers that use detailed firm-level, trade, and product data do find that FDI substitutes for trade when the cost of trade increases.

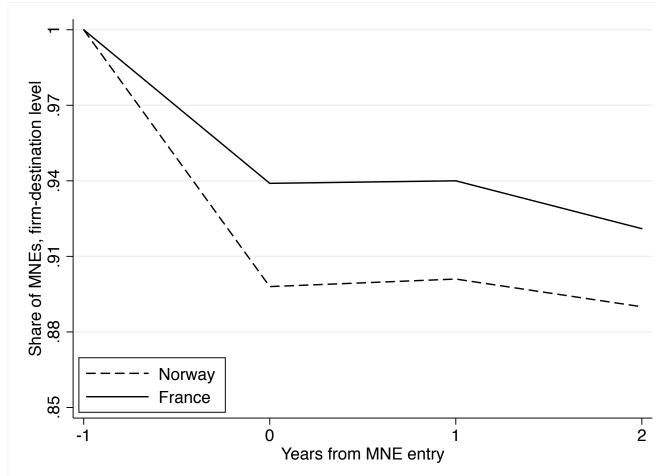
[34] As mentioned at the beginning of Section 3, more than 30 percent of new MNEs start to export simultaneously from the parent to the same market where the affiliate is located. The evidence cited in that section suggests that this new trade from the parent to the the market where the affiliate operates is related to production sharing, for the vast majority of firms.

Figure 10: Substitution between export and MNE activities along the firm's life cycle.

(a) Export-to-MNE sales ratio, Norway



(b) Share of firms that export before MNE entry



Notes: (10a): ratio of exports-to-MNE sales, by years from MNE entry, at the firm-destination level, average over MNE-destination pairs with at least five years in the market and having exports when they enter MNE status. (10b): export participation rates of MNEs that export in the year before MNE entry, by years from MNE entry, for firm-destination pairs that survive at least five years as MNEs in a market.

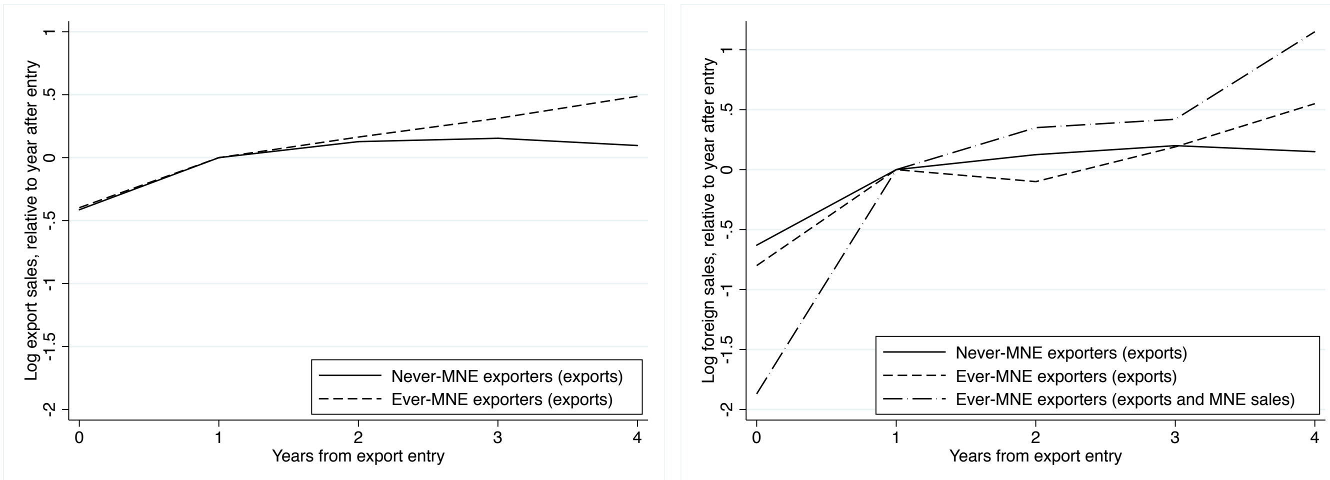
provide suggestive evidence for this mechanism, we compare export sales growth for exporters that do not choose to become MNEs and for exporters that eventually become MNEs (for the years before MNE entry). One can think of this second group as mimicking the world without the MNE option (i.e., without "truncation to the right" in the productivity distribution).

Figure 11 shows that, in the French data, the group of exporters that eventually become MNEs clearly grow faster in terms of exports than the never-MNE exporters. In the Norwegian data, the difference is less marked, but the number of observations decreases substantially. Appendix Figure C.18 compares growth profiles from the calibrated models and data, for France, for ever-MNE and never-MNE exporters. As previewed in the results shown in Figure 7, the model with MNEs almost perfectly matches the growth profile for new exporters that never switch to MNE status—this is the bulk of exporters in the data. In contrast, the model without MNEs is closer to the data on exporters that at some point in their life become MNEs.

The Norwegian data, in addition, allow us to compute the profile of export and MNE sales lumped together all along the life cycle of a firm since its export entry into a foreign market. Figure 11b shows that total foreign sales clearly grow faster than only exports, reminiscent of the result obtained from the calibrated model in Figure 7.

Figure 11: Exporters' sales growth by age and type, data.

(a) France (b) Norway



Notes: Log of firm-destination export (export and MNE) sales with respect to firm-destination export sales in the year after export entry, for firms with five or more years in the market as exporters. Averages across destinations weighted by each destination's share of export firms. Log of sales are first demeaned by industry, year, and destination fixed effects. Never-MNE exporters are exporters that, in our sample period, do not change to MNE status. Ever-MNE exporters are exporters that become MNEs after export entry. Exports for ever-MNE exporters are computed for the years before MNE entry, for exporters that enter MNE status after age four.

7 Conclusions

In this paper, we study the life-cycle dynamics of exporters and multinational enterprises (MNEs). In particular, we analyze the dynamics of the firm's choice of serving a foreign market through exports or through Foreign Direct Investment (FDI) —the dynamics of the proximity-concentration tradeoff. Using the model and new dynamic facts, we qualitatively and quantitatively evaluate the effects of including the MNE choice.

We find that including MNEs as an additional way to serve foreign markets slows down exporters' growth by 35 percent by age four. More importantly, new exporters' dynamics after a trade-liberalization shock are quite different in the dynamic model of the proximity-concentration tradeoff versus a Melitz-type dynamic model: While in the model with MNEs, moving from a high to a low trade cost environment would drastically increase exporters' sales—and drastically decrease exit rates— by age four, it would barely change their life-cycle behavior in the model without MNEs.

Our paper shows that omitting from the analysis the different modes of internationalization available to the firm, given that they create selection patterns "to-the-right" of the productivity distribution, may bias the quantitative implications of closed-economy dynamic models, as well as of exporter-only dynamic models; enriching the canonical model to include a first-order feature of the data—namely, the MNE option—has consequences for the predicted behavior of other firms in the economy.

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A Proofs

A.1 Proof of Proposition 1

We want to show that the productivity of exporters in the export-only model grows faster than that of exporters in the model with MNEs. We focus on the geometric average of the growth rate of exporters' productivity. Formally, we want to show that

$$E\left(z_t - z_{t-1} \mid z_t > \underline{z}, z_{t-1} > \underline{z}\right) > E\left(z_t - z_{t-1} \mid z_t > \underline{z}, z_{t-1} > \underline{z}, z_t < \bar{z}, z_{t-1} < \bar{z}\right), \quad \text{(A.1)}$$

where the expectation is taken over both z_{t-1} using the stationary distribution of exporters' productivity in the two models, respectively, and the shock ϵ_t, which, in turn, leads to z_t. Note that $\bar{z} < \infty$. Let $z_t = \rho z_{t-1} + \sigma_\epsilon \epsilon_t$, with $0 \leq \rho \leq 1$. Thus, $z_t - z_{t-1} = (\rho - 1) z_{t-1} + \sigma_\epsilon \epsilon_t$. Let $g(\cdot)$ denote the density of a normal distribution with mean zero and standard deviation σ_ϵ, and $h(\cdot)$ the density of a normal distribution with mean zero and standard deviation $\sigma_\epsilon/(1-\rho)$. Hence, we want to show that

$$\int_{\underline{z}}^{\infty} \left((\rho-1)z + \int_{\underline{z}+(1-\rho)z}^{\infty} x \frac{g(x)}{1 - G(\underline{z} + (1-\rho)z)} dx \right) \frac{h(z)}{1 - H(\underline{z})} dz$$

$$- \int_{\underline{z}}^{\bar{z}} \left((\rho-1)z + \int_{\underline{z}+(1-\rho)z}^{\bar{z}+(1-\rho)z} x \frac{g(x)}{G(\bar{z} + (1-\rho)z) - G(\underline{z} - (\rho-1)z)} dx \right) \frac{h(z)}{H(\bar{z}) - H(\underline{z})} dz > 0. \quad \text{(A.2)}$$

Rearranging this expression leads to

$$(\rho - 1) \left(\int_{\underline{z}}^{\infty} z \frac{h(z)}{1 - H(\underline{z})} dz - \int_{\underline{z}}^{\bar{z}} z \frac{h(z)}{H(\bar{z}) - H(\underline{z})} dz \right)$$

$$+ \int_{\underline{z}}^{\infty} \left(\int_{\underline{z}+(1-\rho)z}^{\infty} x \frac{g(x)}{1 - G(\underline{z} + (1-\rho)z)} dx \right) \frac{h(z)}{1 - H(\underline{z})} dz$$

$$- \int_{\underline{z}}^{\bar{z}} \left(\int_{\underline{z}+(1-\rho)z}^{\bar{z}+(1-\rho)z} x \frac{g(x)}{G(\bar{z} + (1-\rho)z) - G(\underline{z} + (1-\rho)z)} dx \right) \frac{h(z)}{H(\bar{z}) - H(\underline{z})} dz > 0, \quad \text{(A.3)}$$

which is equivalent to

$$(1 - \rho) \int_{\underline{z}}^{\infty} z \frac{h(z)}{1 - H(\underline{z})} dz + \int_{\underline{z}}^{\infty} \left(\int_{\underline{z}+(1-\rho)z}^{\infty} \frac{x g(x) dx}{1 - G(\underline{z} + (1-\rho)z)} \right) \frac{h(z)}{1 - H(\underline{z})} dz \leq$$

$$(1-\rho)\int_{\underline{z}}^{\bar{z}} z\frac{h(z)}{H(\bar{z})-H(\underline{z})}dz+\int_{\underline{z}}^{\bar{z}}\left(\int_{\underline{z}+(1-\rho)z}^{\bar{z}+(1-\rho)z}\frac{xg(x)}{G(\bar{z}+(1-\rho)z)-G(\underline{z}+(1-\rho)z)}\right)\frac{h(z)}{H(\bar{z})-H(\underline{z})}dz. \tag{A.4}$$

Define $\underline{c}\equiv\underline{z}/\sigma_\epsilon$, $\bar{c}\equiv\bar{z}/\sigma_\epsilon$, and $\mu\equiv(1-\rho)/\sigma_\epsilon$. Notice that

$$\int_{\underline{z}+(1-\rho)z}^{\infty}\frac{xg(x)dx}{1-G(\underline{z}+(1-\rho)z)}=E(x/x>\underline{z}+(1-\rho)z)=\frac{g(\underline{c}+\mu z)}{1-G(\underline{c}+\mu z)}.$$

Equivalently,

$$\int_{\underline{z}+(1-\rho)z}^{\bar{z}+(1-\rho)z}\frac{xg(x)dx}{G(\bar{z}+(1-\rho)z)-G(\underline{z}+(1-\rho)z)}=E(x/\underline{z}+(1-\rho)z<x<\bar{z}+(1-\rho)z)=$$

$$=\frac{g(\underline{c}+\mu z)-g(\bar{c}+\mu z)}{G(\bar{c}+\mu z)-G(\underline{c}+\mu z)}.$$

These are means of truncated normals (i.e., the inverse Mills ratio). Rearranging and applying this definition, we can rewrite (A.4) as

$$(1-\rho)\left[\int_{\underline{z}}^{\infty} z\frac{h(z)}{1-H(\underline{z})}dz-\int_{\underline{z}}^{\bar{z}} z\frac{h(z)}{H(\bar{z})-H(\underline{z})}dz\right]\leq$$

$$\int_{\underline{z}}^{\infty}\frac{g(\underline{c}+\mu z)}{1-G(\underline{c}+\mu z)}\frac{h(z)}{1-H(\underline{z})}dz-\int_{\underline{z}}^{\bar{z}}\frac{g(\underline{c}+\mu z)-g(\bar{c}+\mu z)}{G(\bar{c}+\mu z)-G(\underline{c}+\mu z)}\frac{h(z)}{H(\bar{z})-H(\underline{z})}dz. \tag{A.5}$$

Define

$$F^L(z)\equiv\frac{g(\underline{c}+\mu z)}{1-G(\underline{c}+\mu z)},$$

and

$$F^{LR}(z)\equiv\frac{g(\underline{c}+\mu z)-g(\bar{c}+\mu z)}{G(\bar{c}+\mu z)-G(\underline{c}+\mu z)}.$$

Rewrite (A.5) as

$$(1-\rho)\left[\int_{\underline{z}}^{\infty} z\frac{h(z)}{1-H(\underline{z})}dz-\int_{\underline{z}}^{\bar{z}} z\frac{h(z)}{H(\bar{z})-H(\underline{z})}dz\right]\leq$$

$$\int_{\underline{z}}^{\infty}F^L(z)\frac{h(z)}{1-H(\underline{z})}dz-\int_{\underline{z}}^{\bar{z}}F^{LR}(z)\frac{h(z)}{H(\bar{z})-H(\underline{z})}dz. \tag{A.6}$$

First, notice that both the right-hand and the left-hand sides are positive since $\rho<1$, and the first terms on both sides refer to truncated functions from below, while the second terms refer to truncated functions from below and above. If $\rho\to 1$, then the inequality is true. Because $g(\cdot)$ and $h(\cdot)$ are well-behaved probability-density functions, there exists ρ^* given by

$$\rho^*=1-\frac{\int_{\underline{z}}^{\infty}F^L(z)\frac{h(z)}{1-H(\underline{z})}dz-\int_{\underline{z}}^{\bar{z}}F^{LR}(z)\frac{h(z)}{H(\bar{z})-H(\underline{z})}dz}{\int_{\underline{z}}^{\infty}z\frac{h(z)}{1-H(\underline{z})}dz-\int_{\underline{z}}^{\bar{z}}z\frac{h(z)}{H(\bar{z})-H(\underline{z})}dz},$$

such that for $\rho > \max(\rho^*, 0)$, the inequality in (A.6) strictly holds.■

A.2 Proof of Proposition 2

Firm-productivity z follows a first-order autoregressive process, $z' = \rho z + \sigma_\epsilon \epsilon'$ with $\epsilon' \sim N(0,1)$ and $0 \leq \rho \leq 1$. Let $\bar{z}$ denote the exit cutoff and $\bar{z}_e$ the entry cutoff into an international activity. Let c be a constant in the interval $[\bar{z}_e, \infty)$. Let

$$f(a) = \frac{\int_{\bar{z}_e}^{c} \Pr(\rho x + \sigma_\epsilon \epsilon \leq \bar{z} \mid x) g(x - \rho a) dx}{G(c) - G(\bar{z}_e - \rho a)}$$

denote the probability of exit from status i in t+1 for a firm that is not yet in status i in t-1 and that has a productivity level of a in t-1. The functions $g(\cdot)$ and $G(\cdot)$ denote, respectively, the probability and cumulative density functions of a normal distribution with mean zero and dispersion parameter σ_ϵ.

Let ξ and φ be two positive constants, with $\xi \leq \varphi$. Without loss of generality, the entry cutoff is $\bar{z}_e = \bar{z} + \varphi$. We want to show that when we increase the exit cutoff from $\bar{z}$ to $\bar{z} + \xi$, the exit probability increases more when sunk costs are zero—i.e., $\varphi = 0$,

$$f(a; \xi > 0; \varphi = 0) - f(a; \xi = 0; \varphi = 0) > f(a; \xi > 0; \varphi > 0) - f(a; \xi = 0; \varphi > 0).$$

The first term is given by

$$\begin{aligned} f(a; \xi > 0; \varphi = 0) - f(a; \xi = 0; \varphi = 0) &= \frac{\int_{\bar{z}}^{c} \Pr(\rho x + \sigma_\epsilon \epsilon \leq \bar{z} + \xi \mid x) g(x - \rho a) dx}{G(c) - G(\bar{z} - \rho a)} \\ &- \frac{\int_{\bar{z}}^{c} \Pr(\rho x + \sigma_\epsilon \epsilon \leq \bar{z} \mid x) g(x - \rho a) dx}{G(c) - G(\bar{z} - \rho a)}, \end{aligned} \tag{A.7}$$

while the second one is

$$\begin{aligned} f(a; \xi > 0; \varphi > 0) - f(a; \xi = 0; \varphi > 0) &= \frac{\int_{\bar{z}+\varphi}^{c} \Pr(\rho x + \sigma_\epsilon \epsilon \leq \bar{z} + \xi \mid x) g(x - \rho a) dx}{G(c) - G(\bar{z} + \varphi - \rho a)} \\ &- \frac{\int_{\bar{z}+\varphi}^{c} \Pr(\rho x + \sigma_\epsilon \epsilon \leq \bar{z} \mid x) g(x - \rho a) dx}{G(c) - G(\bar{z} + \varphi - \rho a)}. \end{aligned} \tag{A.8}$$

Rearranging, we get that

$$f(a;\xi>0;\varphi=0)-f(a;\xi>0;\varphi>0)>f(a;\xi=0;\varphi=0)-f(a;\xi=0;\varphi>0),$$

which, after some algebra, yields

$$\begin{aligned}
&\frac{\int\limits_{\bar{z}}^{c}\Pr(\rho x+\sigma_\epsilon\epsilon\leq\bar{z}+\xi\mid x)g(x-\rho a)dx-\int\limits_{\bar{z}+\varphi}^{c}\Pr(\rho x+\sigma_\epsilon\epsilon\leq\bar{z}+\xi\mid x)g(x-\rho a)dx}{(G(c)-G(\bar{z}-\rho a))(G(c)-G(\bar{z}+\varphi-\rho a))}\\
>\ &\frac{\int\limits_{\bar{z}}^{c}\Pr(\rho x+\sigma_\epsilon\epsilon\leq\bar{z}\mid x)g(x-\rho a)dx-\int\limits_{\bar{z}+\varphi}^{c}\Pr(\rho x+\sigma_\epsilon\epsilon\leq\bar{z}\mid x)g(x-\rho a)dx}{(G(c)-G(\bar{z}-\rho a))(G(c)-G(\bar{z}+\varphi-\rho a))}.
\end{aligned}$$

Denominators are always positive and simplify. The numerators can be written as

$$\int_{\bar{z}}^{\bar{z}+\varphi}\Pr(\rho x+\sigma_\epsilon\epsilon\leq\bar{z}+\xi\mid x)g(x-\rho a)dx+\int_{\bar{z}+\varphi}^{c}\Pr(\rho x+\sigma_\epsilon\epsilon\leq\bar{z}+\xi\mid x)g(x-\rho a)dx$$

$$-\int_{\bar{z}+\varphi}^{c}\Pr(\rho x+\sigma_\epsilon\epsilon\leq\bar{z}+\xi\mid x)g(x-\rho a)dx=\int_{\bar{z}}^{\bar{z}+\varphi}\Pr(\rho x+\sigma_\epsilon\epsilon\leq\bar{z}+\xi\mid x)g(x-\rho a)dx,$$

and analogously for the numerator in the right-hand side of the inequality. Hence,

$$\int_{\bar{z}}^{\bar{z}+\varphi}\Pr(\rho x+\sigma_\epsilon\epsilon\leq\bar{z}+\xi\mid x)g(x-\rho a)dx\ >\ \int_{\bar{z}}^{\bar{z}+\varphi}\Pr(\rho x+\sigma_\epsilon\epsilon\leq\bar{z}\mid x)g(x-\rho a)dx.$$

Because $\Pr(\rho x+\sigma_\epsilon\epsilon\leq\bar{z}+\xi\mid x)>\Pr(\rho x+\sigma_\epsilon\epsilon\leq\bar{z}\mid x)$, we show that when we increase the exit cutoff, the probability of exit upon entry increases by less with the presence of sunk costs. ■

A.3 Proof of Proposition 3

We will prove that if a firm had lower productivity in the period before becoming a multinational, it is more likely to exit the year after entry. The proof does not rely on having sunk MNE costs.

Firm productivity z follows a first-order autoregressive process, $z'=\rho z+\sigma_\epsilon\epsilon'$ with $\epsilon'\sim N(0,1)$ and $0\leq\rho\leq1$. Let $\bar{z}_e^m$ and $\bar{z}^m$ be the productivity entry and exit thresholds, respectively. Let $f(a)$ denote the probability of exit from multinational status in $t+1$ for a firm that was not a multinational in $t-1$, and with productivity a in t-1, defined by

$$f(a) = \frac{\int_{\bar{z}_e^m}^{\infty} \Pr(\rho x + \sigma_\epsilon \epsilon \leq \bar{z}^m \mid x) g(x - \rho a) dx}{1 - G(\bar{z}_e^m - \rho a)},$$

where $g(\cdot)$ and $G(\cdot)$ denote, respectively, the probability and cumulative density functions of a normal distribution with mean zero and dispersion parameter σ_ϵ.

Let $\xi \to 0$, with $\xi > 0$. We will show that $f(.)$ is a decreasing function—i.e., $f(a) - f(a - \xi) < 0$. Replacing, we get that

$$f(a) - f(a-\xi) = \frac{\int_{\bar{z}_e^m}^{\infty} \Pr(\rho x + \sigma_\epsilon \epsilon \leq \bar{z}^m \mid x) g(x - \rho a) dx}{1 - G(\bar{z}_e^m - \rho a)} - \frac{\int_{\bar{z}_e^m}^{\infty} \Pr(\rho x + \sigma_\epsilon \epsilon \leq \bar{z}^m \mid x) g(x - \rho a + \rho \xi) dx}{1 - G(\bar{z}_e^m - \rho a + \rho \xi)},$$

which, after some algebra, becomes

$$f(a) - f(a-\xi) = \frac{\int_{\bar{z}_e^m}^{\infty} \Pr(\rho x + \sigma_\epsilon \epsilon \leq \bar{z}^m \mid x) \left[g(x-\rho a)(1 - G(\bar{z}_e^m - \rho a + \rho\xi) - g(x - \rho a + \rho \xi)(1 - G(\bar{z}_e^m - \rho a)) \right] dx}{\left[1 - G(\bar{z}_e^m - \rho a)\right]\left[1 - G(\bar{z}_e^m - \rho a + \rho \xi)\right]}.$$

Since the denominator is always positive, we need to show that the numerator is negative. Note that $\Pr(\rho x + \sigma_\epsilon \epsilon \leq \bar{z}^m \mid x)$ is decreasing in x and that

$$\frac{\int_{\bar{z}_e^m}^{\infty} g(x - \rho a) dx}{1 - G(\bar{z}_e^m - \rho a)} - \frac{\int_{\bar{z}_e^m}^{\infty} g(x - \rho a + \rho \xi) dx}{1 - G(\bar{z}_e^m - \rho a + \rho \xi)} = 0.$$

We then need to show that there exists only one point $m \in [c, \infty]$ such that for $x < m$,

$$g(x - \rho a) \left[1 - G(\bar{z}_e^m - \rho a + \rho \xi)\right] - g(x - \rho a + \rho \xi) \left[1 - G(\bar{z}_e^m - \rho a)\right] < 0,$$

and for $x > m$,

$$g(x - \rho a) \left[1 - G(\bar{z}_e^m - \rho a + \rho \xi)\right] - g(x - \rho a + \rho \xi) \left[1 - G(\bar{z}_e^m - \rho a)\right] > 0.$$

Since for $\xi > 0$ and $\xi \to 0$, $G(x - \xi) = G(x) - \xi g(x)$ and $g(x - \xi) = g(x) - \xi g'(x)$, replacing, we get that

$$\begin{aligned}
& g(x - \rho a) \left[1 - G(\bar{z}_e^m - \rho a + \rho \xi)\right] - g(x - \rho a + \rho \xi) \left[1 - G(\bar{z}_e^m - \rho a)\right] \\
= \; & g(x - \rho a) \left[1 - G(\bar{z}_e^m - \rho a) - \rho \xi g(\bar{z}_e^m - \rho a)\right] - \left[g(x - \rho a) + \rho \xi g'(x - \rho a)\right] \left[1 - G(\bar{z}_e^m - \rho a)\right] \\
= \; & -\rho \xi g(x - \rho a) g(\bar{z}_e^m - \rho a) - \rho \xi g'(x - \rho a) \left[1 - G(\bar{z}_e^m - \rho a)\right] \\
= \; & \rho \xi g(x - \rho a) \left\{ -g(\bar{z}_e^m - \rho a) + \frac{x - \rho a}{\sigma_\epsilon^2} \left[1 - G(\bar{z}_e^m - \rho a)\right] \right\},
\end{aligned} \tag{A.9}$$

where, in the last equality, we use that $g'(x - \rho a) = -g(x - \rho a)(x - \rho a)/\sigma_\epsilon^2$.

Denote the function inside the curly brackets in (A.9) as

$$k(x) \equiv -g(\bar{z}_e^m - \rho a) + \frac{x - \rho a}{\sigma_\epsilon^2} \left[1 - G(\bar{z}_e^m - \rho a)\right].$$

For $x = m$, $k(m) = 0$, with $m = c\sigma_\epsilon^2 + \rho a$ where $c \equiv g(\bar{z}_e^m - \rho a) / \left[1 - G(\bar{z}_e^m - \rho a)\right] > 0$ (since $[1 - G(\bar{z}_e^m - \rho a)]$ and $g(\bar{z}_e^m - \rho a)$ are positive constants). It remains to show that for $x < m$, $k(x)$ is negative, and for $x > m$, $k(x)$ is positive. Taking the derivative of $k(\cdot)$ with respect to x yields

$$k'(x) = \frac{1 - G(\bar{z}_e^m - \rho a)}{\sigma_\epsilon^2},$$

which is positive for all x. Thus, $k(x) < k(m)$, for $x < m$, and $k(x) > k(m)$, for $x > m$, which implies that the expression in (A.9) is decreasing, proving that $f(a)$ is a decreasing function.$\blacksquare$

B The dynamic model with export and MNE sunk costs

The model has the same setup as the one in the body of the paper, with the addition of a one-time sunk cost of opening an affiliate in the foreign market, $F^m > 0$, as well as a sunk cost of exporting, $F^x > 0$, with $F^m > F^x$. Both sunk costs are paid in units of labor.

Firms have three possible states: producing in the domestic market for home consumers only(D); producing in the domestic market for home and foreign consumers (X); or producing in the domestic market for home consumers and in the foreign market for foreign consumers (M).

The value of being a firm with affiliates in the foreign market and with productivity ϕ is given by

$$V(\phi, M) = \frac{X^d(\phi)}{\sigma} + \max\left\{\frac{X^m(\phi)}{\sigma} - f^m + \beta EV(\phi', M \mid \phi),\right.$$
$$\left.\frac{X^x(\phi)}{\sigma} - f^x - F^x + \beta EV(\phi', X \mid \phi), \beta EV(\phi', D \mid \phi)\right\}. \tag{B.1}$$

An MNE chooses among continuing its operations abroad; incurring the per-period fixed cost f^m; shutting down the affiliate and becoming an exporter to the foreign market, incurring a per-period fixed cost f^x and sunk cost F^x; or abandoning the foreign market altogether.

The value of being a domestic firm with productivity ϕ is given by

$$V(\phi, D) = \frac{X^d(\phi)}{\sigma} + \max\left\{\frac{X^m(\phi)}{\sigma} - f^m - F^m + \beta EV(\phi', M \mid \phi),\right.$$
$$\left.\frac{X^x(\phi)}{\sigma} - f^x - F^x + \beta EV(\phi', X \mid \phi), \beta EV(\phi', D \mid \phi)\right\}. \tag{B.2}$$

A domestic firm can choose to become an MNE in the foreign market and pay the per-period fixed cost f^m and the entry sunk cost F^m; export to the foreign market, and pay the per-period fixed cost f^x and sunk cost F^x; or operate in and serve only its home market.

The value of being an exporter with productivity ϕ is given by

$$V(\phi, X) = \frac{X^d(\phi)}{\sigma} + \max\left\{\frac{X^m(\phi)}{\sigma} - f^m - F^m + \beta EV(\phi', M \mid \phi),\right.$$
$$\left.\frac{X^x(\phi)}{\sigma} - f^x + \beta EV(\phi', X \mid \phi), \beta EV(\phi', D \mid \phi)\right\}. \tag{B.3}$$

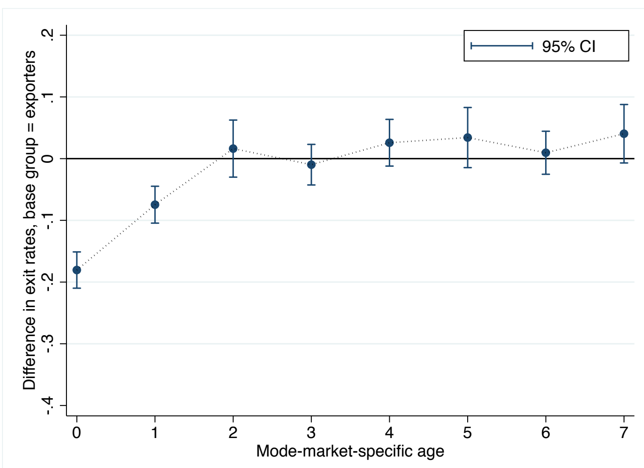
An exporter can choose to become an MNE in the foreign market and pay the per-period fixed cost f^m and the entry sunk cost F^m; continue exporting to the foreign market, and pay the per-period fixed cost f^x; or operate in and serve only its home market. The firm stops being an MNE if choice D or X leads to larger expected discounted profits than choice M. The optimal exit choice for a multinational is characterized by a cutoff value of productivity $\bar{\phi}^m$. With a productivity level below $\bar{\phi}^m$, a current multinational exits to produce only in the domestic market; with a productivity level above $\bar{\phi}^m$, the firm remains a multinational. Similarly, there exists an entry cutoff value of productivity, $\bar{\phi}_e^m$, such that MNEs with $\phi \in [\bar{\phi}^m, \bar{\phi}_e^m]$ keep their multinational status. Exporters face a similar problem: They will stop being exporters if their productivity drops below $\bar{\phi}^x$ and will enter multinational activities if productivity is larger than $\bar{\phi}_e^m$. There exits an entry cutoff value of productivity, $\bar{\phi}_e^x$, such that exporters with $\phi \in [\bar{\phi}^x, \bar{\phi}_e^x]$ keep their exporter status. These "inaction" zones exist by virtue of the sunk costs of entry into export activities and MNE activities, respectively.

We assume that $\bar{\phi}^m > \bar{\phi}^x$ and check in our calibration that this assumption is satisfied for the set of calibrated parameters. Notice that this assumption is implicit in the way the value functions are written: The marginal MNE is indifferent between being an exporter or an MNE, and the marginal exporter is indifferent between being only domestic or an exporter.

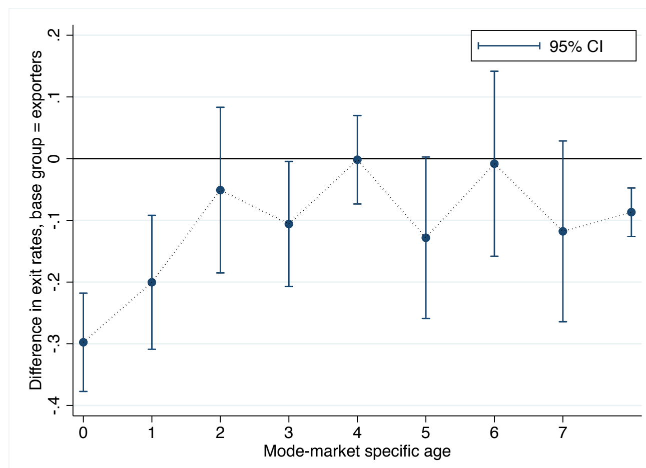
C Additional figures

Figure C.1: Exit rates by age: MNEs versus exporters, OLS.

(a) France



(b) Norway



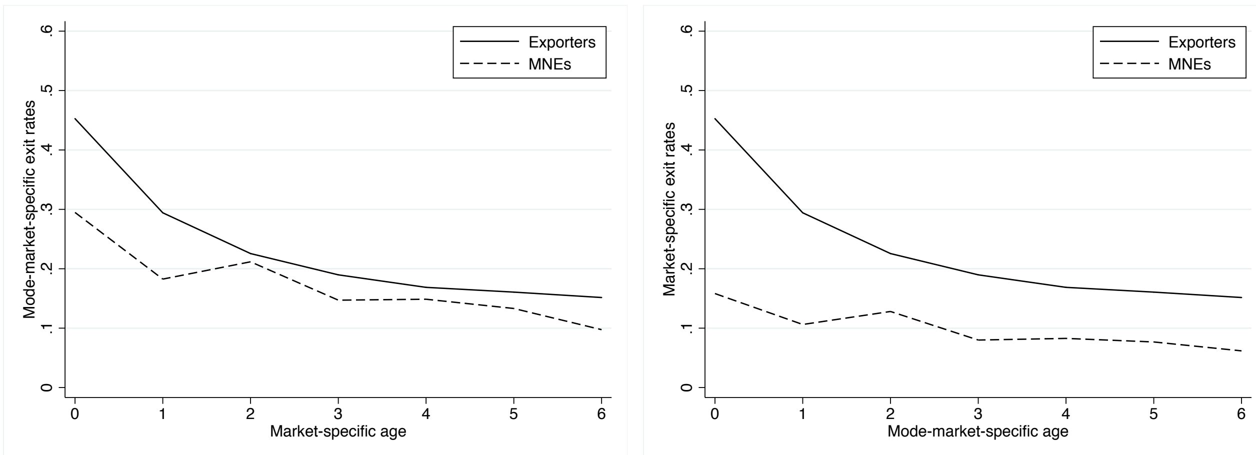
Notes: Difference in coefficients and 95%-confidence bands from estimating, by OLS,

$$
\begin{aligned}
D(Exit_{inmta}) = \beta_0 MNE_{inta} + \sum_a \beta_1^a D(age_{inmt} = a) \\
+ \sum_a \beta_2^a MNE_{inta} \times D(age_{inmt} = a) + \beta_3 \log home\ sales_{imta} + \epsilon_{inmta},
\end{aligned}
$$

where $D(Exit_{inmta})$ is a dummy equal to one in the year t in which firm i of age a exits mode m in market n, and zero otherwise; MNE_{inta} is one if firm i at age a is active in market n and year t as an MNE, and zero otherwise; and $D(age_{inmt} = a)$ equals one if firm i in market n and mode m at time t is of age a, and zero otherwise. We include year, industry, and country fixed effects. Standard errors are clustered by industry. Exporters are the base group. Observations are at the firm-destination-year level. Exporters refers to non-MNE exporters only.

Figure C.2: Exit rates by age, robustness, France.

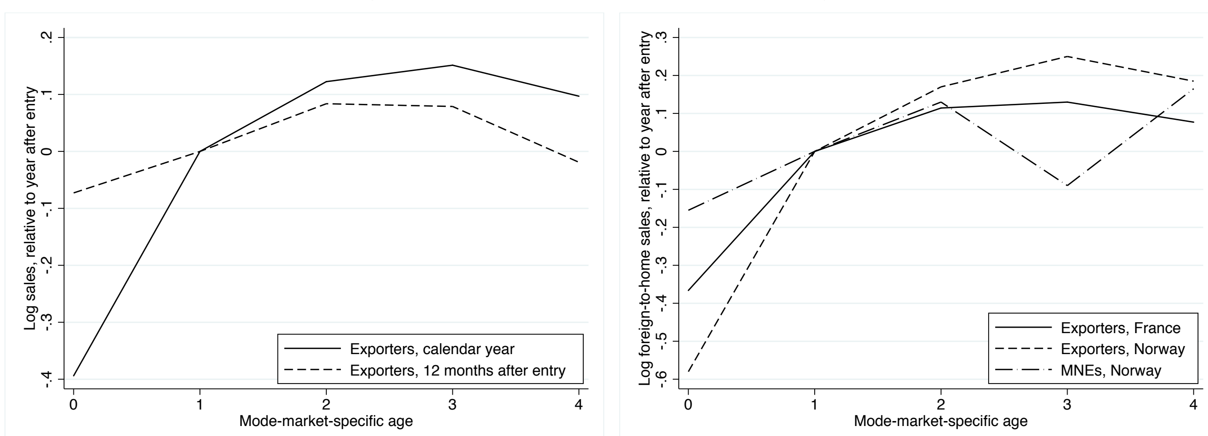
(a) Market-specific age (b) Market-specific exit rates



Notes: (C.2a): number of exits from a mode-market relative to the number of firms active in a mode-market, by market-specific age, for exporters and MNEs. (C.2b): number of exits from a market relative to the number of firms active in a market, by mode-market-specific age, for exporters and MNEs. Averages across destinations weighted by each destination's share of export (MNE) firms. Exporters refers to non-MNE exporters only.

Figure C.3: Sales growth rates by age, robustness.

(a) Adjusted-export sales growth, France (b) Foreign-to-domestic sales ratio

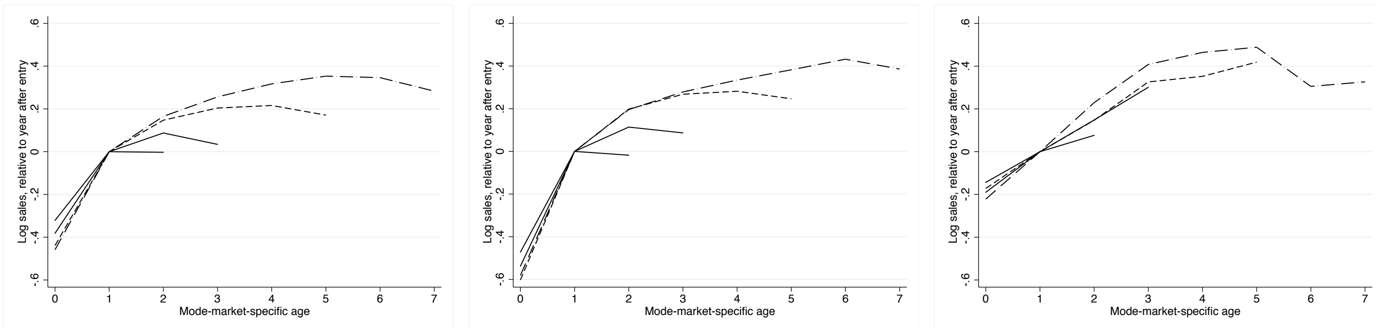


Notes: (C.3a): log of firm-destination sales relative to firm-destination sales in the year after entry. (C.3b): log of firm-destination ratio of foreign-to-domestic sales relative to firm-destination ratio in the year after entry.

Firms with five or more years in the market. Averages across destinations weighted by each destination's share of export (MNE) firms. Log of sales (sales ratios) first demeaned by industry, year, and destination fixed effects. Exporters refers to non-MNE exporters only.

Figure C.4: Sales growth by age and cohort.

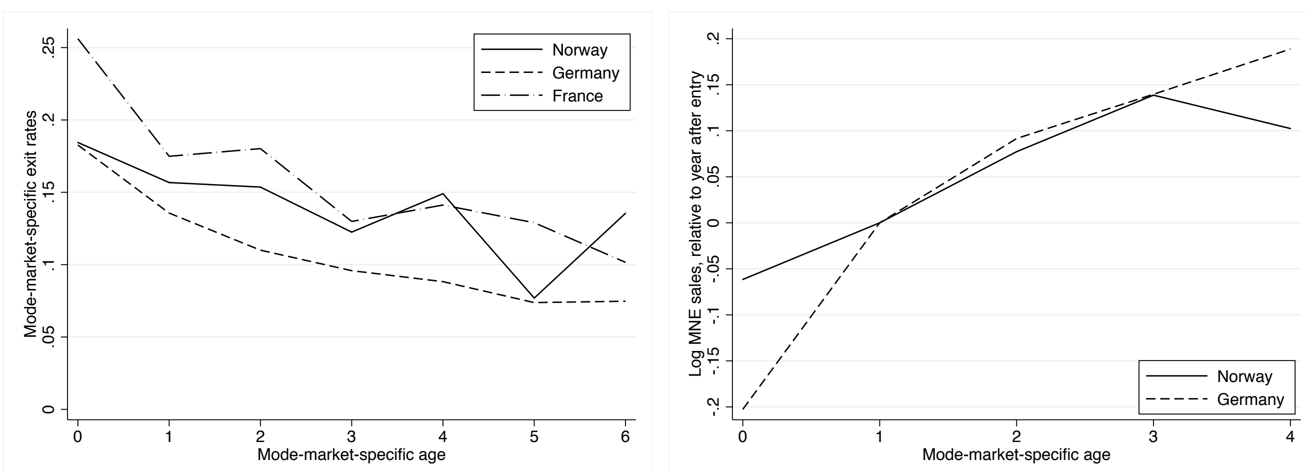
(a) Exporters, France (b) Exporters, Norway (c) MNEs, Norway



Notes: Log of firm-destination export (affiliate) sales with respect to firm-destination export (affiliate) sales in the year after entry, firms with at least t years in the market, selected cohorts in each mode. Averages across destinations weighted by each destination's share of export (MNE) firms. Log of sales first demeaned by industry, year, and destination fixed effects. Exporters refers to non-MNE exporters only.

Figure C.5: MNEs: Germany, France, and Norway.

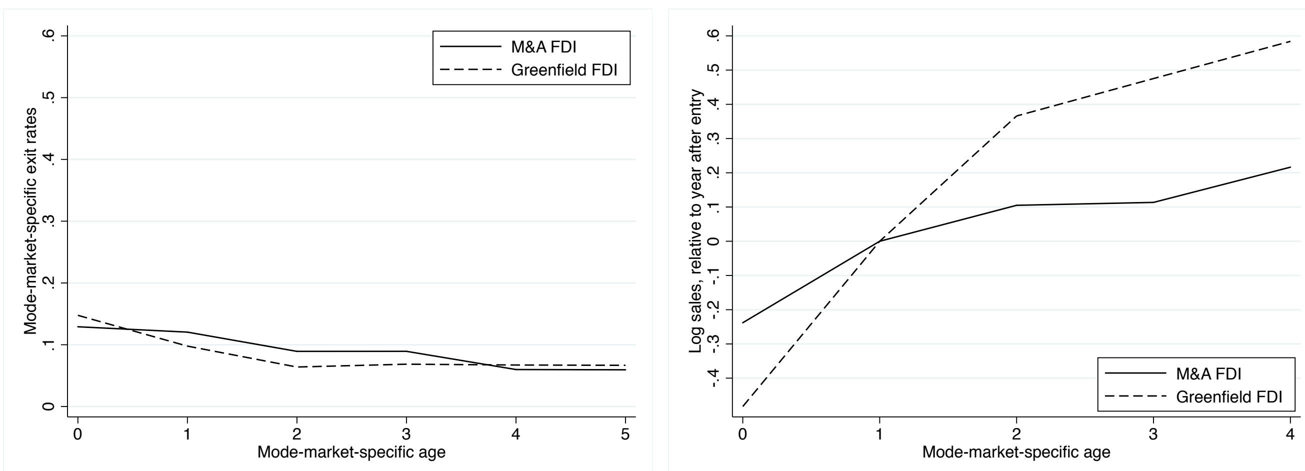
(a) Exit rates by age (b) Sales growth by age



Notes: (C.5a): number of exits from a mode-market relative to the number of firms active in a mode-market, by mode-market-specific age. (C.5b): log of firm-destination MNE sales with respect to firm-destination MNE sales in the year after entry, firms with five or more years in the market. Log of sales first demeaned by industry, year, and destination fixed effects.
Averages across destinations weighted by each destination's share of MNE firms.

Figure C.6: Greenfield versus M&A FDI, Germany.

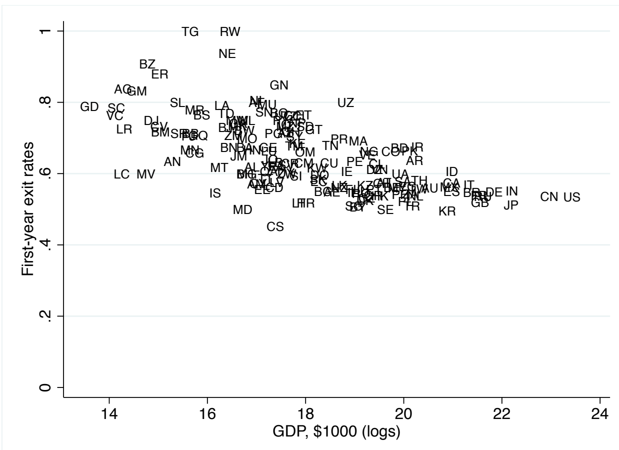
(a) Exit rates by age (b) Sales growth by age



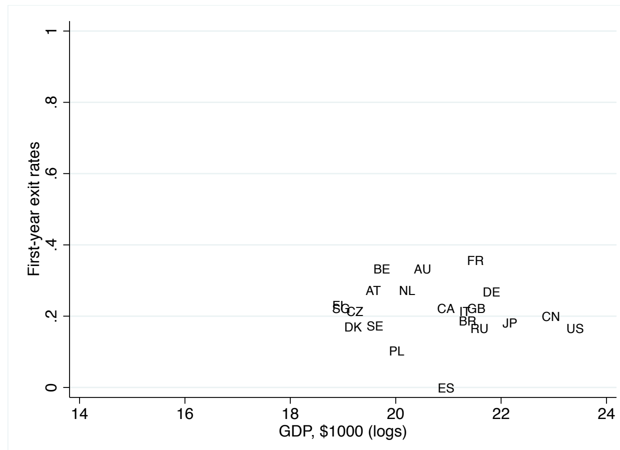
Notes: (C.6a): number of exits from a mode-market relative to the number of firms active in a mode-market, by mode-market-specific age. (C.6b): log of firm-destination MNE sales with respect to firm-destination MNE sales in the year after entry, firms with five or more years in the market. Averages across destinations weighted by each destination's share of MNE firms. Log of sales first demeaned by industry, year, and destination fixed effects. The sample period is 2005-2011 (no information on FDI entry mode available before 2005).

Figure C.7: First-year exit rates and market characteristics, Norway.

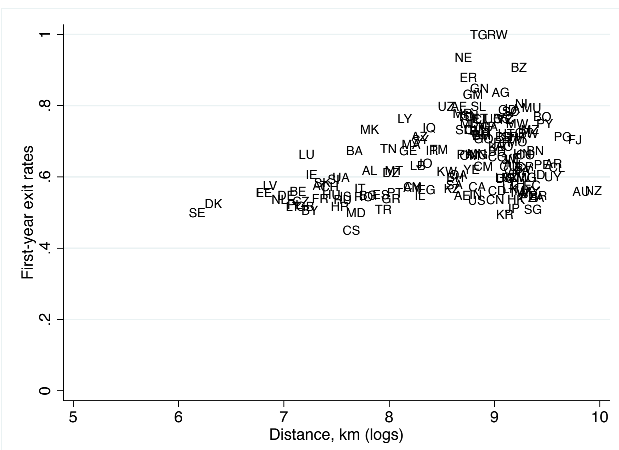
(a) Exporters – market size



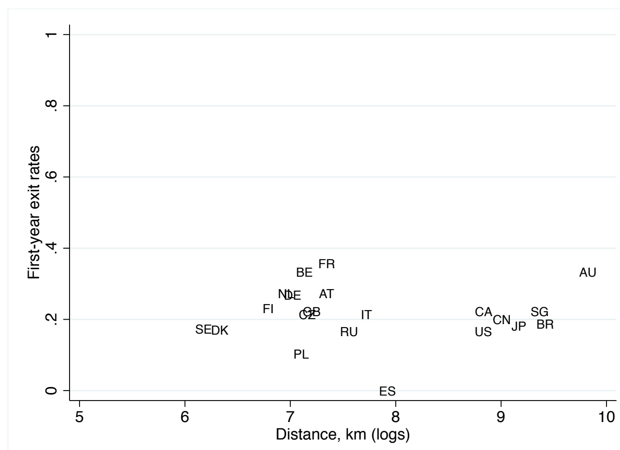
(b) MNEs – market size



(c) Exporters – distance

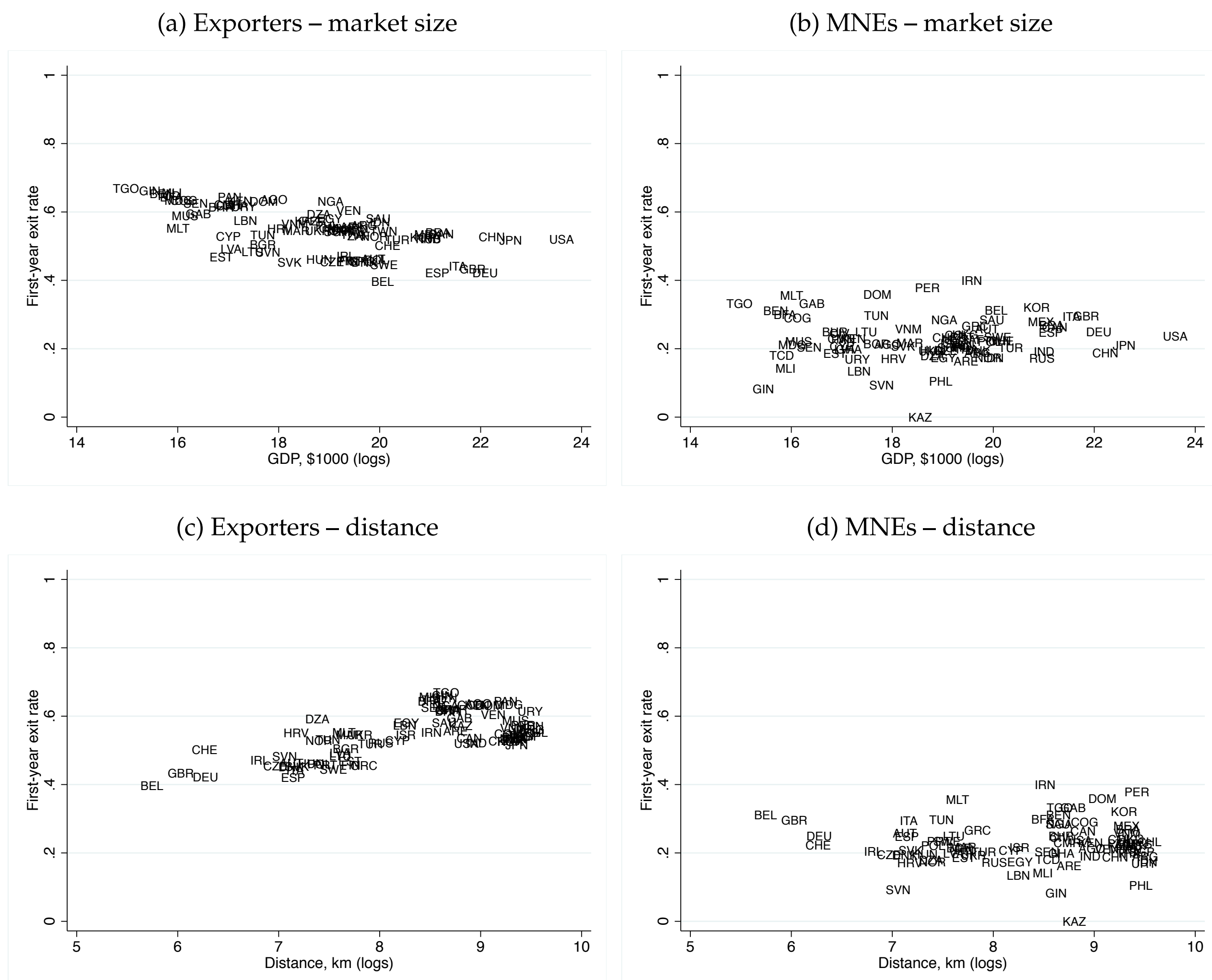


(d) MNEs – distance



Notes: Number of exits from a mode-market relative to the number of firms active in a mode-market, for exporters and MNEs, in the first year upon market-mode entry (i.e., age zero). Destinations with ten or more firm-year observations and with available GDP data. Exporters refers to non-MNE exporters only. GDP data from *International Financial Statistics* (IMF). Distance data from *CEPII* (Mayer and Zignago, 2011).

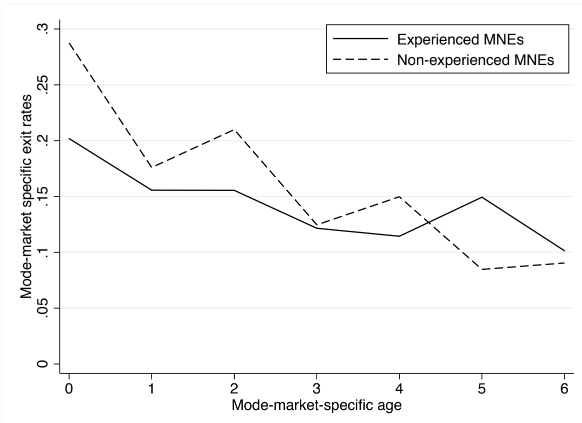
Figure C.8: First-year exit rates and market characteristics, same set of countries, France.



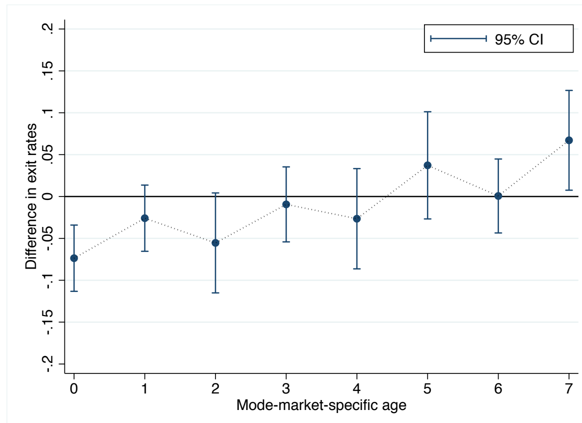
Notes: Number of exits from a mode-market relative to the number of firms active in a mode-market, for exporters and MNEs, in the first year upon market-mode entry (i.e., age zero). Destinations with ten or more firm-year observations and with available GDP data. Exporters refers to non-MNE exporters only. GDP data from *International Financial Statistics* (IMF). Distance data from *CEPII* (Mayer and Zignago, 2011).

Figure C.9: Exit rates by age: experienced versus non-experienced MNEs, France.

(a) Raw data



(b) OLS coefficients

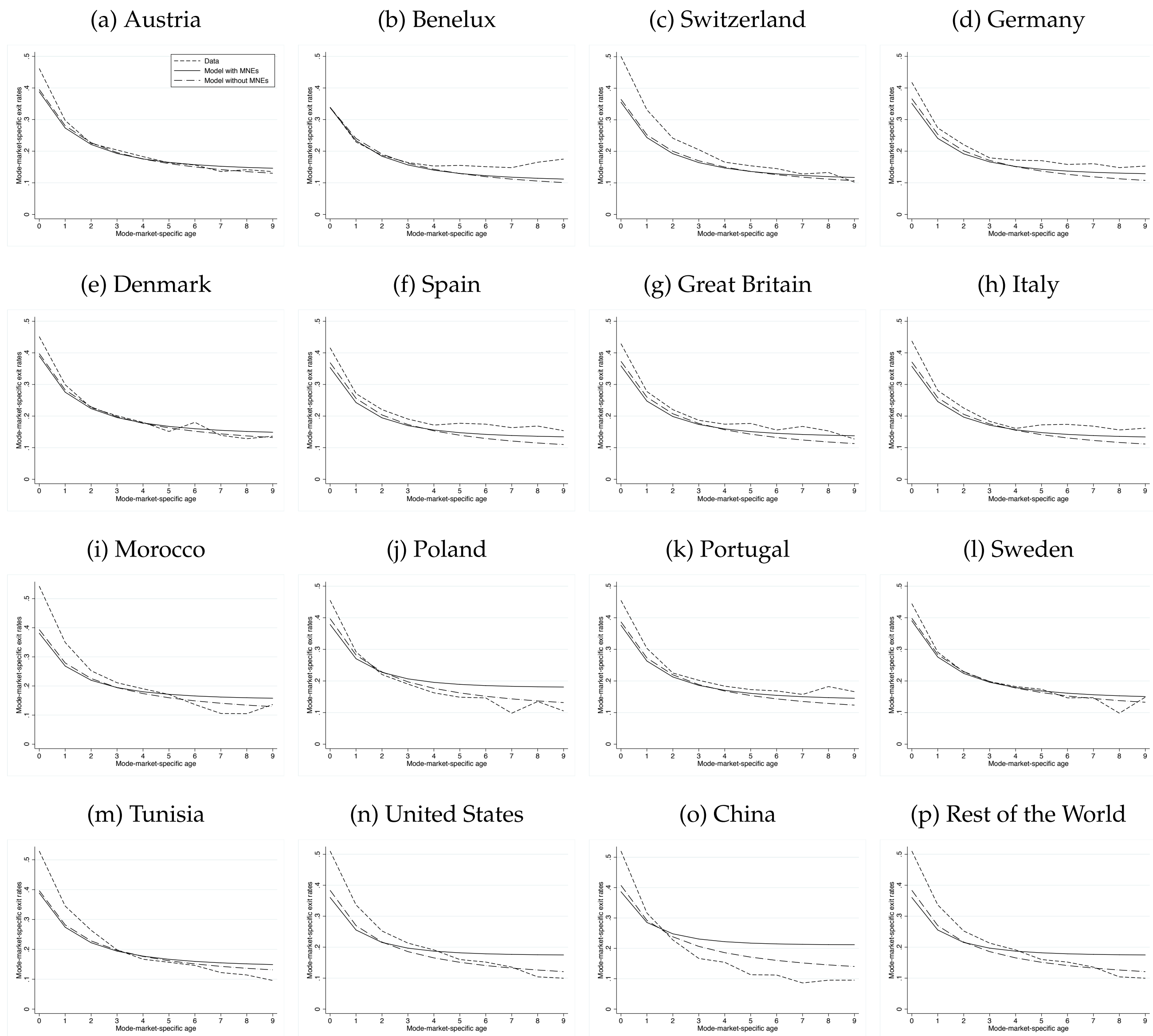


Notes: Experienced MNEs are new affiliates of MNEs that exported to a foreign market for one or more years before opening an affiliate there. (C.9a): number of exits from a mode-market relative to the number of firms active in a mode-market, by mode-market-specific age. (C.9b): difference in coefficients and 95%-confidence bands from estimating, by OLS,

$$\begin{aligned} D(Exit_{inmta}) = \beta_0 MNE_{inta} + \sum_a \beta_1^a D(age_{inmt} = a) + \sum_a \beta_2^a MNE_{inta} \times D(age_{inmt} = a) \\ + \beta_3 exp.mne_{inmta} + \sum_a \beta_4^a exp.mne_{inmta} \times D(age_{inmt} = a) \\ + \beta_5 exp.mne_{inmta} \times MNE_{inta} + \sum_a \beta_6^a D(age_{inmt} = a) \times MNE_{inta} \times exp.mne_{inmta} \\ + \beta_7 \log home\ sales_{imta} + \epsilon_{inmta}, \end{aligned} \tag{C.1}$$

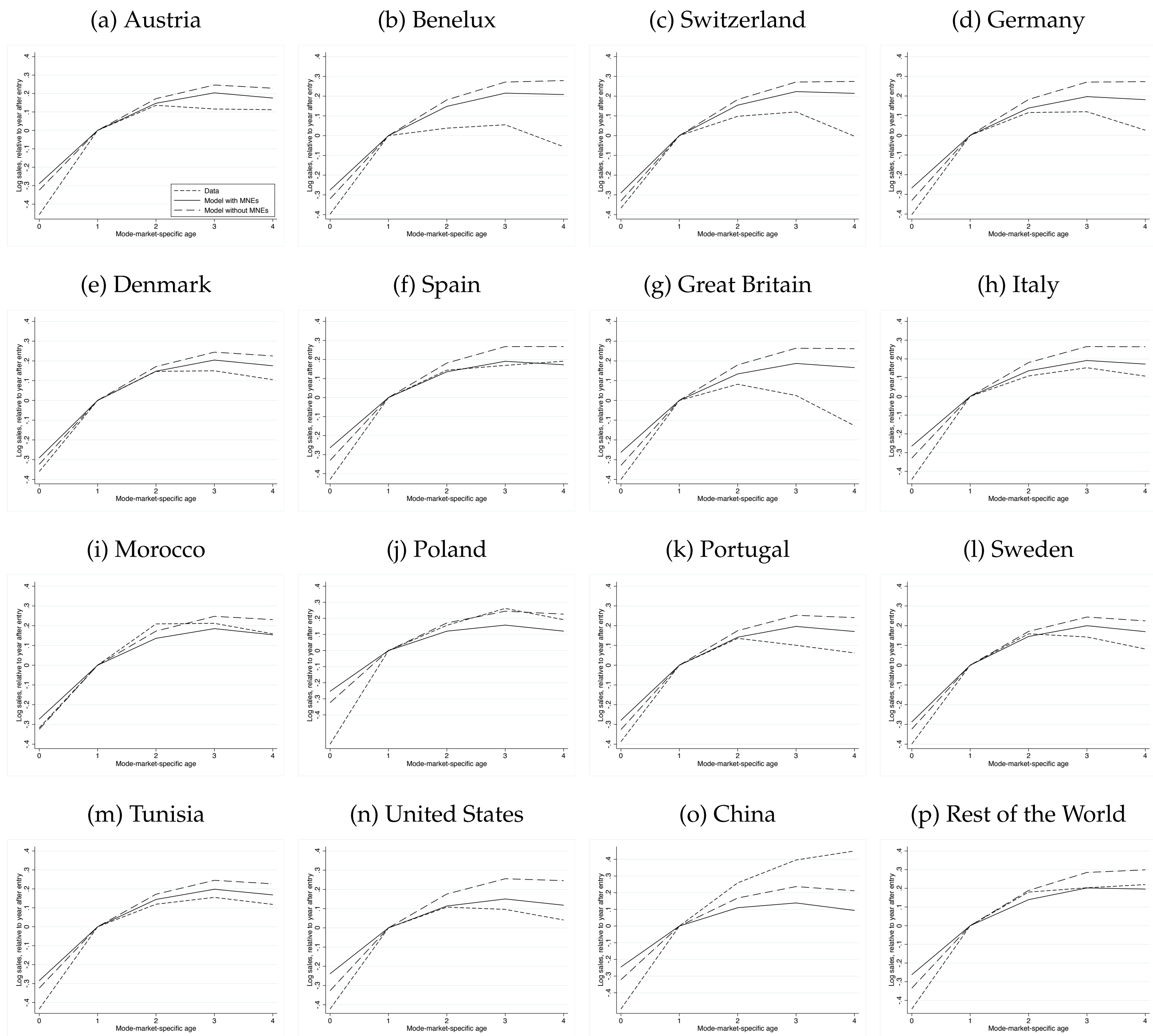
where $D(Exit_{inmta})$ is a dummy equal to one in the year t in which firm i of age a exits mode m in market n, and zero otherwise; MNE_{inta} is one if firm i at age a is active in market n and year t as an MNE, and zero otherwise; and $D(age_{inmt} = a)$ equals one if firm i in market n and mode m at time t is of age a, and zero otherwise. $exp.mne_{inmta}$ indicates the years of export experience before MNE entry in market n, for firm i at age a and year t. We include year, industry, and country fixed effects, and robust standard errors. Non-experienced MNEs are the base group. Observations at the firm-destination-year level.

Figure C.10: Exporters’ exit rates by age: calibrated models and data, by country.



Notes: Models calibrated to French data. Number of exits from a mode-market relative to the number of firms active in a mode-market, for exporters, for each destination. Rest of the World is a weighted average among the remaining countries in the sample. Exporters in the data refers to non-MNE exporters only.

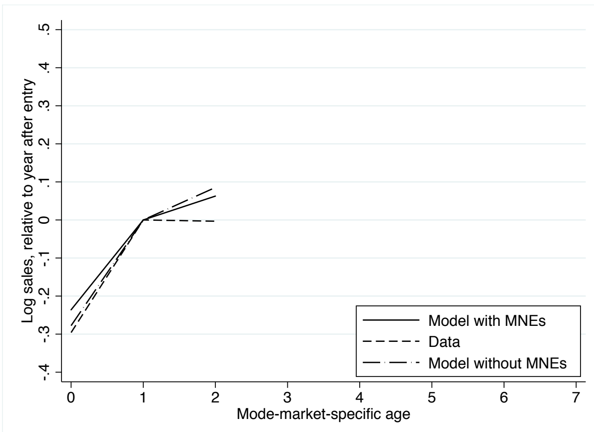
Figure C.11: Exporters' sales growth by age: calibrated models and data, by country.



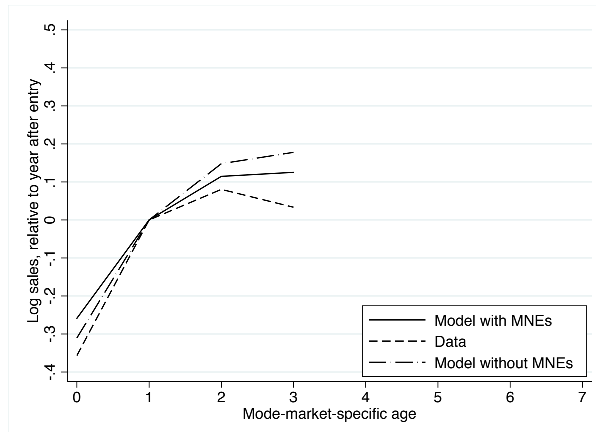
Notes: Models calibrated to French data. Log of firm-destination export sales with respect to firm-destination export sales in the year after entry, average over firms with five or more years in the market, by destination. Rest of the World is a weighted average among the remaining countries in the sample. Exporters in the data refers to non-MNE exporters only.

Figure C.12: The role of MNEs in new exports' dynamics, by exporters' cohort, France.

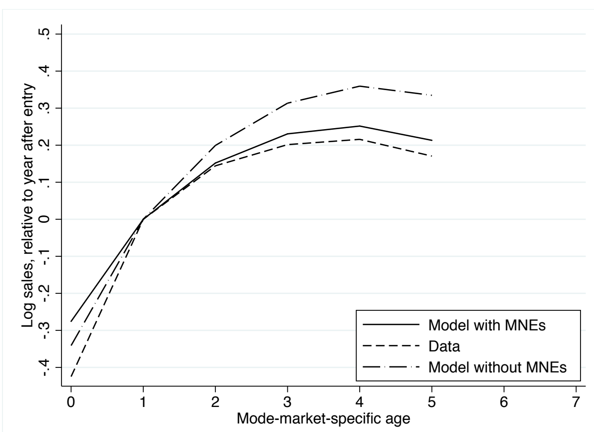
(a) Exporters with at least three years in market



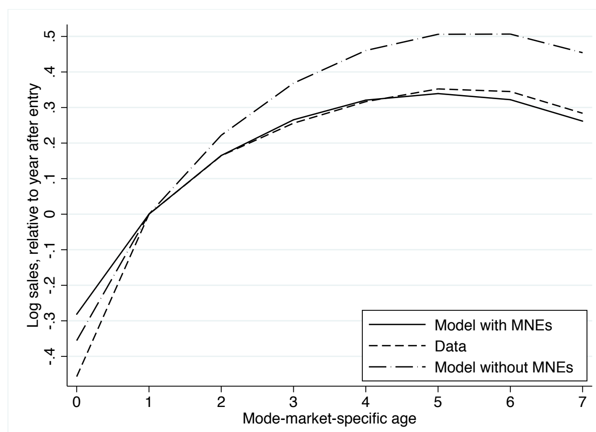
(b) Exporters with at least four years in market



(c) Exporters with at least six years in market



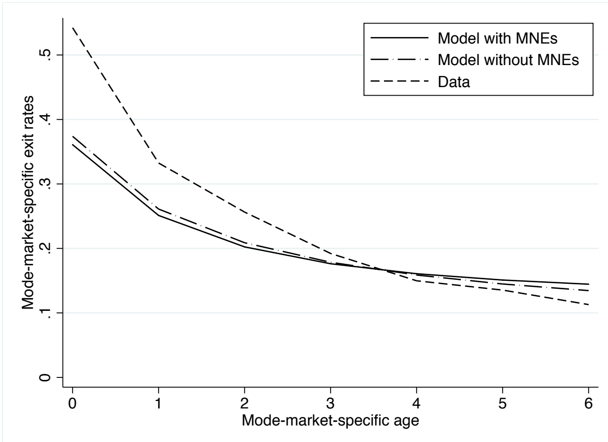
(d) Exporters with at least eight years in market



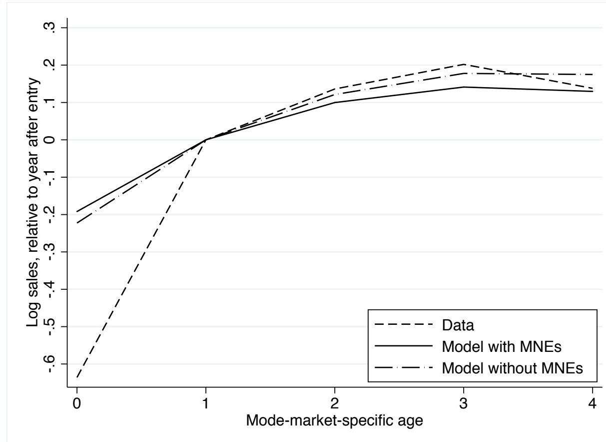
Notes: Models calibrated to French data. Log of firm-destination export sales with respect to firm-destination export sales in the year after entry, firms with at least t years in the market as exporters, selected cohorts. In the data, log of sales first demeaned by industry, year, and destination fixed effects. Averages across destinations included in the calibration, weighted by each destination's share of export firms. Weights are data-based and model-based, for data and model variables, respectively. Exporters in the data refers to non-MNE exporters only.

Figure C.13: The role of MNEs in new exporters' dynamics.

(a) New exporters' exit rates



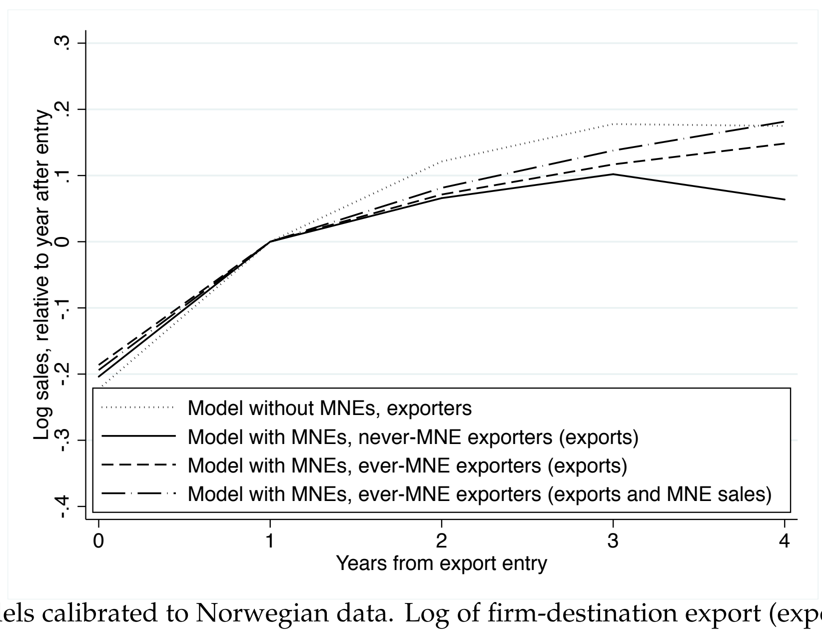
(b) New exporters' sales growth



Notes: Models calibrated to Norwegian data. (C.13a): number of exits from a mode-market relative to the number of firms active in a mode-market, by mode-market-specific age. (C.13b): log of firm-destination export sales with respect to firm-destination export sales in the year after entry, firms with five or more years in the market. In the data, log of sales are first demeaned by industry, year, and destination fixed effects.

Averages across destinations included in the calibration, weighted by each destination's share of export firms. Weights are data-based and model-based, for data and model variables, respectively. Exporters in the data refers to non-MNE exporters only.

Figure C.14: Exporters' sales growth by age and type, calibrated models.

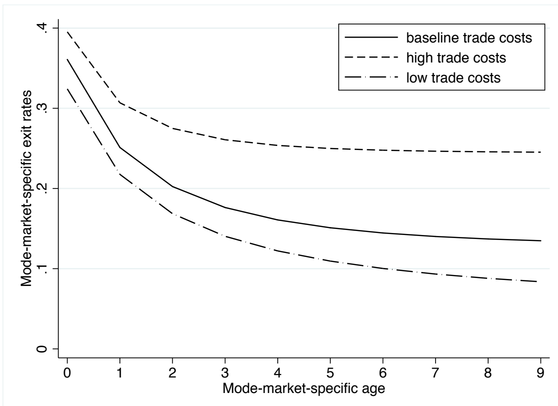


Notes: Models calibrated to Norwegian data. Log of firm-destination export (export and MNE) sales with respect to firm-destination export sales in the year after export entry, an average over firms with five or more years in the market as exporters. Averages across destinations included in the calibration, weighted by each destination's share of export firms. Weights are model-based. Never-MNE exporters are exporters that, in our sample period, do not change to MNE status. Ever-MNE exporters are exporters that become MNEs after export entry. Exports for ever-MNE exporters are computed for the years before MNE entry. Exporters in the data refers to non-MNE exporters only.

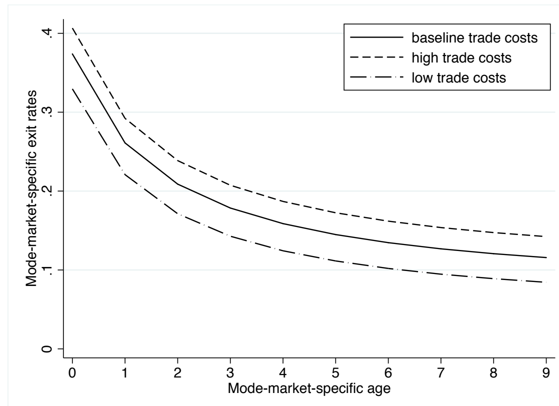
Figure C.15: New exporters' dynamics, high and low iceberg trade costs.

New exporters' exit rates

(a) Model with MNEs

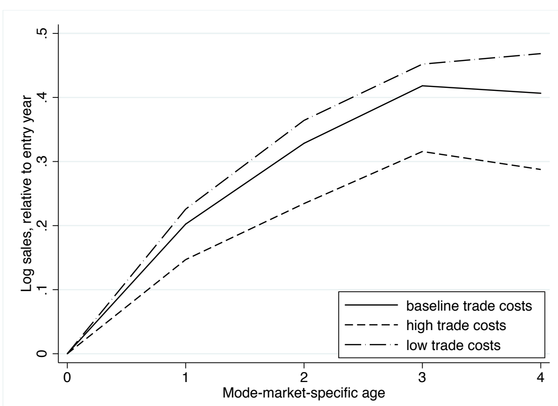


(b) Model without MNEs

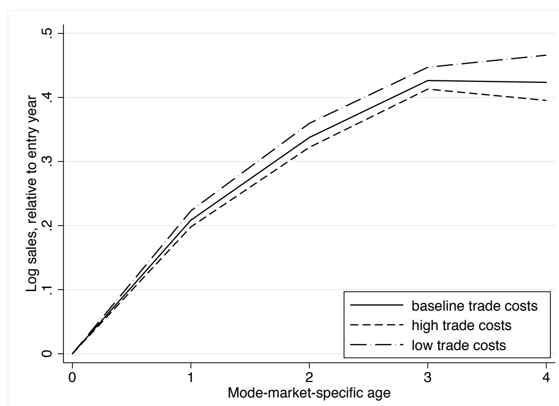


New exporters' sales growth

(c) Model with MNEs



(d) Model without MNEs

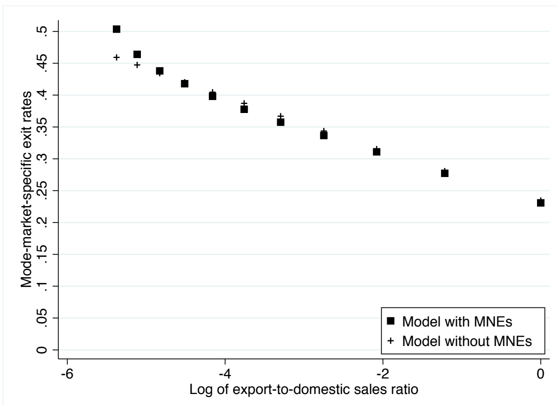


Notes: Models calibrated to Norwegian data. Upper panels: number of exits from a mode-market relative to the number of firms active in a mode-market, by mode-market-specific age. Lower panels: log of firm-destination export sales with respect to firm-destination export sales in the year after entry, firms with five or more years in the market.
Averages across destinations included in the calibration, weighted by each destination's share of export firms. Weights are model-based. High, low, and baseline refer, respectively, to iceberg trade costs, τ_n, that are 30 percent higher, 30 percent lower, and equal to the baseline calibrated values, for each destination n.

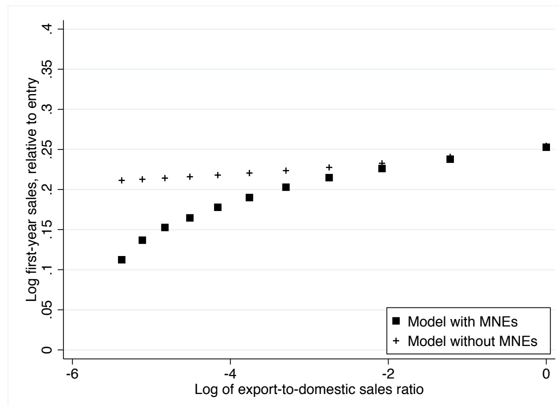
Figure C.16: New exporters' dynamics, comparative statics.

First year after export entry

(a) Exporters' exit rates

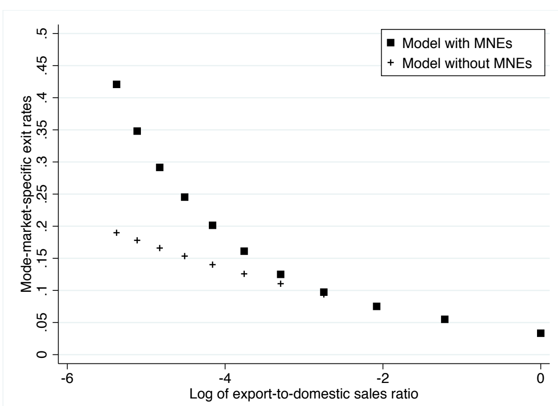


(b) Exporters' sales, relative to entry

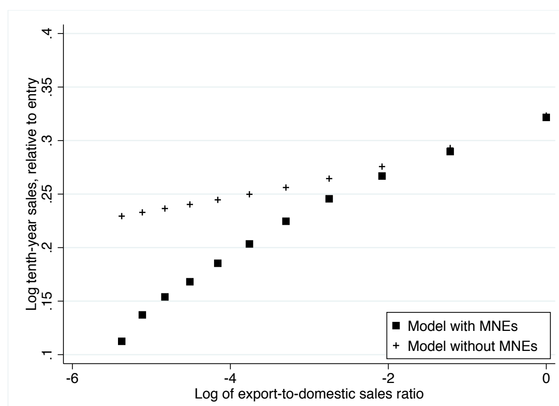


Tenth year after export entry

(c) Exporters' exit rates



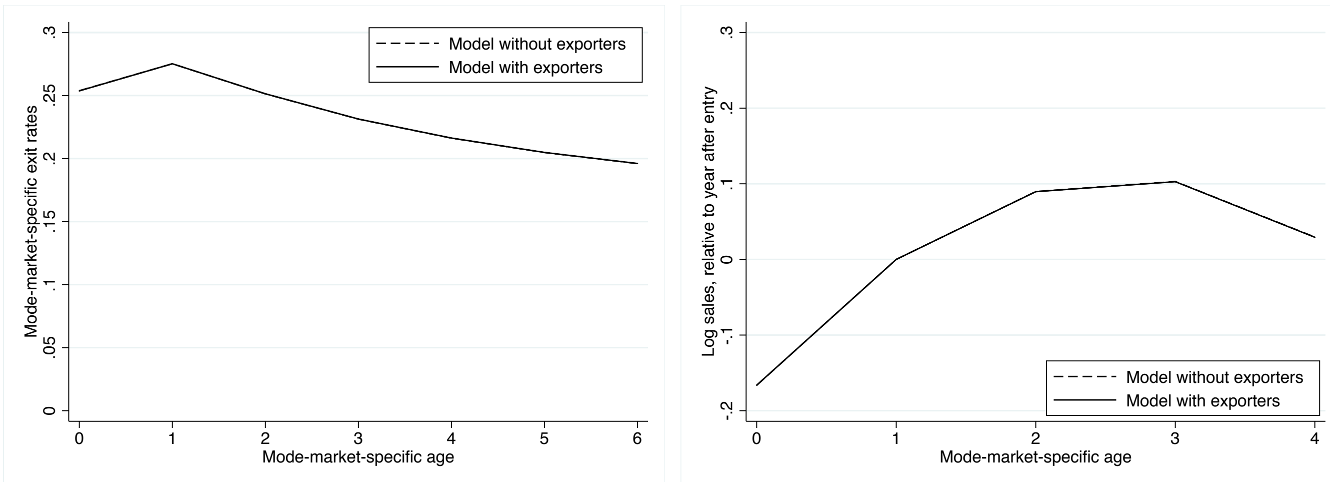
(d) Exporters' sales, relative to entry



Notes: Models calibrated to Norwegian data. (9a) and (9c): number of exits from a mode-market relative to the number of firms active in a mode-market, at age zero. (9b) and (9d): log of firm-destination export sales with respect to firm-destination export sales at age zero, firms with five or more years in the market. Averages across destinations included in the calibration, weighted by each destination's share of export firms. Weights are model-based.

Figure C.17: The role of exporters in new MNEs' dynamics.

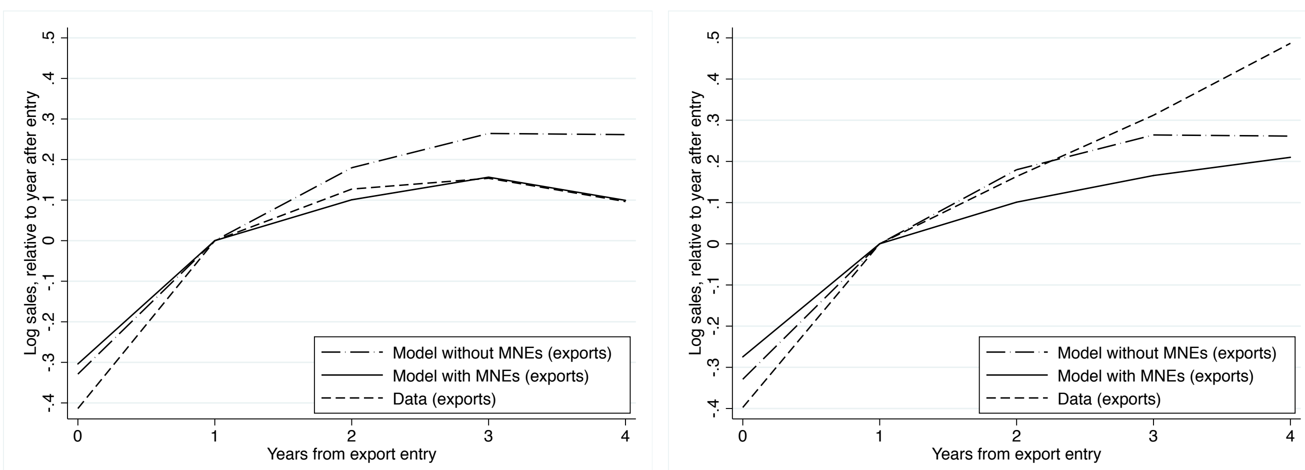
(a) New MNEs' exit rates | (b) New MNEs' sales growth



Notes: Models calibrated to French data. (C.17a): number of exits from a mode-market relative to the number of firms active in a mode-market, by mode-market-specific age. (C.17b): log of firm-destination MNE sales with respect to firm-destination MNE sales in the year after entry, firms with five or more years in the market.
Averages across destinations included in the calibration, weighted by each destination's share of MNE firms. Weights are model-based.

Figure C.18: Exporters' sales growth by age and type, calibrated models and data.

(a) Never-MNE exporters | (b) Ever-MNE exporters



Notes: Models calibrated to French data. Log of firm-destination export sales with respect to firm-destination export sales in the year after export entry, an average over firms with five or more years in the market as exporters. Averages across destinations included in the calibration, weighted by each destination's share of export firms. Weights are model-based. Never-MNE exporters are exporters that, in our sample period, do not change to MNE status. Ever-MNE exporters are exporters that become MNEs after export entry. Exports for ever-MNE exporters are computed for the years before MNE entry. Exporters in the data refers to non-MNE exporters only.

D Additional tables

Table D.1: Summary statistics.

	France			
	share of revenues	share of employment	share of firm-year obs	firm-year obs
Domestic firms	0.076	0.116	0.697	671,283
Non-MNE exporters	0.289	0.317	0.287	276,499
Non-exporter MNEs	0.005	0.010	0.001	1,007
Exporters MNEs	0.630	0.557	0.015	14,589
	Norway			
	share of revenues	share of employment	share of firm-year obs	firm-year obs
Domestic firms	0.153	0.235	0.622	55,359
Non-MNE exporters	0.625	0.630	0.364	32,376
Non-exporter MNEs	0.002	0.002	0.002	136
Exporter MNEs	0.220	0.133	0.013	1,147

Notes: Non-MNE exporters are exporters that do not have MNE activities. Non-exporter MNEs are MNEs that are not exporters. Exporter MNEs are MNEs that also export.

Table D.2: Size at entry and exit.

Dep. var.: log of Home sales	France coefficient	France standard error	Norway coefficient	Norway standard error
Transition dummies				
domestic to exporter	0.353	0.009	0.032	0.004
domestic to MNE	0.973	0.073	0.337	0.097
exporter to domestic	0.162	0.006	0.025	0.005
exporter to exporter	0.459	0.012	0.022	0.003
exporter to MNE	0.826	0.046	0.148	0.031
MNE to domestic	-0.524	0.119	-0.048	0.092
MNE to exporter	0.665	0.042	0.019	0.031
MNE to MNE	0.816	0.053	0.095	0.015

Notes: OLS coefficients from regressing (log of) domestic sales on a dummy for transitioning from status i to j. The regression includes year and firm fixed effects, and robust standard errors. Observations at the firm-destination level are 6,885,530 for France and 426,917 for Norway. Exporters refers to non-MNE exporters only.

Table D.3: Foreign-to-domestic sales ratio, by country.

France	r_n^x	r_n^m	Norway	r_n^x	r_n^m
Austria	0.003	0.024*	Austria	0.009	0.432
Benelux	0.068	0.135*	Belgium	0.029	0.086
Switzerland	0.011	0.064	Canada	0.010	0.130
China	0.014	0.213*	Germany	0.087	0.456
Germany	0.123	0.181	Denmark	0.030	0.501
Denmark	0.003	0.017*	Spain	0.031	0.051
Spain	0.044	0.119	Finland	0.025	0.546
Great Britain	0.040	0.181	France	0.045	0.231
Italy	0.054	0.100	Great Britain	0.069	0.193
Morocco	0.004	0.037	Italy	0.034	0.094
Portugal	0.006	0.019*	Netherlands	0.031	0.178
Poland	0.013	0.038	Poland	0.016	0.088
Sweden	0.012	0.037*	Sweden	0.065	0.918
Tunisia	0.004	0.008*	Singapore	0.018	0.382
United States	0.038	0.427*	United States	0.056	0.749
RoW	0.067	0.074	RoW	0.009	0.110

Notes: r_n^x refers to the export-to-domestic sales ratio, while r_n^m refers to the MNE affiliate-to-domestic sales ratio, for market n. (*) imputed values. RoW refers to the rest of the world, a weighted average among the remaining countries in the sample.

Table D.4: Targeted moments, model and data, summary statistics.

	Data, avg		Model, avg		Correlation, data-model	
	France	Norway	France	Norway	France	Norway
Share of MNEs	0.003	0.003	0.003	0.003	0.70	0.86
Share of exporters	0.090	0.087	0.088	0.086	0.99	0.99
First-year exit rate, exporters	0.462	0.528	0.369	0.380	0.59	0.65
First-year exit rate, MNEs	0.248	0.181	0.248	0.181	0.99	0.99

Notes: Unweighted averages across destination markets included in the calibration. Age zero refers to the entry year. Exporters in the data refers to non-MNE exporters only.

Table D.5: Targeted moments, model and data, by country.

	Data				Model			
	sh. exporters	sh. MNEs	first-year exit rates		sh. exporters	sh. MNEs	first-year exit rates	
			exporters	MNEs			exporters	MNEs
France								
Austria	0.054	0.001	0.462	0.258	0.054	0.001	0.388	0.257
Benelux	0.158	0.004	0.339	0.299	0.158	0.004	0.338	0.299
Switzerland	0.133	0.003	0.501	0.223	0.131	0.003	0.356	0.223
China	0.036	0.003	0.521	0.188	0.036	0.003	0.387	0.188
Germany	0.128	0.005	0.418	0.250	0.127	0.005	0.351	0.249
Denmark	0.050	0.001	0.452	0.195	0.050	0.001	0.390	0.195
Spain	0.118	0.005	0.416	0.249	0.117	0.005	0.354	0.249
Great Britain	0.105	0.004	0.429	0.297	0.104	0.004	0.359	0.296
Italy	0.111	0.004	0.438	0.295	0.110	0.004	0.358	0.296
Morocco	0.057	0.002	0.543	0.218	0.056	0.002	0.381	0.218
Poland	0.051	0.003	0.455	0.223	0.051	0.003	0.379	0.223
Portugal	0.070	0.002	0.455	0.235	0.069	0.002	0.376	0.235
Sweden	0.049	0.001	0.445	0.235	0.049	0.001	0.390	0.236
Tunisia	0.052	0.001	0.529	0.298	0.051	0.001	0.389	0.297
United States	0.078	0.006	0.511	0.238	0.077	0.006	0.360	0.237
RoW	0.194	0.008	0.488	0.273	0.191	0.008	0.334	0.273
Norway								
Austria	0.031	0.001	0.527	0.263	0.031	0.0010	0.405	0.262
Belgium	0.055	0.001	0.552	0.214	0.054	0.0010	0.392	0.214
Canada	0.039	0.001	0.549	0.222	0.039	0.0010	0.400	0.222
Germany	0.135	0.004	0.541	0.182	0.132	0.0040	0.356	0.182
Denmark	0.193	0.004	0.511	0.163	0.188	0.0040	0.344	0.164
Spain	0.060	0.001	0.533	0.059	0.065	0.0010	0.388	0.058
Finland	0.099	0.002	0.544	0.192	0.097	0.0020	0.371	0.192
France	0.073	0.003	0.524	0.310	0.072	0.0030	0.375	0.310
Great Britain	0.123	0.006	0.506	0.179	0.121	0.0060	0.354	0.179
Italy	0.062	0.002	0.553	0.154	0.063	0.0020	0.383	0.157
Netherlands	0.100	0.002	0.528	0.238	0.098	0.0020	0.370	0.239
Poland	0.055	0.002	0.504	0.071	0.054	0.0020	0.389	0.072
Sweden	0.249	0.007	0.484	0.158	0.242	0.0070	0.329	0.158
Singapore	0.035	0.002	0.505	0.150	0.035	0.0020	0.398	0.151
United States	0.077	0.004	0.519	0.130	0.076	0.0040	0.372	0.130
RoW	0.005	0.0001	0.572	0.204	0.005	0.0001	0.458	0.205

Notes: First-year exit rate refers to exit at age zero. RoW refers to the rest of the world, a weighted average among the remaining countries in the sample. Exporters in the data refers to non-MNE exporters only.

Table D.6: Calibrated parameters, by country.

	Model with MNEs				**Model without MNEs**		**Model without exporters**	
	f_n^x	f_n^m	F_n^x	F_n^m	f_n^x	F_n^x	f_n^m	F_n^m
France								
Austria	0.02	3.09	4.55E-05	1.77	0.02	1.66E-06	3.50	1.97
Benelux	0.14	4.25	2.91E-05	1.48	0.15	1.16E-04	8.29	2.94
Switzerland	0.03	3.82	1.53E-06	2.46	0.03	1.08E-06	4.55	2.94
China	0.14	13.9	4.88E-05	11.21	0.16	1.07E-06	14.8	11.98
Germany	0.32	3.28	2.89E-05	1.50	0.34	3.48E-04	9.25	4.61
Denmark	0.02	1.97	1.24E-06	1.66	0.02	4.40E-05	2.36	2.03
Spain	0.13	3.95	9.14E-05	1.96	0.14	2.10E-05	6.06	3.09
Great Britain	0.14	8.80	2.80E-06	3.22	0.14	3.69E-04	11.1	4.11
Italy	0.17	3.00	3.45E-05	1.03	0.18	1.30E-05	6.12	2.25
Morocco	0.03	3.08	1.13E-05	2.14	0.03	3.64E-05	3.41	2.35
Portugal	0.03	1.25	6.75E-06	0.75	0.03	4.84E-06	1.78	1.10
Poland	0.10	1.88	2.36E-04	1.14	0.10	2.24E-05	2.69	1.76
Sweden	0.10	3.68	1.15E-06	2.37	0.10	1.12E-05	5.30	3.47
Tunisia	0.04	0.66	1.10E-03	0.28	0.03	1.49E-05	1.19	0.53
United States	0.18	17.6	3.24E-04	9.38	0.19	8.20E-05	19.0	10.30
RoW	0.10	0.36	4.61E-05	0.10	0.11	3.42E-05	2.71	1.07
Norway								
Austria	0.03	6.80	1.02E-05	2.57	0.03	1.62E-05	6.88	2.63
Belgium	0.09	0.99	8.62E-03	0.55	0.07	1.01E-06	1.33	0.69
Canada	0.03	1.90	1.00E-06	0.92	0.03	8.35E-06	2.03	1.00
Germany	0.10	3.27	6.14E-05	1.78	0.10	1.28E-04	3.91	2.17
Denmark	0.02	4.04	2.50E-06	2.53	0.03	1.02E-06	4.25	2.66
Spain	0.06	0.33	2.01E-04	0.40	0.07	3.03E-05	0.68	1.02
Finland	0.04	6.09	1.72E-06	3.36	0.04	1.37E-06	6.34	3.56
France	0.08	2.02	1.40E-05	0.47	0.08	5.95E-05	2.39	0.58
Great Britain	0.09	0.97	6.00E-04	0.48	0.09	2.22E-05	1.37	0.75
Italy	0.07	0.76	1.83E-04	0.50	0.07	4.24E-05	1.07	0.75
Netherlands	0.05	1.80	2.91E-05	0.74	0.05	3.21E-06	2.12	0.89
Poland	0.04	0.79	2.35E-05	0.99	0.04	7.54E-06	0.92	1.18
RoW	0.08	3.66	5.11E-05	2.33	0.04	2.83E-06	3.90	2.52
Sweden	0.04	5.65	1.03E-06	3.48	0.06	1.03E-06	6.02	3.69
Singapore	0.05	4.18	1.43E-06	3.01	0.10	3.31E-04	4.31	3.12
United States	0.10	5.87	1.41E-05	4.54	0.08	5.38E-05	6.21	4.85

Notes: f_n^x are per-period fixed export costs; f_n^m are per-period fixed MNE costs; F_n^x are sunk export costs; and F_n^m are sunk MNE costs. RoW refers to the rest of the world, a weighted average among the remaining countries in the sample.

Table D.7: The size of calibrated costs, by country.

	as % of sales, for median firm				in U.S. dollars, for median firm			
	f_n^x	f_n^m	F_n^x	F_n^m	f_n^x	f_n^m	F_n^x	F_n^m
France								
Austria	12.99	12.64	0.027	7.24	3,372	n.a.	7.0	n.a.
Benelux	10.85	7.35	0.002	2.57	12,530	n.a.	2.6	n.a.
Switzerland	11.25	11.50	0.001	7.42	3,338	n.a.	0.2	n.a.
China	14.21	12.64	0.005	10.16	6,563	n.a.	2.2	n.a.
Germany	11.46	4.91	0.001	2.25	13,020	n.a.	1.2	n.a.
Denmark	13.16	11.36	0.001	9.58	3,318	n.a.	0.2	n.a.
Spain	11.76	9.00	0.008	4.46	9,591	n.a.	6.8	n.a.
Great Britain	11.95	11.28	0.000	4.13	9,984	n.a.	0.2	n.a.
Italy	11.80	6.96	0.002	2.38	8,850	n.a.	1.8	n.a.
Morocco	13.06	12.44	0.005	8.63	3,729	n.a.	1.6	n.a.
Portugal	12.61	9.79	0.003	5.90	3,731	n.a.	0.8	n.a.
Poland	13.46	9.55	0.033	5.80	5,889	n.a.	14	n.a.
Sweden	13.16	9.76	0.000	6.29	4,228	n.a.	0.1	n.a.
Tunisia	13.65	7.86	0.323	3.35	4,390	n.a.	104	n.a.
United States	12.83	12.59	0.024	6.71	6,471	n.a.	12	n.a.
RoW	10.42	1.81	0.005	0.52	7,975	n.a.	3.7	n.a.
Norway								
Austria	16.99	16.85	0.00	6.40	5,356	1,466,707	0.44	556,550
Belgium	11.60	11.58	0.01	5.55	3,981	295,513	4.59	141,719
Canada	16.73	15.71	0.00	7.59	4,996	1,132,263	1.06	546,922
Germany	14.88	13.57	0.00	7.28	6,153	1,079,257	0.35	579,026
Denmark	13.97	15.19	0.00	9.54	3,788	1,626,206	0.15	1,021,119
Spain	27.64	8.06	5.26	8.23	13,242	153,706	2,522	156,870
Finland	15.37	15.76	0.00	8.67	5,409	1,280,906	1.07	704,948
France	16.04	14.54	0.00	3.38	7,772	750,075	0.11	174,448
Great Britain	14.80	11.36	0.00	5.72	7,948	604,086	1.44	304,151
Italy	15.02	11.15	0.02	6.95	7,344	770,015	10.1	479,670
Netherlands	15.39	14.29	0.00	5.85	6,580	1,038,968	0.47	425,271
Poland	16.47	12.73	0.00	15.65	7,510	462,444	0.48	568,523
Sweden	12.50	17.92	0.00	12.86	4,959	1,264,241	0.22	907,372
Singapore	31.28	15.52	0.00	11.97	14,440	1,646,378	0.85	1,269,826
United States	24.98	13.58	0.02	8.58	12,918	1,818,547	11.1	1,149,656
RoW	6.82	14.27	0.00	8.80	1,672	938,725	0.09	578,789

Notes: f_n^x are per-period fixed export costs; f_n^m are per-period fixed MNE costs; F_n^x are sunk export costs; and F_n^m are sunk MNE costs. Median firm refers to the firm with median export (MNE) sales in destination n. RoW refers to the rest of the world, a weighted average among the remaining countries in the sample.