

The Dynamics of Multinational Activity: Evidence from U.S. Firms*

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Abstract

This paper examines how the activities performed by multinational firms change over their life cycle. Using a panel of U.S. multinational firms over 25 years from the U.S. Bureau of Economic Analysis, we classify affiliate sales as horizontal, vertical, or export platform based on their destination, and we trace the evolution of these three types of affiliate sales within firms over time. We establish two stylized facts. First, affiliate sales, both to the local market and to other countries, grow very little over the life cycle of the affiliate. Second, affiliates of U.S. multinational firms specialize in a core activity at birth, which persists as the main activity during the life cycle. Some diversification is observed later in life, particularly from horizontal to export activities. Informed by these facts, we propose a dynamic model of multinational production that is consistent with them. The model can be calibrated to shed light on the nature of the costs of multinational activity, which are essential ingredients to quantify the gains from openness arising from multinationals' operations.

JEL Codes: F1.

Key Words: Multinational firms, Firm dynamics, Foreign direct investment.

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1 Introduction

This paper starts by documenting the dynamic behavior of U.S.-based multinational enterprises (henceforth, MNEs). Multinationals are complex production structures, with affiliates in many locations, often involved in different activities spanning multiple countries and sectors. Using a panel of U.S. multinational firms over 25 years from the U.S. Bureau of Economic Analysis (BEA), we examine how the organization of their activities in space evolves over time.

In order to understand MNEs activities, we classify their affiliate sales as horizontal, vertical, or export platform based on their destination, and we trace the evolution of these three types of affiliate sales within firms over time. The analysis of the data delivers two interesting stylized facts. First, growth profiles are flat for all types of affiliates, particularly when they are compared with new exporters' growth. Second, affiliates of U.S. multinational firms specialize in a core activity at birth, which persists as the main activity during the life cycle. Diversification across the three types of sales is observed later in life, particularly from horizontal to export platform activities.

Multinational firms are the largest players in the world economy: Bernard et al. (2009) report that in the year 2000 they accounted for the vast majority of U.S. trade, and employed almost 20 percent of the entire U.S. workforce. For this reason, improving our understanding of their activities is a first-order concern to understand globalization.

We believe that studying the time dimension of MNEs' operations is important for two other reasons. First, most contributions in the literature have analyzed MNEs' complex choices in static settings. As evident in the models in Arkolakis et al. (2014) and Tintelnot (2014), allowing firms to set up affiliates in countries that might differ from the destinations of their sales results in a very complex combinatorial problem when fixed costs of productions are taken into account. We believe that the sharp patterns arising from the observation of affiliates over time can help to simplify this problem by reducing the choice set of firms in a way that is consistent with the data. More precisely, given that most new affiliates in the data start out as entities specialized in horizontal foreign direct investment (henceforth, FDI) and possibly diversify into other modes of operation later in life, we argue that the decision of performing different types of FDI can be separated into simple choices that happen at different points in time. This significantly simplifies the problem of the firm.

Second, and more substantially, dynamic features of the data inform us on the nature of the costs

of FDI: whether these costs are country and/or mode dependent, and on the relative importance of variable, fixed, and sunk costs. In turn, shedding light on the nature of the costs of FDI is crucial for the quantification of the gains from openness arising from MNEs operations.

The stylized facts that we present motivate a structural dynamic model of the evolution of the multinational firm. We model a set of Home-based firms that must decide whether, how and when to serve foreign markets through affiliate sales. Starting from the observation that almost the totality of firms have horizontal FDI, we assume that firms that decide to do FDI must first set up an affiliate and sell to the local market, and in a second stage decide whether to export from that affiliate (back Home or to third countries). Affiliate sales are associated with fixed and sunk costs of production, and firms decide whether or not to set up an affiliate (and then export from it) based on the interaction among their individual productivity level, an aggregate productivity shock, and demand conditions in foreign markets.

The model is successful at replicating qualitatively the stylized facts, and delivers additional testable implications, which are also borne in the data: diversified affiliates have larger horizontal sales than pure-type horizontal affiliates, and affiliates that start exporting later in life have larger horizontal sales than affiliates that start exporting at the beginning of their life cycle.

We conclude the paper by bringing the model to the data also quantitatively. This allows us to shed light on the nature and magnitudes of the costs of FDI, and to conduct welfare analysis in a dynamic setting. (IN PROGRESS)

[Literature review TBA]

The rest of the paper is organized as follows. Section 2 establishes the stylized facts about affiliates' dynamics. Section 3 presents the model and its qualitative testable implications. Section 4 contains the quantitative analysis. Section 5 concludes.

2 Establishing the Facts

Our descriptive empirical analysis is conducted using data from the Bureau of Economic Analysis (BEA). The BEA collects firm-level data on U.S. multinational companies' operations in its annual surveys of U.S. direct investment abroad. All U.S. headquartered firms with at least one foreign affiliate and that meet a minimum size threshold are required by law to respond to these surveys.

The data include detailed information on the firms' operations both in the U.S. and at their foreign affiliates, for the period 1987-2011. Each foreign affiliate in the dataset is assigned an industry classification based on its primary activity according to the BEA International Surveys Industry (ISI) system, which closely follows the 3-digit Standard Industrial Classification (SIC) system.¹ We include affiliates that list an activity in manufacturing as their primary activity and belong to a U.S. parent operating in any sector.

When a firm has more than one plant operating in the same country and industry, we group their activities together and refer to them as a single affiliate. We do this for two reasons. First, the firms themselves are permitted to report combined data for small affiliates in this way, making it difficult to isolate individual plants. Second, to the extent that the costs of opening a new affiliate are incurred at the country and industry level, this is the appropriate level of aggregation for our analysis. In a robustness exercise, we use reported openings of new plants in a country-industry in which the firm already had existing affiliates to check whether costs are incurred at the plant or country-industry level. This exercise, though based on noisy data, confirms that focusing on the country-industry-firm-, rather than plant-level, is appropriate.

Additionally, we restrict our attention to affiliates that do not operate in tax haven countries. Our goal is to capture actual MNE production, and reported tax haven activity may reflect accounting practices rather than actual output. Affiliates in tax haven countries are also likely to open for different reasons and be subject to different cost structures than those in non-tax haven countries, confounding our analysis. We compile our list of tax havens using information from Gravelle (2015). We omit countries that meet some of the criteria for tax haven status but that also have a substantial amount of real FDI production from the list. If a country is in the top ten percent of U.S. FDI destinations measured by total U.S. MNE affiliate employment, we consider it to be a location for actual production rather than a strict tax haven. Based on this definition, Hong Kong and Singapore are the only two countries from the Gravelle (2015) list that we do not classify as tax havens. A full list of tax haven countries is included in Appendix A.

In most of the analysis, we focus on *new* affiliates of existing U.S. corporations that survive for at least ten consecutive years in the market. We further trim from the sample affiliates and parents with zero total sales, assuming that there is a reporting error. Appendix A provides more details on the BEA data and the construction of our sample.

¹The BEA data use 3-digit SIC-based ISI codes for years prior to 1999. From 1999 onward, they use 4-digit NAICS-based ISI codes. For consistency, we convert the NAICS-based codes to 3-digit SIC-based ISI codes for the relevant years.

Table 1: Summary statistics: number of observations, by activity type.

Activity type	Horizontal	Vertical	Export-platform
All affiliates			
No. of observations	146,742	146,742	146,742
with positive sales	139,293 (94.92%)	78,014 (53.16%)	95,123 (64.82%)
<i>of which:</i>			
pure type	40,336 (27.49%)	2,071 (1.41%)	2,676 (1.82%)
share of sales accounted for by pure type affiliates	8.657%	0.632%	1.244%
Affiliates in our sample			
No. of observations	34,181	34,181	34,181
with positive sales	32,335 (94.6%)	15,869 (46.43%)	20,127 (58.88%)
<i>of which:</i>			
pure type	11,072 (32.39%)	523 (1.53%)	639 (1.87%)
share of sales accounted for by pure type affiliates	11.989%	0.823%	1.42%

Note: Observations are at the affiliate-year level. Affiliates in our sample, or “new” affiliates, are firms born during our sample period and survive for at least ten consecutive years. All affiliates are in the manufacturing sector. Horizontal, vertical, and export-platform refers, respectively, to sales to: the market where the affiliate is located; the home market; and third markets—outside the local and home markets. A pure-type affiliate is an affiliate with all its sales in only one activity type.

Crucially, the BEA data allow us to classify MNEs affiliates’ activities based on the destination of the affiliate sales.² Affiliate sales can be of the following three types: horizontal sales (H) are sales to the market where the affiliate is located; vertical sales (V) are sales to the home market—the United States in our data; and export-platform sales (E) are sales to third markets—outside both the local and U.S. markets.

Table 1 shows how our sample of manufacturing affiliates is distributed among the three different activities. Most of our affiliate-year observations have some sales in their host country (horizontal activities), while around half of our affiliates have some vertical or export-platform activity. A third of the observations corresponding to horizontal activities are of “pure type” (i.e., affiliates

²For now, we disregard the role of ownership and do not distinguish among transactions that take place at arm’s length or intrafirm.

with 100 percent of their sales in only one activity), while the shares of vertical and export-platform pure-type affiliates are negligible. Additionally, around 35 percent of our affiliate-year observations have all three type of activities, but a similar percentage have only one of the possible activities (not shown).

New affiliates are more specialized in horizontal activities than the magnitude observed among all affiliates: 60 percent of the affiliate-year observations with some horizontal activity had all its sales dedicated to the host market when they were born.³ Additionally, the higher share of affiliates with positive sales in all three activities observed among all affiliates, relative to new affiliates, loosely suggests that during their life-cycle, affiliates diversify away from the activity they started with when young and toward the other activities. We explore in detail these features below.

Table 2 shows in more detail the distribution of sales of each type, as a share of total affiliate sales. On average, almost three quarters of the affiliate sales are to the host market, while less than ten percent are back to the home country; the remaining 20 percent are affiliate exports to third markets. Indeed, as found by Ramondo et al. (2015), vertical sales, and to a lesser extent export-platform sales, are very concentrated in few affiliates, as indicated by the sales shares across the different percentiles. While the 75pc for horizontal shares is one, for vertical shares is less than five percent (and 29 percent for export-platform shares).⁴

Appendix A reports summary statistics for the time series.

2.1 New affiliates have flat sales growth profiles, regardless of their activity.

We start by examining the growth profiles of foreign affiliates of MNEs. These growth profiles for affiliates of MNEs are analogous to the ones documented by Ruhl and Willis (2015) for new exporters. Figure 1 shows the ratio of affiliate-to-parent sales, for each activity type, by affiliate age.

On average, new affiliates have sales volumes of about six percent of the parent's sales. Over the initial five years of life of the affiliate, this ratio goes up to about eight percent, reaching ten percent by the 10th year of life. As a comparison, Ruhl and Willis (2015) report that export shares

³77 percent of new affiliates were born as purely horizontal (this number is computed as the number of pure-horizontal born affiliates over the total number of affiliates at age one).

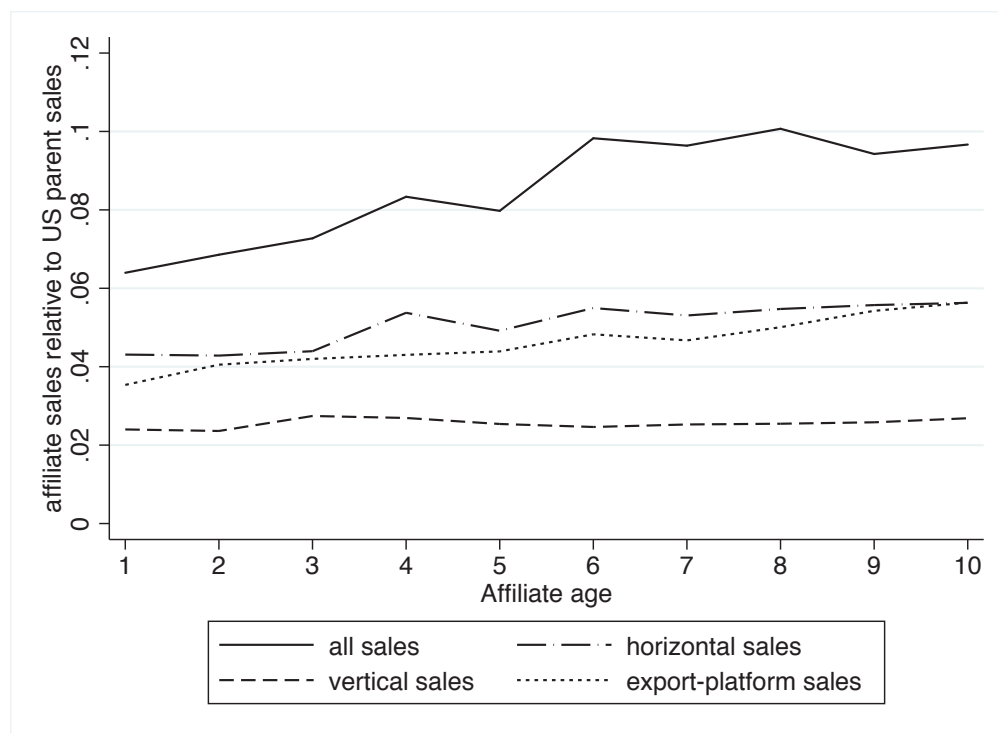
⁴To be clear, percentiles are taken with respect to the variable of interest so that the X-percentile affiliate changes as the sorting variable changes.

Table 2: Sample: affiliate sales, by activity type.

Activity type	Horizontal	Vertical	Export-platform (as a share of total affiliate sales)
average	0.723	0.080	0.197
std dev	0.343	0.200	0.291
25 pc	0.540	0.000	0.000
50 pc	0.897	0.000	0.022
75 pc	1.000	0.044	0.310
90 pc	1.000	0.244	0.723
95 pc	1.000	0.529	0.905

Note: Observations at the affiliate-year level, for new affiliates that survive for at least 10 consecutive years, in manufacturing. Horizontal, vertical, and export-platform refers, respectively, to sales to: the market where the affiliate is located; the home market; and third markets—outside the local and home markets. Averages of the 11 firms around the indicated percentile are reported to preserve confidentiality.

Figure 1: Affiliate to parent sales, by activity type.



Notes: Sample of new affiliates that survive for at least 10 consecutive years, in manufacturing. Horizontal, vertical, and export-platform refers, respectively, to sales to: the market where the affiliate is located; the home market; and third markets—outside the local and home markets.

more than double in the first five years of exporting. Looking at sales growth by activity type, the ratio of horizontal to parent sales increases by only one percentage point from 4.6 percent. Vertical sales appear flat, representing around 2.5 percent of the parent sales over the ten first years of life of the affiliate. In contrast, export platform sales, relative to the parent’s sales, grow steadily during the first years of life of the affiliate, increasing from 3.5 to 5.5 percent.

The patterns emerging from Figure 1 are captured by the following regression:

$$\text{affiliate sales}_a^i / \text{parent sales} = \beta_a \text{age} + FE + \varepsilon_a^i. \quad (1)$$

The left-hand side variable is the ratio of sales of type $i = H, V, E$, for a new affiliate of age a , to sales of the parent, age is the age of the affiliate (from 1 to 10), and ε_a^i is the error term. We include country-year and industry fixed effects, and alternately, country-year and affiliate fixed effects. Our sample consists of new affiliates in manufacturing that survive for at least ten consecutive years. Table 3 reports the results of estimating (1) by Ordinary Least Squares (OLS). The flat profiles observed in Figure 1 are confirmed by the regression analysis: the ratio of affiliate to parent sales is not significantly correlated with affiliate age, controlling for country-industry fixed effects. Notice that this result holds when comparing the cross-section of firms in the sample. Conversely, the specification with affiliate fixed effects displays negative and significant coefficients both in the pooled sample and for each affiliate type. We believe that this result is driven by the fact that – as a firm gets older – its total global sales grow, so the denominator of the affiliate/parent sales ratio may be driving the negative coefficients.

As a robustness check, we also include as controls the size of the affiliate and the size of the corporation, measured as employment and global sales, respectively; results are unchanged.

2.2 Affiliates are specialized in a core activity.

We present here several pieces of evidence to show that: (1) Affiliates are born specialized and this specialization persists later in life, even though affiliates may incorporate a secondary activity; (2) the specialization observed in the first year of life is persistent particularly for vertical and export-platform activities; and (3) most new affiliates are born overwhelmingly doing horizontal activities and become exporters later in their life cycle at a low intensity.

We document the evolution of sales in each activity over the life-cycle of new affiliates, and

Table 3: Affiliate to parent sales, by activity type. OLS.

Dep var	<i>affiliate sales_aⁱ/parent sales</i>							
	<i>i = all</i>		<i>i = H</i>		<i>i = V</i>		<i>i = E</i>	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
aff. age	0.002 (0.002)	-5.856*** (0.905)	0.002 (0.001)	-1.579*** (0.214)	0.0002 (0.0007)	-1.617*** (0.261)	0.0004 (0.001)	-1.561*** (0.317)
ind fe	yes	no	yes	no	yes	no	yes	no
ctry-yr fe	yes	yes	yes	yes	yes	yes	yes	yes
aff. fe	no	yes	no	yes	no	yes	no	yes
Obs	34,179	34,179	32,335	32,335	15,869	15,869	20,127	20,127
R-sq	0.0174	0.0003	0.0138	0.0001	0.0398	0.0002	0.0229	0.0003
within	0.0197	0.0010	0.0125	0.0007	0.0632	0.0008	0.0273	0.0001
between	0.0015	0.0013	0.0452	0.0052	0.0000	0.0000	0.0144	0.0015

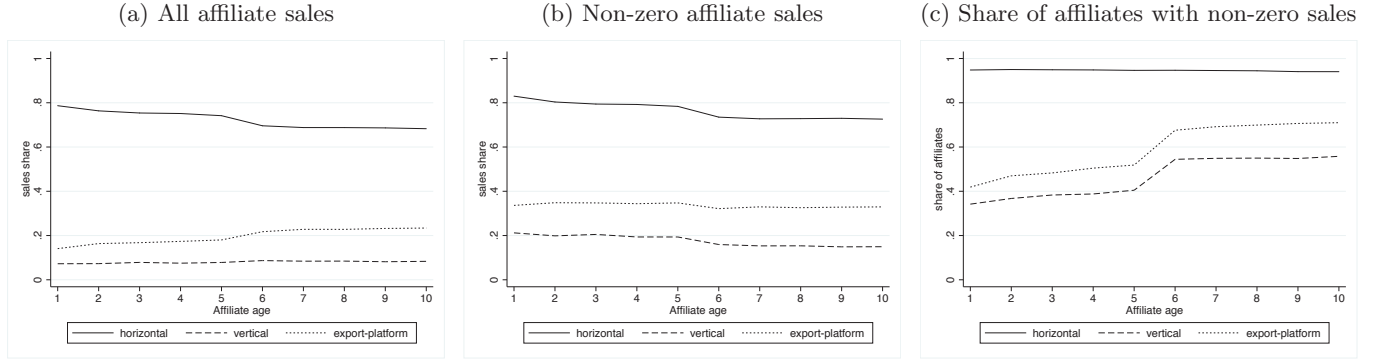
Note: Observations at the affiliate-year level, for new affiliates that survive for at least 10 consecutive years, in manufacturing. The variables H , V and E refer, respectively, to horizontal, vertical and export-platform sales. The dependent variable $affiliate\ sales_a^i/parent\ sales$ refers to the sales of type $i = H, V, E$ for a new affiliate of age a relative to the domestic sales of the U.S. parent. Robust standard errors, clustered at the parent level, are in parenthesis. Levels of significance are denoted *** $p < 0.01$, ** $p < 0.05$, and * $p < 0.1$.

decompose it into intensive and extensive margins. Figure 2 shows the evolution of mean affiliate sales of each type, as a share of total affiliate's sales, by affiliate age. Panel (a) plots the data for all new affiliates, while panel (b) is limited to affiliates with only positive sales in a given activity (intensive margin). To capture new affiliates transitioning into different kinds of sales, panel (c) plots the percentage of affiliates with non-zero sales in a particular type of activity (changes in panel (c) represent the extensive margin). While the mean horizontal share decreases with affiliate age from 0.78 in the first year in which the affiliate operates to 0.68 in the tenth year of life, the average vertical sale shares increases only slightly from 0.07 to 0.08, while the export platform sales share increases from 0.14 to 0.23. Changes in sales shares are mostly due to the intensive margin in the case of horizontal activities, while for vertical and export-platforms, affiliates with previously zero sales on those activities are the ones contributing to the increase in those activities.

The data also suggest that, over time, affiliates born with mostly horizontal sales diversify toward vertical and export-platform sales, which are in the minority. In general, all affiliates move toward having at least two of the three types of activities by their tenth year of life, as also suggested by the statistics in Table 1.

Figure 2 shows the raw data, but this pattern is confirmed by regressions including a battery

Figure 2: Intensive and extensive margins of sale shares, by activity type. All new affiliates.



Notes: Sample of new affiliates that survive for at least 10 consecutive years, in manufacturing. Horizontal, vertical, and export-platform refers, respectively, to sales to: the market where the affiliate is located; the home market; and third markets—outside the local and home markets. Average of sales in each type, as share of total affiliate’s sales, including all affiliates (2a) and affiliates with only positive sales in the corresponding activity (2b). Number of affiliates with positive horizontal, vertical and export-platform sales, respectively, as a share of the total number of affiliates (2c).

of fixed effects. Tables 4 and 5 report the results of the following regression:

$$\text{affiliate sales}_a^i / \text{total affiliate sales}_a = \beta_a \text{age} + FE + \varepsilon_a^i \quad (2)$$

where the left-hand side variable is sales of type $i = H, V, E$, for a new affiliate of age a , as a share of total sales of the affiliate, age is the age of the affiliate (from 1 to 10), and ε_a^i is the error term. We include country-year and industry fixed effects, and alternatively, country-year and affiliate fixed effects. In the robustness section, we also include the size of the affiliate and the size of the corporation measured as employment and global sales, respectively; results are unchanged.

On average, sales shares in each activity type for younger affiliates are not significantly different from the shares for older affiliates, but the share of affiliates doing vertical and export-platform activities is higher among older affiliates. Results are sharper when within-affiliate changes are considered: over time, new affiliates abandon horizontal sales (almost one-to-one) for export platform activities, both at the intensive and extensive margin. The patterns observed in Figure 2 are driven by within-firm variation.

The next figure and table focus on the sub-set of pure-type affiliates (i.e., affiliates with all sales in only one activity). First, it is worth noting that affiliates which are born with only horizontal sales represent half the number of observations corresponding to new affiliates with some positive horizontal activity, while the ones purely vertical or export-platform only represent less than five percent of observations in their respective activity group.

Table 4: Sale shares and age, by activity type. All new affiliates. OLS.

Dep var	$sales_a^i/total\ sales_a$					
	$i = H$		$i = V$		$i = E$	
	(1)	(2)	(3)	(4)	(5)	(6)
aff age	-0.002 (0.002)	-0.014*** (0.002)	0.001 (0.001)	0.001** (0.001)	0.001 (0.002)	0.01*** (0.001)
ind fe	yes	no	yes	no	yes	no
ctry-yr fe	yes	yes	yes	yes	yes	yes
aff fe	no	yes	no	yes	no	yes
Obs	34,181	34,181	34,181	34,181	34,181	34,181
R-sq	0.094	0.006	0.076	0.047	0.000	0.008
within	0.095	0.025	0.067	0.056	0.001	0.026
between	0.104	0.000	0.098	0.044	0.001	0.001

Note: Observations at the affiliate-year level, for new affiliates that survive for at least 10 consecutive years, in manufacturing. The variables H , V and E refer, respectively, to horizontal, vertical and export-platform sales. $sales_a^i/total\ sales_a$ refers to sales of type $i = H, V, E$ for a new affiliate of age a , as a share of total affiliate's sales. Robust standard errors, clustered at the parent level, are in parenthesis. Levels of significance are denoted $***p < 0.01$, $**p < 0.05$, and $*p < 0.1$.

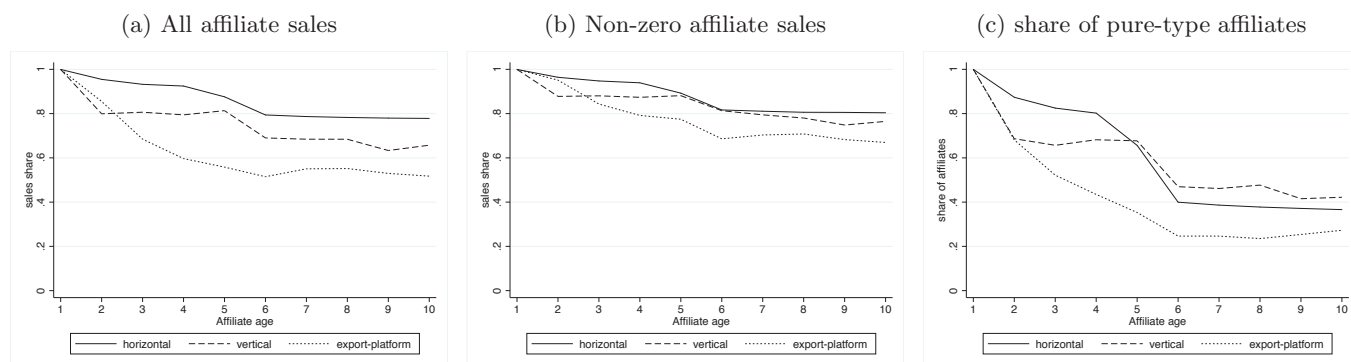
Table 5: Intensive and extensive margins of sale shares, by activity type. All new affiliates. OLS.

Dep var	$sales_a^i (sales_a^i > 0)/total\ sales_a$						$D(sales_a^i > 0)$					
	$i = H$		$i = V$		$i = E$		$i = H$		$i = V$		$i = E$	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
aff age	-0.002 (0.002)	-0.015*** (0.0015)	-0.002 (0.002)	-0.003** (0.0013)	-0.005** (0.002)	0.005*** (0.0015)	-0.001 (0.001)	-0.0003 (0.0009)	0.006*** (0.002)	0.035*** (0.003)	0.014*** (0.003)	0.042** (0.003)
ind fe	yes	no	yes	no	yes	no	yes	no	yes	no	yes	no
ctry-yr fe	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
aff fe	no	yes	no	yes	no	yes	no	yes	no	yes	no	yes
Obs	32,335	32,335	15,869	15,869	20,127	20,127	34,181	34,181	34,181	34,181	34,181	34,181
R-sq	0.080	0.006	0.093	0.005	0.046	0.007	0.044	0.000	0.088	0.008	0.067	0.033
within	0.081	0.035	0.080	0.003	0.066	0.005	0.037	0.000	0.059	0.053	0.042	0.062
between	0.069	0.000	0.198	0.008	0.024	0.021	0.067	0.001	0.186	0.006	0.124	0.011

Note: Observations at the affiliate-year level, for new affiliates that survive for at least 10 consecutive years, in manufacturing. The variables H , V and E refer, respectively, to horizontal, vertical and export-platform sales. In columns (1)-(6), $sales_a^i (sales_a^i > 0)/total\ sales_a$ refers to sales of type $i = H, V, E$ for a new affiliate of age a , conditional on having positive sales in type i , as a share of total affiliate's sales. In columns (7)-(12), $D(sales_a^i > 0)$ is a dummy variable equal to one if sales of type $i = H, V, E$ for a new affiliate of age a are positive. Robust standard errors, clustered at the parent level, are in parenthesis. Levels of significance are denoted $***p < 0.01$, $**p < 0.05$, and $*p < 0.1$.

That is, new affiliates with all their sales in vertical or export-platform activities in their first year of life are extremely few. With this in mind, Figure 3 shows that, on average, sale shares of all pure-type born affiliates decrease with age: the initial specialization is soon followed by more diversified sales patterns. One may get the misleading impression that horizontal sale shares decrease by less than vertical and export-platform shares for affiliates born with only one type of sales, respectively. However, it is worth noting that by the tenth year of life, a pure-vertical born affiliate, for instance, is still in the 95 percentile of the vertical sale share distribution (0.52), as indicated by Table 2—and much above the average (0.08) and median (0.0001) of the distribution—while an affiliate born exclusively serving the host market, by age ten, is around the 50 percentile of the horizontal sale share distribution (0.81). A similar concentration is observed for export-platforms: affiliates born with only exports to third markets end up, by their age ten with an average export-platform sales share of 65 percent, which correspond to the 75-95 percentile of this variable’s distribution. We analyze in more detail the persistence of these specialization patterns below.

Figure 3: Intensive and extensive margins of sale shares, by activity type. Pure-type-born affiliates.



Notes: Sample of new affiliates that survive for at least 10 consecutive years, in manufacturing. Horizontal, vertical, and export-platform refers, respectively, to sales to: the market where the affiliate is located; the home market; and third markets—outside the local and home markets. Figures 3a and 3b show the average horizontal, vertical, and export-platform sales (as a share of the total affiliate affiliates), respectively, with and without including zero sales in the activity, for the sub-set of pure-type born affiliates (i.e, with all sales in only one activity). Figure 3c shows the number of pure-type affiliates, as a share of the total number of affiliates.

Affiliates devoted exclusively to vertical and export-platform activities are a stable set of very few affiliates. The set of purely horizontal affiliates shrinks over the life cycle of affiliates indicating, once again, that new affiliates start by serving their host market almost exclusively, and then, they start exporting, both back home and to other markets. This is reminiscent of the life cycle of a domestic firm: first, they serve their home market, then they become exporters (and do so at a low intensity in terms of the ratio of export to domestic sales).

Table 6: Sale shares and age, by activity type. Pure-type-born affiliates. OLS.

Dep var	$sales_a^i/total\ sales_a$					
	$i = H$		$i = V$		$i = E$	
	(1)	(2)	(3)	(4)	(5)	(6)
aff age	-0.013*** (0.002)	-0.021*** (0.002)	-0.004 (0.015)	-0.042*** (0.011)	-0.030 (0.019)	-0.059*** (0.009)
ind fe	yes	no	yes	no	yes	no
ctry-yr fe	yes	yes	yes	yes	yes	yes
aff fe	no	yes	no	yes	no	yes
Obs	16,908	16,908	657	657	683	683
R-sq	0.132	0.023	0.035	0.059	0.090	0.08
within	0.065	0.078	0.273	0.124	0.429	0.191
between	0.176	0.001	0.001	0.003	0.008	0.004

Note: Observations at the affiliate-year level, for new affiliates that survive for at least 10 consecutive years, in manufacturing. The variables H , V and E refer, respectively, to horizontal, vertical and export-platform sales. The sample is restricted to affiliates born with 100 percent of their sales in type $i = H, V, E$, with $sales_a^i/total\ sales_a$ being sales of type $i = H, V, E$, as a share of total affiliate's sales, for an affiliate of age a . Robust standard errors, clustered at the parent level, are in parenthesis. Levels of significance are denoted *** $p < 0.01$, ** $p < 0.05$, and * $p < 0.1$.

Interestingly, Tables 6 and 7 show that the downward-sloping profile observed in Figure 3a for affiliates born with only vertical and export-platform activities, is a result of within-affiliate changes. That is, on average, affiliates of different age have undistinguishable vertical and export-platform sales shares, but a pure-type born new affiliate decreases these shares as it gets older. For affiliates born with only horizontal sales the effect is a mix of between- and within-firm effects.

Finally, Figure 4 shows the mean sales share in each activity for affiliates that start that activity at age one, two, ... , ten. This figure makes clear that affiliates which are born performing one activity will stick to it for the remaining of their life, but if the activity is incorporated later in life, it is not the core activity of the affiliate. Affiliates that are born doing some horizontal FDI have an average horizontal FDI sale share of above 80 percent (slightly less than the median of this variable's distribution), while affiliates that are born doing some vertical (export-platform) activities have an average vertical (export-platform) sale share of almost 20 percent (30 percent), which correspond to almost the 90th percentile (75th percentile) of that share's distribution. If an affiliate were to start doing horizontal sales in its tenth year of life, on average, it would dedicate only 25 percent of its sales to the local market, while it would dedicate at most 3 percent of its sales to exports. The message from this figure complements the ones above: an affiliate is most likely to start its main life-long activity of business right away.

Table 7: Intensive and extensive margins of sale shares, by activity type. Pure-type-born affiliates. OLS.

Dep var	$sales_a^i (sales_a^i > 0) / total\ sales_a$						$D(sales_a^i / total\ sales_a = 1)$				
	$i = H$		$i = V$		$i = E$		$i = H$		$i = V$		$i = E$
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
aff age	-0.012*** (0.002)	-0.021*** (0.002)	0.008 (0.009)	-0.043*** (0.011)	-0.006 (0.011)	-0.059*** (0.009)	-0.041*** (0.004)	-0.063*** (0.004)	-0.013 (0.015)	-0.069*** (0.011)	-0.051** (0.020)
ind fe	yes	no	yes	no	yes	no	yes	no	yes	no	yes
ctry-yr fe	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
aff fe	no	yes	no	yes	no	yes	no	yes	no	yes	no
Obs	16,556	16,556	588	588	549	549	16,908	16,908	657	657	683
R-sq	0.13	0.023	0.059	0.059	0.030	0.0780	0.239	0.067	0.063	0.068	0.123
within	0.06	0.078	0.226	0.125	0.564	0.1918	0.081	0.160	0.282	0.198	0.386
between	0.14	0.001	0.002	0.003	0.012	0.0036	0.368	0.000	0.000	0.009	0.026

Note: Observations at the affiliate-year level, for new affiliates that survive for at least 10 consecutive years, in manufacturing. The variables H , V and E refer, respectively, to horizontal, vertical and export-platform sales. In columns (1)-(6), the sample is restricted to pure-type born affiliates with positive sales in the respective activity type. In columns (7)-(12), $D(sales_a^i / total\ sales_a = 1)$ is a dummy variable equal to one if the affiliate at age a is of pure-type $i = H, V, E$ (i.e., the share of sales of type i in total sales is 1). Robust standard errors, clustered at the parent level, are in parenthesis. Levels of significance are denoted *** $p < 0.01$, ** $p < 0.05$, and * $p < 0.1$.

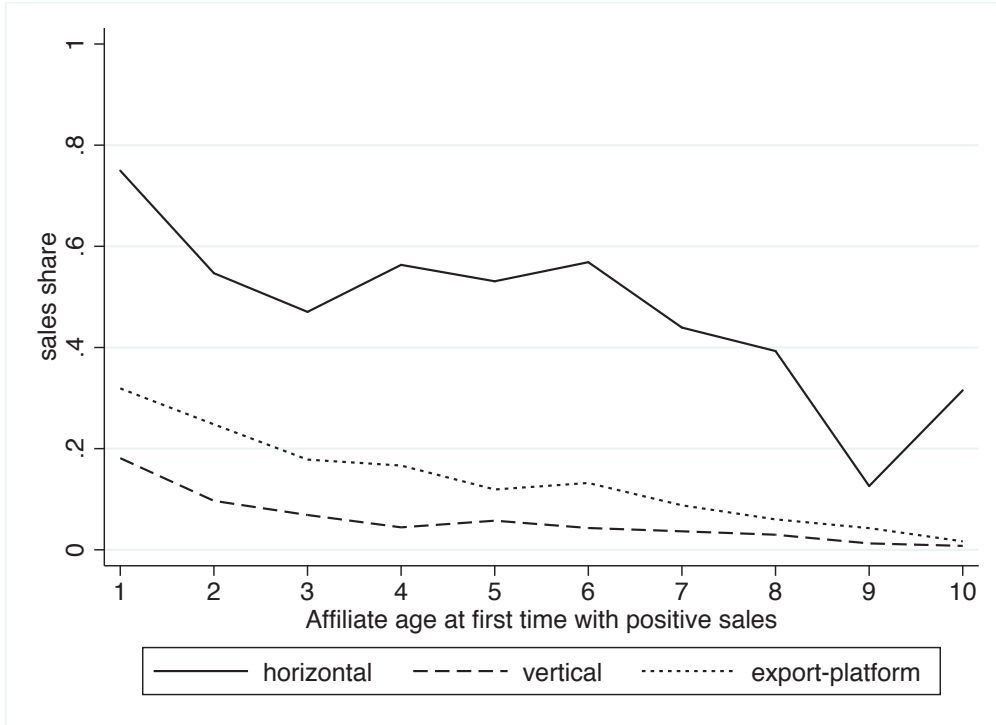
In the next section we propose a simple model of affiliate expansion that mimics the facts illustrated here.

3 Model

In this section we develop a dynamic model of FDI that is designed to reproduce the facts illustrated in Section 2. The static components of our setting follow the treatment of FDI in Helpman et al. (2004), while the dynamic choice of whether or not to enter a country with an affiliate is modeled as in Fillat et al. (2015). The model features the three types of FDI that we study in the data: horizontal, vertical, and export platform, and as such shares important features with Arkolakis et al. (2014).

For simplicity, and to convey intuition about the channels of the model, we start from a simplified version in which we do not distinguish between vertical and export platform FDI sales, or among export platform sales to different destinations, but simply treat all these sales as exports of the affiliate. We will re-introduce this distinction in the quantitative analysis that follows.

Figure 4: Sales shares and entry age, by activity type.



Notes: Sample of new affiliates that survive for at least 10 consecutive years, in manufacturing. Average sales shares in each activity for affiliates that enter that particular activity at age 1, 2, ..., 10. Horizontal, vertical, and export-platform refers, respectively, to sales to: the market where the affiliate is located; the home market; and third markets—outside the local and home markets.

3.1 Preferences and Technologies

The economy is composed by $N + 1$ countries: the Home country (the U.S. in our data) and N possibly asymmetric foreign countries. The Home country is populated by a given mass of domestic firms, who decide whether to operate only in their home market or to establish foreign affiliates in other countries.

In each country, consumers have CES preferences:

$$U = \int_0^\infty e^{-\rho t} Q(t) dt \quad (3)$$

where $Q(t) = [\int q_i(t)^{1-1/\eta} di]^{1/(\eta-1)}$ and $\eta > 1$. Each country is populated by a continuum of firms. Each firm produces one good i and firms operate under monopolistic competition.

Like in Melitz (2003), each firm is endowed with a productivity parameter φ , drawn from a distribution $G(\varphi)$. Each firm sets prices to maximize profits from sales of its own good, and prices

are given by a constant mark-up over marginal cost: $p(\varphi) = \frac{\eta}{\eta-1}MC(\varphi)$, where $MC(\cdot)$ denotes the marginal cost of the firm. When the firm produces domestically, $MC_d(\varphi) = w_d/\varphi$, where w_d is the wage in the Home country. When the firm sets up an affiliate in a foreign country j ($j = 1, \dots, N$), $MC_j(\varphi) = w_j/\varphi$, as it hires labor in the country where production takes place. In order to produce, firms also have to pay fixed continuation costs. For simplicity, we assume that there are no fixed costs associated with domestic activity (so that all firms produce in the Home market), while production in foreign country j is associated with a fixed cost $f_j > 0$. When a firm enters a foreign market by establishing an affiliate there, we also assume that it has to pay a one-time sunk entry cost, that we denote with $F_j > 0$.

When a firm establishes an affiliate in a foreign country, it starts by selling there, so engaging in horizontal FDI. Once the affiliate is in place though, it can be used to produce volumes that are destined also to other countries, so engaging in vertical FDI (if the affiliate sells goods back to the Home market) or export platform FDI (if the affiliate sells to third countries, other than Home and the country where the affiliate is located). In this way, we can have pure-type horizontal affiliates, but also affiliates that choose more than one mode of operation.⁵ We assume that affiliates' exports are associated with start-up costs F_j^e , fixed costs f_j^e , and variable iceberg costs τ_j^e .

Let $\pi_d(\varphi)$ denote a firm's domestic profits, $\pi_j^h(\varphi)$ denote the profits from local sales of an affiliate located in country j (horizontal sales), and $\pi_j^e(\varphi)$ denote the profits from exports of an affiliate located in country j , to the U.S. and/or to third markets other than j (vertical and export platform FDI):

$$\pi_d(\varphi) = H \left(\frac{w_d}{\varphi} \right)^{1-\eta} P_d^\eta Q_d \quad (4)$$

$$\pi_j^h(\varphi) = H \left(\frac{w_j}{\varphi} \right)^{1-\eta} P_j^\eta Q_j - f_j^h \equiv \bar{\pi}_j^h(\varphi) - f_j^h \quad (5)$$

$$\pi_j^e(\varphi) = H \left(\frac{\tau_j w_j}{\varphi} \right)^{1-\eta} P_{\sim j}^\eta Q_{\sim j} - f_j^e \equiv \bar{\pi}_j^e(\varphi) - f_j^e \quad (6)$$

where $H \equiv \eta^{-\eta}(\eta-1)^{\eta-1}$, P_j is the aggregate price index in country j , and Q_j is the aggregate quantity demanded in country j . $P_{\sim j}^\eta Q_{\sim j}$ represents the total market size for the exports of affiliates located in j .

⁵This version of the model does not feature pure-type vertical or pure-type export platform affiliates. Appropriate choices of the shock process may give rise to those as well, but this may not be a first-order issue: as we reports in Section 2, pure-type vertical and and export platform affiliates are only 3.4% of all affiliates in our sample, and account for only 2.24% of total affiliate sales.

Firms take decisions about whether, when and how to enter a market by computing their expected profits net of entry and continuation costs depending on their productivity and market specific variables (productivity or demand shocks), which represent the aggregate state of the economy. For simplicity, we define firm-level productivity φ to be the product of a constant firm-specific component, z , and of a stochastic Home country-specific component, Z , like in Ghironi and Melitz (2005): $\varphi \equiv z \cdot Z$, where z is a firm-specific draw from a given distribution $G(z)$ (say a Pareto), and $Z = e^X$, where X is a standard Brownian motion with drift:⁶

$$dX = \mu dt + \sigma dz \quad (7)$$

for $\mu \in \Re$ and $\sigma > 0$. So the state of the economy is given by the vector of country-specific productivity shocks $X = (X_1, X_2, \dots, X_{N+1})$.

3.2 Value Functions

Based on this structure, we are now in a position to define the value functions and Bellman equations. Let $\mathcal{V}(z, X)$ denote the expected net present value of a firm with productivity z , when the state of the economy is described by X , and following optimal policy. The value of the firm is given by the value of its domestic operations (which we denote with $V_d(z, X)$), and by the value of its affiliates, which also depend on the affiliates' activities:

$$\mathcal{V}(z, X) = V_d(z, X) + \sum_{j=1}^N \max \left\{ V_j^o(z, X), V_j^h(z, X), V_j^e(z, X) \right\} \quad (8)$$

where $V_j^o(z, X)$ denotes the option value of opening an affiliate in country j , $V_j^h(z, X)$ denotes the value of a pure type horizontal affiliate in country j , and $V_j^e(z, X)$ denotes the value of an affiliate based in country j that also exports, back home and/or to third markets.

Since all firms always operate in the domestic market, the Bellman equation for the value of domestic operations simply describes the evolution of domestic profits over time depending on the aggregate state. Over a generic time interval Δt :

$$V_d(z, X) = \frac{1}{1 + (\rho + \delta)\Delta t} \left[\pi_d(z, X)\Delta t + E[V_d(z, X')|X] \right] \quad (9)$$

⁶Impullitti et al. (2013) also model log-productivity with a unit root process.

where ρ is the subjective time discount rate, δ is an exogenous death rate, and X' denotes the aggregate state in the next period.

For each foreign country $j = 1, \dots, N$, the firm may or may not have an affiliate located there. If a firm does not have an affiliate in country j , all the value from operations in j is option value, *i.e.*, the value of the possibility of entering j in the future. The Bellman equation describing the value of an option country is:

$$V_j^o(z, X) = \max \left\{ \frac{1}{1 + (\rho + \delta)\Delta t} E[V_j^o(z, X')|X]; V_j^h(z, X) - F_j^h \right\} \quad (10)$$

which describes the fact that a firm may keep the option of entering market j (and get the continuation value of that option), or may enter country j by opening an affiliate there, in which case it pays the entry cost F_j^h and gets the value of a horizontal affiliate in j , $V_j^h(z, X)$.

Alternatively, a firm may have an affiliate located in country j . In this case, it gets value from horizontal sales to the local market in j . However, once the affiliate is set up, the firm may decide to produce in j to export to other markets, the Home country (vertical FDI) or third countries (export platform FDI).⁷ This option is reflected in the Bellman equation:

$$V_j^h(z, X) = \max \left\{ \frac{1}{1 + (\rho + \delta)\Delta t} \left[\pi_j^h(z, X)\Delta t + E[V_j^h(z, X')|X] \right]; V_j^e(z, X) - F_j^e \right\} \quad (11)$$

where $V_j^e(z, X)$ is the value of sales of an affiliate in country j which is also involved in vertical and/or export platform sales, and F_j^e is the sunk cost of starting exporting from an affiliate in j . Lastly, the value of an affiliate that both sells domestically and exports is simply given by its flow profit over time:

$$V_j^e(z, X) = \frac{1}{1 + (\rho + \delta)\Delta t} \left[(\pi_j^h(z, X) + \pi_j^e(z, X))\Delta t + E[V_j^e(z, X')|X] \right] \quad (12)$$

The structure that we imposed on the profit functions and the shock process implies that, by evaluating the Bellman Equations in their continuation regions and applying Ito's lemma, we can solve for the value functions in closed form up to multiplicative parameters.⁸

⁷For now we bundle together vertical and platform FDI, and model only aggregate exports of an affiliate, a magnitude that we can measure in the data. This assumption will be removed in the quantitative analysis.

⁸The derivation of the value functions is contained in Appendix B.

The value of domestic sales is simply given by the present discounted value of profits from domestic sales:

$$V_d(z, X) = \frac{\pi_d(z, X)}{\rho + \delta - \hat{\mu}} \quad (13)$$

where $\hat{\mu} = \mu(\eta - 1) - \frac{1}{2}\sigma^2(\eta - 1)^2$, and the discount rate takes into account the exogenous exit rate and the effect of the evolution of aggregate productivity on profits.

The option value of opening an affiliate is given by:

$$V_j^o(z, X) = B_j^o(z)e^{\beta X} \quad (14)$$

where $B_j^o(z) > 0$ is a firm-specific parameter to be determined and β is the positive root of: $\frac{1}{2}\sigma^2\xi^2 + \mu\xi - (\rho + \delta) = 0$. The option value is increasing in the realization of the aggregate productivity shock, indicating that there is a higher value to be obtained from opening an affiliate when aggregate productivity is high.

The value of a pure-type horizontal affiliate in country j is:

$$V_j^h(z, X) = B_j^h(z)e^{\beta X} + \frac{\bar{\pi}_j^h(z, X)}{\rho + \delta - \hat{\mu}} - \frac{f_j^h}{\rho + \delta} \quad (15)$$

where $B_j^h(z) > 0$ is a firm-specific parameter to be determined. The value of a horizontal affiliate is composed of discounted profits plus the option value of expanding to third markets. Also the option value of exporting is increasing in the realization of the aggregate productivity shock, indicating that there is a higher value to be obtained from exporting from an affiliate when aggregate productivity is high.

Finally, the value of an affiliate in country j who sells locally and exports is given by the present discounted value of its profits:

$$V_j^e(z, X) = \frac{\bar{\pi}_j^h(z, X) + \bar{\pi}_j^e(z, X)}{\rho + \delta - \hat{\mu}} - \frac{f_j^h + f_j^e}{\rho + \delta}. \quad (16)$$

To completely characterize the problem of the firm, it remains to solve for the two parameters $B_j^o(z)$, $B_j^h(z)$ and for the thresholds in the realizations of the aggregate shocks that induce a firm to change status.

Let $X_j^h(z)$ denote the realization of X that induces a firm with productivity z to open a plant

in j , and let $X_j^e(z)$ denote the realization of X that induces a firm with productivity z with a plant in j to export from its foreign plant. The values of $B_j^o(z)$, $B_j^h(z)$, $X_j^h(z)$ and $X_j^e(z)$ are identified by the following system of value matching and smooth pasting conditions:

$$V_j^o(z, X_j^h) = V_j^h(z, X_j^h) - F_j^h \quad (17)$$

$$V_j^h(z, X_j^e) = V_j^e(z, X_j^e) - F_j^e \quad (18)$$

$$V_j^{o'}(z, X_j^h) = V_j^{h'}(z, X_j^h) \quad (19)$$

$$V_j^{h'}(z, X_j^e) = V_j^{e'}(z, X_j^e). \quad (20)$$

The above is a system of 4 equations in 4 unknowns that must be solved for each firm and for each foreign country. The simple structure of the model allows us to solve for the firms' value functions and policy functions in closed form.

The value function parameters $B_j^o(z)$ and $B_j^h(z)$ are given by:

$$B_j^o(z) = k_B \cdot \left[\left(\frac{k_j^h(z)}{\beta(\rho + \delta - \hat{\mu})} \right)^{\frac{\beta}{(\eta-1)}} \cdot \left(\frac{f_j^h + (\rho + \delta)F_j^h}{\rho + \delta} \right)^{\frac{\eta-1-\beta}{\eta-1}} + \dots \right. \\ \left. \dots \left(\frac{k_j^e(z)}{\beta(\rho + \delta - \hat{\mu})} \right)^{\frac{\beta}{(\eta-1)}} \cdot \left(\frac{f_j^e + (\rho + \delta)F_j^e}{\rho + \delta} \right)^{\frac{\eta-1-\beta}{\eta-1}} \right] \quad (21)$$

$$B_j^h(z) = k_B \cdot \left(\frac{k_j^e(z)}{\beta(\rho + \delta - \hat{\mu})} \right)^{\frac{\beta}{(\eta-1)}} \cdot \left(\frac{f_j^e + (\rho + \delta)F_j^e}{\rho + \delta} \right)^{\frac{\eta-1-\beta}{\eta-1}} \quad (22)$$

where k_B is a combination of parameters: $k_B \equiv \frac{(\eta-1)}{(\beta-\eta+1) \frac{(\eta-1-\beta)}{(\eta-1)}}$ and $k_j^h(z)$, $k_j^e(z)$ are firm-specific revenue terms:

$$k_j^h(z) = H \left(\frac{w_j}{z} \right)^{1-\eta} P_j^\eta Q_j \\ k_j^e(z) = H \left(\frac{\tau_j w_j}{z} \right)^{1-\eta} P_{\sim j}^\eta Q_{\sim j}.$$

These parameters describe, respectively, the firm-specific components of the option value of opening an affiliate ($B_j^o(z)$) and of the option value of exporting from an existing affiliate ($B_j^h(z)$). Under the parameter restriction $\beta > \eta - 1$, equation (21) shows that the option value of opening an affiliate is decreasing in both the fixed and sunk costs of opening an affiliate and in the fixed and sunk costs of exporting from the affiliate. In other words, less costly are an affiliate's operations in

a country, the more appealing is to open an affiliate there. Similarly, from equation (22), the option value of exporting from an affiliate is decreasing in both the fixed and sunk costs of exporting from the affiliate. Notice that the option value of exports does not depend on the setup and operating cost of maintaining the affiliate. Finally, both option value parameters are increasing in firm-level productivity z , indicating that affiliate operations are more appealing for more productive firms.

The aggregate log-productivity thresholds to open an affiliate ($X_j^h(z)$) and to start exporting from it ($X_j^e(z)$) are given by:

$$X_j^h(z) = \frac{1}{\eta - 1} \log \left[\left(\frac{\beta}{\beta - \eta + 1} \right) \cdot \left(\frac{\rho + \delta - \hat{\mu}}{k_j^h(z)} \right) \cdot \left(\frac{f_j^h + (\rho + \delta)F_j^h}{\rho + \delta} \right) \right] \quad (23)$$

$$X_j^e(z) = \frac{1}{\eta - 1} \log \left[\left(\frac{\beta}{\beta - \eta + 1} \right) \cdot \left(\frac{\rho + \delta - \hat{\mu}}{k_j^e(z)} \right) \cdot \left(\frac{f_j^e + (\rho + \delta)F_j^e}{\rho + \delta} \right) \right]. \quad (24)$$

As expected, equation (23) illustrates that the aggregate productivity threshold to open an affiliate in country j is increasing in the fixed and sunk costs of opening the affiliate. Similarly, equation (24) illustrates that the aggregate productivity threshold to export from an affiliate in country j is increasing in the fixed and sunk costs of exporting from the affiliate. Both thresholds are decreasing in firm-level productivity z , indicating that more productive firms need smaller positive productivity shocks to start and expand affiliate operations compared to less productive firms.

3.3 Qualitative Testable Implications

We argue that the model presented here is a useful tool to represent the patterns that we observe in the data.

First, we have shown in Section 2 that MNEs' affiliates start out their operations as sizeable entities, and that their sales growth profiles (affiliate sales/parent sales) are almost flat in the first years after the establishment of the affiliate, regardless of the destination of their sales. Our simple shock process captures exactly this fact: aggregate shocks to domestic productivity imply that a firm's domestic sales and foreign sales are hit by the same shocks and perfectly co-move, so that their ratio is flat.⁹ Moreover, the presence of fixed and sunk costs implies that affiliates "start big".

⁹The ratio affiliate sales/parent sales is completely flat in partial equilibrium, since the effects of aggregate shocks on both parent's sales and affiliate's sales cancel out. However, in an industry equilibrium, aggregate prices and

These simple assumptions imply that the model is consistent with the facts documented in Figure 1.

Second, we documented in Section 2 that almost all affiliates have some horizontal sales at birth and that a negligible share of affiliates are pure type vertical or export platform. The assumptions that make the model tractable are broadly consistent with these observations. In the model, firms start FDI either as pure horizontal or as a combination of horizontal and other modes.¹⁰ There are no pure-type vertical or export platform affiliates in the model, but those are only 3.4% of affiliates in the data, and they account for 2.24% of total affiliate sales during our sample period.

The specification of the aggregate productivity shock as a unit root process drives persistence in affiliate type in the model, like we observe in the data. Moreover, if aggregate productivity grows over time ($\mu > 0$), firms tend to expand internationally and give rise to the diversification pattern that we documented in Figures 2 and 3. Affiliates that start as pure horizontal will start exporting, to the U.S. and other destination countries.¹¹

Third, the relationship between firm-level productivity and the entry and exporting thresholds $X_j^h(z)$, $X_j^e(z)$ has interesting testable implications. Since larger and more productive firms have lower entry thresholds, we expect affiliates that start as “diversified” (*i.e.*, sell in the country where they are based and also export) to have larger horizontal sales than affiliates that start as pure-type horizontal affiliates. Similarly, affiliates that start exporting later in life should have smaller horizontal sales than affiliates that start exporting at the beginning of their life cycle. We provide evidence in support of these predictions below.

3.3.1 Supporting Evidence

1. Diversified Affiliates Have Larger Horizontal Sales than Pure-Type Horizontal Affiliates.

quantities fluctuate and drive fluctuations in the ratio. The fluctuations induced by productivity shocks on aggregate variables are typically small in this class of models, so we expect that also in the industry equilibrium the ratio of affiliate to parent sales will be relatively stable over time.

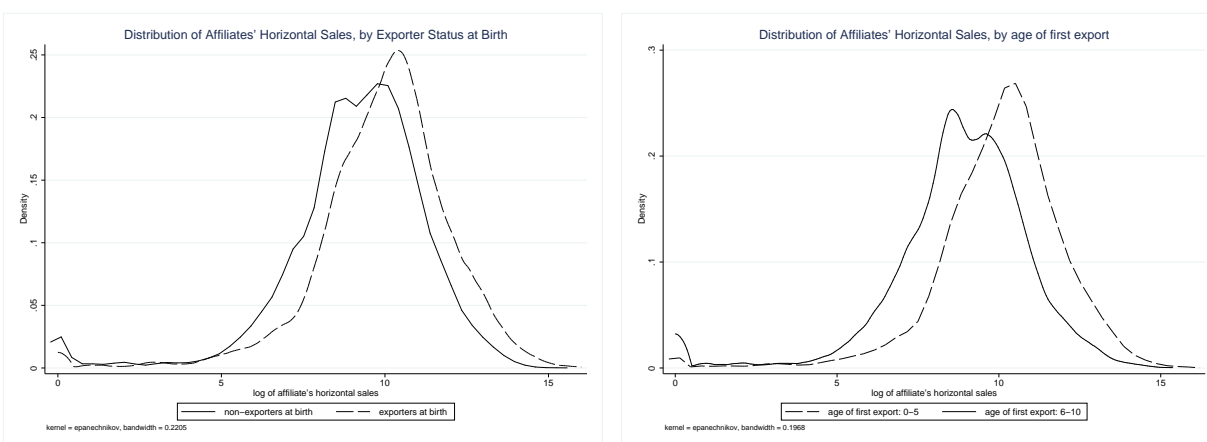
¹⁰Spelling out the model in continuous time implies that even if all firms technically start FDI as pure type horizontal, some firms may decide to start vertical and/or export platform instantaneously, so that observationally this is equivalent to firms starting FDI with a combination of modes.

¹¹This simple version of the model has no predictions about the choice of vertical versus platform FDI, or about the choice of third countries where to do platform FDI. However, the BEA data does not contain information on the destination countries of affiliate exports other than the U.S. Additionally, the model predicts sorting in the order in which a MNE opens affiliates over time: a MNE will open first affiliate located in countries with lower entry costs (lower $f_j^h + (\rho + \delta)F_j^h$).

We start by illustrating graphically the relationship between the size of an affiliate in the country where it is located and the extent of its diversification across FDI modes. The left panel of Figure 5 plots the kernel density of log horizontal sales for two subset of affiliates in our sample: affiliates that are born as pure horizontal, and affiliates that are born as having both horizontal sales and sales to other markets (back Home or in third countries). The Figure clearly shows that “diversified” affiliates, with sales that go beyond the host country, are on average larger than pure horizontal affiliates, consistently with what the model predicts.

To test the robustness of this prediction beyond the graphical illustration, we regress the affiliate’s horizontal sales on a dummy variable taking value 1 if the affiliate is born as a pure horizontal one. Columns (I) and (II) in Table 8 report the results.

Figure 5: Horizontal Sales versus Extent and Timing of Diversification in Space.



Notes: Sample of new affiliates that survive for at least 10 consecutive years, in manufacturing. The left panel of the Figure shows the kernel density of log horizontal sales for two subset of affiliates: affiliates that are born as pure horizontal, and affiliates that are born as also exporting. Pure vertical and pure export platform affiliates are dropped. The left panel of the Figure shows the kernel density of log horizontal sales for other two subset of affiliates: affiliates that start exporting in their first five years of life, and affiliates that start exporting after five years of life. Affiliates that never export are dropped, together with pure vertical and pure export platform affiliates.

As expected, horizontal sales are negatively correlated with the fact of being a pure horizontal affiliate. In other words, affiliates that diversify the destination of their sales (selling back home or to third countries) are larger in their host country than affiliates for which the destination of sales is limited to the host country. This result holds controlling for affiliate age, and is robust to the inclusion of country-year and industry fixed effects.

2. Affiliates that Start Exporting Later in Life Have Larger Horizontal Sales than Affiliates that Start Exporting at the Beginning of their Life Cycle.

Table 8: Size differences by activity type. OLS.

	(1)	(2)	(3)	(4)	(5)	(6)
born pure H	-0.856*** (0.912)	-0.86*** (0.088)			-0.606*** (0.085)	-0.573*** (0.083)
age of first export			-0.133*** (0.019)	-0.133*** (0.019)	-0.078*** (0.018)	-0.083*** (0.017)
affiliate age	0.075*** (0.014)	0.071*** (0.012)	0.086*** (0.015)	0.086*** (0.015)	0.075*** (0.014)	0.074** (0.013)
country-year FE	yes	yes	yes	yes	yes	yes
industry FE	no	yes	no	yes	no	yes
Obs	31558	31558	27774	27774	27774	27774
within R-sq	0.046	0.1141	0.043	0.043	0.058	0.131

Note: Observations at the affiliate-year level, for new affiliates that survive for at least 10 consecutive years, in manufacturing. The dependent variable refers to the horizontal sales of the affiliate. Robust standard errors, clustered at the parent level, are in parenthesis. Levels of significance are denoted *** $p < 0.01$, ** $p < 0.05$, and * $p < 0.1$.

The right panel of Figure 5 illustrates the relationship between the size of an affiliate in its host country, measured by \log -sales, and the time in the affiliate's life cycle at which the affiliate decides to diversify the destination of sales.¹² As the picture shows, affiliates that start exporting earlier in life are smaller in their host country compared to affiliates that start exporting later.

Columns (III) and (IV) in Table 8 show the econometric equivalent of the figure: the negative relationship between size in the host country and age of first export is robust to controlling for affiliate age, and to the inclusion of country-year and industry fixed effects.

Finally, columns (V) and (VI) in Table 8 show that the two testable implications of our simple model are jointly satisfied in the data.

3.4 Aggregation and Industry Equilibrium

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¹²In Figure 5 we split the sample between affiliates that start exporting in the first five years of life and affiliates that start exporting later in their life cycle, but the qualitative properties of the plot do not depend on the specific age cutoff.

4 Quantitative Analysis

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5 Conclusions

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Appendix

A Data Description

B Derivation of the Solution of the Model

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