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Occasional and perennial exporters ☆

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ABSTRACT

We document several new features of firms' export entry and exit behaviors: i) one-third of exporting firms enter into and exit from exporting multiple times; ii) most continuing exporters enter and exit specific export destinations multiple times; iii) firms re-entering exporting often sell the same product(s) to the same importer(s). We provide a model in which this behavior is an optimal response for firms facing increasing costs and stochastic demand. The model has a number of predictions that do not come out of models of trade in which firms have constant marginal cost. Our data strongly support these predictions.

1. Introduction

Over the past several years, researchers have identified entry into and exit from exporting by individual firms as a key driver of observed trade flows (see, for instance, Eaton et al., 2004; Bernard et al., 2007; Eaton et al., 2008). A striking feature of the firm-level export entry (and exit) data is the number of firms each year that enter into exporting, that exit from exporting entirely and that continue exporting but enter and exit specific export destinations. For instance, in a typical year, more than half of Colombia's exporters are new exporters – they are firms that did not export in the previous year – and most of these new export firms will exit exporting by the following year (Eaton, Eslava, Kugler, and Tybout). Even firms that export on an on-going basis still enter into and exit from specific export destinations quite regularly (Lawless, 2009; Buono et al., 2008). These observations raise the question of what drives export entry and exit behavior at the firm and market levels.

To address this question, we provide new and more detailed evidence on export entry and exit behavior of firms and, based on this evidence, a firm-level model of these decisions. Transaction level data on Chilean exports from 1991 to 2008 show that, of the approximately twenty-one thousand Chilean firms that ever exported during this period, more than seven thousand exhibit multiple spells of exporting. These firms enter into and exit (entirely) from exporting multiple times with at least one year between exit and subsequent re-entry. The average length of time between exporting spells for these firms is small, roughly 2.5 years, and these firms often re-enter the same market(s) and sell the same products they sold to that country before. There are another five thousand firms that one would typically classify as continuing exporters. These firms have multiple transactions over consecutive years and either export through the end of the sample or exit and never return to exporting. The vast majority of these firms exhibit multiple exporting spells to specific export destinations (i.e., firms enter into and exit from the same export destination multiple times). They also often sell the same products they sold to that country before.[1] Finally, matched Chilean exporter–Colombian importer data for the period 2004–2006, and matched Argentinean exporter–Chilean importer data for the period 2004–2008 reveal that a significant fraction of Chilean firms that exit and subsequently re-enter Colombia, and Argentinean firms that exit and subsequently re-enter Chile, sell the same product(s) to the same importer(s) upon re-entry.

We argue that this behavior is an optimal response for firms that have increasing marginal cost and face stochastic demand for their products. We model the increasing cost as arising from capital investments that are fixed relative to the frequency of demand shocks;

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[1] The remaining nine thousand firms either have exactly 1 export transaction or have a few transactions concentrated within a period of a few months.

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however, we note that any other fixed factor will produce the same behavior. The simple intuition is that, when a firm experiences a negative domestic demand shock, it is able to free up (utilize more of) the fixed capital to sell output in foreign markets; when domestic demand is relatively high, the firm quits selling abroad, either entirely or to some destinations, in order to serve the more profitable (less costly) domestic market. Our model is in the tradition of many other trade papers that emphasize the twin roles that fixed capital investments and stochastic demand play in explaining export behavior (see, for instance, Viner, 1923; Staiger and Wolak, 1992b; Rob and Vettas, 2003; Blonigen and Wilson, 2010).[2] What is new is that capacity and stochastic demand serve as key sources of heterogeneity in firms' export decisions and are important determinants of the extensive margin of trade.

To formalize these ideas, we adopt a heterogeneous firm model, a la Melitz (2003). In the model, each firm draws a productivity parameter upon entering the market. Prior to the realization of any industry demand outcomes, each firm makes a fixed (over the period of the demand shocks) capital investment. Once demand outcomes are realized, firms make output, price, and export decisions. Because capital is fixed when these latter decisions are made, firms face increasing marginal costs. Depending on the level of fixed capital investment, the model predicts that exporters are one of two possible types: occasional exporters or perennial exporters. Perennial exporters are the highly efficient firms that invest in enough capital to serve the domestic and (some) foreign markets, regardless of demand levels. Occasional exporters are less efficient, smaller firms whose export decision varies with the state of demand. When domestic demand is relatively low, these firms' capital is "under-utilized" domestically so they utilize their capital by selling abroad. When domestic demand is relatively high, these firms exit foreign markets and sell only domestically.

The above mechanism is consistent with anecdotal evidence for high fixed cost industries like steel, where firms dump output on foreign markets when domestic demand is weak. The question is whether it successfully describes export behavior more broadly. We use Chilean plant-level data from 1992 to 2005 (Chilean Annual Industrial Survey — ENIA) to address this question. Specifically, the model makes three predictions that we examine in the data: i) firms reduce domestic sales when they enter foreign markets; ii) controlling for foreign demand shocks, occasional exporters enter exporting when the industry experiences a negative demand shock at Home and exit exporting when the industry demand shock is positive; iii) occasional exporters are smaller in terms of sales and employment than perennial exporters. We find support for all three predictions in the data.

While our model provides an explanation for the behavior of occasional exporters, and the movements in and out of certain destinations by perennial exporters, we cannot claim that it accounts for all of the observed heterogeneity in firms' export decisions. For instance, our story seems an unlikely explanation for the large number of firms that enter exporting for a year or less and then never export again, the export failures. Even for firms that move into and out of exporting more frequently, however, our story needn't be the sole explanation. Eaton et al. (2010) and Albornoz et al. (2010) propose learning explanations for export entry and exit. Under these models, firms enter exporting and particular foreign markets with small quantities to "test the water" and learn whether or not they can export their product successfully to the given destination. These models account for the export failures – permanent exits from exporting or export destinations – and export successes – permanent exporting to particular destinations – found in the data. We view our model and these other models as complementary explanations of exporting behavior in the sense that the export entry and exit patterns we observe are likely the result of both learning activities and responses to demand shocks when costs are increasing.

[2] Other literatures in economics have highlighted the importance of fixed capital investments. See Cooper and Haltiwanger (2006) for evidence on the role of adjustment costs in investment decisions, Hamermesh and Pfann (1996) for the effects of adjustment costs on firms' employment decisions, Bils and Klenow (1998) and Hansen and Prescott (2005) for evidence on the importance of costly capacity adjustment for explaining firms' output and pricing decisions over the business cycle, and Staiger and Wolak (1992a) for the effects of capacity constraints on firms' pricing behavior.

Table 1
Descriptive statistics — Chilean Customs Data 1991–2008.

Total number	
Exporters	21,212
Exporters per year (average)	4,938
HS6 products	5,399
HS6 products per year (average)	3,277
Destination countries	204
Destination countries per year (average)	152
Average annual value per firm	
Export value	US $1,669,950
Transactions	20.7
Transaction value	US $99,673
HS6 products	3.76
Destination countries	2.14

2. Exporting spells and the extensive margin of trade

As discussed in the Introduction, about one-third of all exporters from Chile exit and re-enter exporting one or more times. Among firms that export for more than 1 year, about 70% exit and re-enter exporting to a given country one or more times. This section provides more detail on the movement in and out of foreign markets by Chilean firms. It documents that it is the smaller exporters that tend to enter and exit exporting entirely and the larger exporters that tend to continue exporting but repeatedly enter and exit certain destination markets. In this latter case, the destinations to which firms have multiple spells of exporting tend to be the smaller export destinations. Finally, the section documents that, when exporters re-enter a market, they often sell the same product to the same importer.

2.1. Data description

We examine transaction-level export data from Chile for the period 1991 to 2008. For each transaction, the data give the identity of the exporter, the 8-digit HS code of the products exported, destination country, date of the transaction, and shipment characteristics — weight, quantity, FOB and CIF values. We focus only on export transactions by firms, excluding all individual transactions from the analysis. Table 1 shows summary statistics.

Table 2 shows statistics on Chilean firms' decisions to enter and exit export markets. In a typical year of the sample, there are 4,938 Chilean exporters. More than one-third of these exporters are firms that are entering/re-entering exporting; that is, more than one-third are firms that did not export at all in the previous year. A little less than one-third will exit exporting entirely in the following year. More than two-thirds of Chilean exporters in a typical year enter/re-enter at least one export destination market: these firms did not export to that market last year but export this year. About two-thirds of Chilean exporters will stop exporting to at least one destination market during the following

Table 2
Descriptive statistics on entry and exit behavior — Chilean Customs Data 1991–2008.

Typical year	Number	Exports (millions US $)
Exporters	4,938	26,010
Firms that enter exporting (did not export in previous year)	1,489	370
Firms that stop exporting	1,390	304
Firms that enter at least one foreign market	3,555	23,800
Firms that stop exporting to at least one foreign market	3,381	20,700

Table 3
Classification of Chilean exporters according to their number of exporting spells.

X = number of exporting spells	Number of firms with X exporting spells	Average # of days in between exporting spells	Average length in days of the spells	Average annual exports (US $)	Median annual exports (US $)
0	461	–	6,499	31,731,863	2,192,773
1	13,691	–	707	1,178,532	30,705
1 year, 1 transaction	4,810	–	1	25,904	4,870
1 year, >1 transaction	3,598	–	138	206,319	29,113
Multiple years	5,283	–	1,738	3,000,423	259,756
2	4,117	1,033	532	951,575	34,609
3	1,629	943	422	300,813	35,010
4	777	872	383	220,944	34,594
5	314	829	287	179,841	24,758
6	163	744	262	124,760	26,493
7	43	695	189	65,514	24,947
8	16	684	112	20,307	19,720
9	1	516	213	20,401	20,401
Total	21,212	976	754	1,669,950	34,217

Note: An export spell is defined as a period of exporting transactions in which consecutive transactions are less than 365 days apart and in which there is a period of at least 365 days prior or subsequent (or both) to this period in which there are no export transactions.

year. The table also shows that those firms that enter and exit exporting entirely in any given year account for a small share of Chile's total exports. By contrast, those exporters that enter or exit specific destination markets account for the lion's share of the country's total exports.

2.2. Exporting spells

Because the data we use contain information at the transaction-level, we know the exact date when firms first enter/re-enter exporting and when they exit exporting. This means that we can define exporting spells for each firm based on periods of consecutive exporting activity (transactions) or inactivity (lack of transactions) and so avoid problems due to measuring exports on a calendar year basis. To be consistent with the practice of reporting annual export activity (see, for instance Besedes and Prusa, 2006; Roberts and Tybout, 1997; Eaton et al., 2008) and to avoid any impacts due to possible seasonality in export behavior, we define an export spell as a period of exporting transactions in which consecutive transactions in the spell are less than 365 days apart and in which there is a period of at least 365 days prior or subsequent (or both) to this period in which there are no export transactions. As an example, a firm that has export transactions in May, June, and August of 1991 and does not export again over the sample period is classified as having one exporting spell. The same is true for a firm that has export transactions in December of 1994 and January of 1995 and does not export again over the sample period. A firm that has export transactions between 1995 and 1999, with the number of days between transactions never greater than 365, is also classified as having one spell. To distinguish the two first cases from the third one, we will classify the first two firms as having "one exporting spell, single year, multiple transactions" and the latter as having "one exporting spell, multiple years". An example of a firm with two exporting spells is one that has no export transactions prior to 1992 or after 1998, has at least one export transaction in both 1992 and in 1998 and, in the intervening period, has exactly one interval of at least 365 days in which it has no export transaction. Firms with other numbers of exporting spells are classified analogously.

Table 3 classifies Chilean exporters according to the number of "exporting spells" each export firm has over the period 1991–2008, and reveals new data patterns. First, only 461 firms export throughout the 18 years of the sample (these are classified as having zero exporting spells). These are the very large exporters. Second, almost two-thirds of the exporters have exactly one exporting spell, but there is significant heterogeneity within these exporters. Around 35% of them carry only a single export transaction. These are small exporters, with the median value of the only transaction being US $4,870. Another 25% of the firms with one exporting spell carry multiple transactions, but all occur over a period of less than 365 days after which these firms exit exporting permanently. On average, these firms' transactions occur over 138 days. They are somewhat larger exporters than the one-transaction firms, and the median exporter in this group sells US $29,113. Finally, around 40% of the firms with one exporting spell carry multiple transactions over multiple years. These are large exporters, selling on average over $3 million per year; the median exporter sells US $259,756.

Third, the remaining one-third of the firms have multiple exporting spells. For these firms, the interval between export spells tends to be small, with the average being 2.67 years and the average number of days in an exporting spell, i.e., the average number of days between the first and last transactions of an exporting spell, a little over a year in each spell. Finally, Table 3 shows that there is a roughly monotonic relationship between the firms' average annual exports and the number of exporting spells. Firms with few spells tend to be large exporters; those that go in and out of exporting multiple times tend to be smaller exporters.

Table 4 examines firms' export activity in terms of entry into and exit from specific foreign markets. This panel classifies each Chilean exporter according to the maximum number of country-specific exporting spells the firm has over the sample period. Analogous to the notion of an exporting spell, a country-specific exporting spell represents a period of exporting to a specific country preceded or followed (or both) by a period of at least 365 days without any export transactions to that country. For example, suppose a Chilean firm exports in every month of every year of the sample to Country A but has four blocks of export transactions to Country B, each of them separated from the other by more than 365 days. This firm will have one exporting spell to Country A and four exporting spells to country B. In this case, Table 4 assigns this firm to $Y = 4$ under "Maximum Number of Exporting Spells to a Given Country". A similar process is followed for every exporting firm. The first point to note is that virtually all exporters entered, exited, or entered and exited at least one country during the sample period.[3] Among firms that export over multiple years,[4] sixty-five percent have multiple exporting spells to specific countries, with the interval between spells being not quite 2.5 years. These firms export, on average, for less than two hundred days to these countries in each exporting spell.[5] The firms with many export spells to specific destinations are large exporters (see the last column).[6]

[3] In particular, only three firms are classified as having zero country-specific spells.
[4] Table 3 shows that there are 12,343 firms with one export spell over multiple years (5,283 firms) or with multiple export spells (7,060 firms).
[5] Figures B1 and B2 in the Online Appendix, at www.rotman.utoronto.ca/bblum/personal/front.htm, confirm that the export re-entry behavior described in Tables 3 and 4 occurs across industries in Chile.
[6] For firms that have 5 or more exporting spells to a specific country, this country accounts for less than 3% of the firms' exports.

Table 4
Classification of Chilean exporters according to their number of country-specific exporting spells.

Y = maximum number of exporting spells to a given country	Number of firms with Y exporting spells to a given country	Average # of days in between exporting spells	Average length in days of the spells	Average annual exports (US $)	Median annual exports (US $)
0	3	–	6,497	10,239,363	828,868
1	12,875	–	162	358,502	18,132
1 year,1 transaction	5,794	–	1	29,919	5,478
1 year, >1 transaction	4,191	–	100	200,684	31,939
Multiple years	2,890	–	574	1,246,880	141,303
2	4,259	932	213	870,174	56,898
3	1,980	883	252	1,485,872	115,678
4	1,090	847	253	5,440,922	208,167
5	563	780	253	8,959,389	482,163
6	282	721	234	17,227,053	516,591
7	104	691	201	16,290,455	614,550
8	45	607	171	128,562,823	998,050
9	7	587	105	12,464,384	365,670
10	3	545	85	6,048,848	2,539,021
11	1	423	209	2,880,493	2,880,493
Total	21,212	887	190	1,617,921	34,217

Note: A country-specific exporting spell represents a period of exporting to a specific country preceded or followed (or both) by a period of at least 365 days without any export transactions to that country.

Table 5 looks more closely at firms that repeatedly enter and exit a specific destination country and investigates the extent to which they tend to sell the same HS product to that country. This analysis can only be done on a subset of HS6 products whose product definition remains the same over the entire sample period.[7] This subset of codes represents 91% of the Chilean exports over the period 1991–2008. The results show that between 50% and 90% of subsequent exporting spells to a specific country contain at least one product that was already exported by the firm to that country in a previous exporting spell. On average, products that were already exported by the firm to that country in a previous export spell account for around 55% of the products and 40% of the value exported in subsequent spells.

Finally, Table 6 takes an even closer look at the export behavior of firms that repeatedly enter and exit a specific destination country by investigating the extent to which they tend to sell the same HS product *to the same importer* in that country. This analysis is done using two separate data sets, one a matched Chilean exporter–Colombian importer data set for the period 2004–2006 and the other a matched Chilean importer–Argentinean exporter data set for the period 2004–2008. The key aspect of these data sets is that they contain information on the identity of the importer and exporter associated with each transaction (see Blum et al., 2009 for a detailed discussion of the Chile–Colombia data set and Blum et al., 2010 for a detailed discussion of the Chile–Argentina data set). Since the Chilean exporter–Colombian importer data are for three years only, any export firm must have either 1 exporting spell (807 firms) or 2 exporting spells (61 firms). Of the 61 firms with two exporting spells, more than half transact with the exact same set of importers in the second spell as in the first; almost 70% transact with at least one of the same importers. Almost 70% of exporters with two spells also sell the exact same set of HS6 products. The data for Argentina–Chile trade show a similar pattern. In this case, there are 1063 Argentinian exporters with two exporting spells between 2004 and 2008. Of these exporters, almost 60% transact with at least one of the same Chilean importers in both spells, while 38% transact with the exact same set of importers in both spells. Over 75% of exporters with two exporting spells to Chile sell at least one of the same HS6 product in each spell and 37% sell the same set of HS6 products in each spell. Finally, 46% of the Argentine exporters with two exporting spells to Chile sell at least one of the same products to one of the same importers in both spells.

To summarize, the data show that one export behavior that features prominently in the data is firms frequently entering and exiting foreign markets over short intervals. Exporters that enter into and exit from exporting altogether tend to be the smaller exporters that often sell the same product in countries to which they had exported before. Exporters that continue exporting over extended periods of time but enter and exit specific destination markets multiple times tend to be the larger exporters and they also often sell the same product in the countries to which they had previously exported. In the case of both the Chilean exporters that enter and exit Colombia multiple times and the Argentinean exporters that enter and exit Chile multiple times, these firms often sell the same products to the same importers. Finally, we find that this re-entry behavior occurs across most industries in Chile.

3. A model with fixed capital investments

In this section we develop a heterogeneous firm model in which each firm must make a fixed capital investment prior to the realization of an industry demand shock. The fixed capital investment means that, upon realization of the demand shock, each firm faces an increasing marginal cost curve. The purpose of the model is to demonstrate that the striking features of the Chilean data – firms moving in and out of exporting, either entirely or to a particular country, multiple times over short periods and often returning to the same country with the same product and same import partner – are consistent with a model of increasing costs and regular demand shocks. In particular, the model will show that, when domestic demand is low relative to foreign demand, it pays domestic firms to shift capital utilization, and so production, toward export sales; when domestic demand is relatively high, it pays domestic firms to shift capital utilization and production away from export sales. Those firms that are marginal exporters exit exporting in the latter case and enter exporting, with the same product to the same destination(s), in the former case. The model provides additional predictions about export behavior that we test in a subsequent section.

To fix ideas, we begin with a closed economy model with deterministic demand and an exogenous distribution of fixed capital. Next, we develop a two-country, open-economy model with stochastic demand and a capital investment decision. While we do not present a multi-country extension, it should be clear how the predictions extend to a setting where countries are ranked by "attractiveness" (see Helpman et al., 2004).

3.1. The closed economy

The basic model is in the spirit of the Melitz (2003) model of trade. Specifically, in any country, there are 2 final goods sectors, a perfectly

[7] This analysis is conducted at the HS6 level due to lack of reliable information on the set of HS8 codes with unchanged definitions over the sample period.

Table 5
Products exported by firm that repeat destination countries.

Y = maximum number of exporting spells to a given country	Number of firms	Share of subsequent export spells that contain at least 1 OLD product	Share of products in subsequent export spells that are OLD	Share of export value in subsequent export spells in OLD products
2	4,259	0.659	0.528	0.433
3	1,980	0.735	0.602	0.356
4	1,090	0.755	0.616	0.344
5	563	0.780	0.642	0.341
6	282	0.773	0.630	0.338
7	104	0.788	0.652	0.359
8	45	0.821	0.695	0.277
9	7	0.862	0.661	0.310
10	3	0.826	0.676	0.310
11	1	0.926	0.820	0.194
Overall	8,334	0.707	0.573	0.390

Note: Products defined at the HS6 level.

competitive sector producing a homogeneous good, X, and a monopolistically competitive sector with a continuum of firms producing differentiated products indexed by ω. There are two factors of production, labor and capital. These endowments are denoted by $\overline{L}$ and $\overline{K}$, respectively.

3.1.1. Production

Good X is produced with a constant returns to scale technology utilizing only labor and with units defined so that one unit of labor produces one unit of X. We assume that X is the numeraire good with the price of X normalized to 1. This implies that the wage, $w=1$.

In the monopolistically competitive sector each firm is endowed with a fixed amount of capital. The amount of fixed capital is assumed to vary exogenously across firms, with the distribution of capital given by the distribution function $G(K)$ having support $[K',K'']$ and density $g(K)$.[8] Production for a firm with capital K (a type K firm) is given by the function $y(K)=AK^{.5}L^{.5}$, where $y(K)$ is the output of the type K firm and L is its labor utilization. The corresponding cost function is $C(K)=(1/A^2)(1/K)y(K)^2$. Because capital is a fixed factor, each firm operates with increasing marginal costs. The measure of firms in the Y-sector equals N and is, for now, exogenous (i.e., $\int g(K)=N$).

3.1.2. Consumer preferences

All consumers in a country are identical with preferences given by the utility function $U=Y^{\alpha}X^{(1-\alpha)}$, where Y is a CES aggregator defined as $Y=[\int y(\omega)^{\rho}di]^{1/\rho}$ and $y(\omega)$ is the quantity consumed of variety ω. We assume that $\alpha\in(0,1)$ and $\rho\in(0,1)$. Given Cobb–Douglas preferences, consumption of X is given by $(1-\alpha)I$, where I is total income.

The amount αI is spent on differentiated products. Given CES preferences for Y, demand for a variety ω produced by a type K firm is given by the expression $y(K)=\alpha I p(K)^{-\sigma}P^{\sigma-1}$, where $P=[\int p(K)^{1-\sigma}g(K)dK]^{1/1-\sigma}$ is the CES price index, $p(K)$ is the price of a variety produced by a type K firm and $\sigma=1/(1-\rho)>1$.

3.1.3. Autarky equilibrium

In the monopolistically competitive sector, profit maximization implies that the price charged by a type K firm is given by the condition $p(K)=MC(K)/\rho$, where $MC(K)$ is the marginal cost for a producer with capacity K. This condition yields a profit maximizing price of

$$p(K)=\left[\frac{2A^{-2}}{\rho}\alpha I P^{(\sigma-1)}\frac{1}{K}\right]^{1/(1+\sigma)}. \quad (1)$$

[8] Note that, in contrast to the typical case, $g(K)$ is not a probability density function and so does not integrate to 1. We adopt this non-standard notation here to make the analysis in this and the next sub-section consistent with the analysis of the endogenous capital investment model in Sub-section 3.3. As will be seen, in the model with endogenous capital investments, firms enter, draw a productivity parameter from a pdf and then choose capital levels, K. The density $g(K)$ in this sub-section captures the density that arises from this endogenous entry and capital investment choice.

Substitution for $p(K)$ into the price index yields

$$P=\left[\frac{2A^{-2}}{\rho}\alpha I\right]^{.5}\left[\int K^{(\sigma-1)/(1+\sigma)}g(K)dK\right]^{(1+\sigma)/2(1-\sigma)}. \quad (2)$$

As in Melitz, we can define a variable $\tilde{K}=\left[\int K^{(\sigma-1)/(1+\sigma)}g(K)dK\right]^{(1+\sigma)/(\sigma-1)}$ such that $P=p(\tilde{K})$. Then, substitution of Eqs. (1) and (2) into the expression for demand gives the output of a type K firm as

$$y(K)=\left[.5A^{-2}\rho\alpha I\right]^{.5}K^{\sigma/(1+\sigma)}\tilde{K}^{(\sigma-1)/2(1+\sigma)}. \quad (3)$$

Variable profits for a type K firm are $\pi(K)=R(K)(1-.5\rho)$, where $R(K)=p(K)y(K)$. Finally, aggregate income is given by the expression

$$I=\overline{L}+(1-.5\rho)\int R(K)g(K)dK. \quad (4)$$

For future reference, it will be useful to define the impacts of changes in α on the relevant variables. From Eqs. (1) and (3), income constant, both $p(K)$ and $y(K)$ are increasing in α. This implies that gross revenue, $R(K)$, and variable profits, also increases in α, income constant. Finally, from Eq. (4), $dI/d\alpha>0$. Therefore, including general equilibrium effects, an increase in α increases aggregate income and causes an increase in prices, firm output and profits in the Y sector.[9]

3.2. An open economy model with stochastic demand

Consider now a world with two countries: Home and Foreign. Foreign is as described above, with relevant variables labeled with an asterisk (*). Home is essentially as above with one difference: Y-sector demand is stochastic. To capture this feature of demand, we assume that the parameter α in the Home utility function is a random variable that takes on one of two possible values, α_1 or $\alpha_2>\alpha_1$. The probability that $\alpha=\alpha_1$ (Home demand for Y is low) is given by $\lambda>0$. Firms are assumed to know the demand realization prior to making any decision on price and exporting. Y-sector demand in Foreign is assumed to be deterministic, with the utility parameter in Foreign given by $\alpha^*=\alpha_2$. We also assume that there is free trade between the two economies in both X and Y and that transport costs are zero. For the Y-sector, we assume that there is a fixed cost of exporting, measured in units of labor, of $E>0$. There are no fixed or variable costs of exporting in the X-sector. Finally, we assume that Y-sector markets are segmented internationally. Endowments in the two countries are assumed identical: that $\overline{L}=\overline{L}^*$, $\overline{K}=\overline{K}^*$, $G(K)=G^*(K)$.

[9] From Eq. (4), $dI/da=(1-.5\rho)\int\frac{\partial R(K)}{\partial\alpha}g(K)dK/\left[1-(1-.5\rho),\int\frac{\partial R(K)}{\partial I}g(K)dK\right]$.

Table 6
Exporter–importer matches by firm that repeat destination countries.

	Chile–Colombia (2004–2006)	Argentina–Chile (2004–2008)
Number of exporters	868	6,438
Exporters with two spells	61	1,063
… of those with two spells:		
Repeats at least 1 importer	42 (68.9%)	613 (57.7%)
Repeats all importers	33 (54.1%)	406 (38.2%)
Repeats at least 1 HS6	52 (85.2%)	806 (75.8%)
Repeats all HS6	42 (68.9%)	395 (37.1%)
Repeats at least 1 importer-HS6 pair	37 (60.7%)	492 (46.3%)
Repeats all importer-HS6 pairs	22 (36.1%)	198 (18.6%)

Note: See Blum et al. (2009) for description of the Chile–Colombia matched data and Blum et al. (2010) for description of the Argentina–Chile matched data.

3.2.1. Trading equilibrium

Given this set-up, we can describe the pricing and export decisions of a representative type K firm in either Home or Foreign, assuming the firm exports. For a type K Home firm, the pricing decisions involve setting a price $p_H(K)$ at Home and a price $p_F(K)$ for Foreign to maximize overall profits given by:

$$\pi_H = p_H(K)^{1-\sigma}\alpha_j IP_H^{\sigma-1} + p_F(K)^{1-\sigma}\alpha^* I^* P_F^{\sigma-1} - \frac{1}{A^2K}\left[\alpha_j Ip_H(K)^{-\sigma}P_H^{\sigma-1} + \alpha^* I^* p_F(K)^{-\sigma}P_F^{\sigma-1}\right]^2 - E$$

where α_j gives the demand realization in Home and P_H,P_F represent the Home Country and Foreign Country price indices, respectively.[10] An analogous maximization problem defines a representative type K Foreign exporting firm's prices $p_H^*(K)$ and $p_F^*(K)$. The profit maximizing prices are given by:

$$p_H^j(K) = p_H^{*j}(K) = p_F^j(K) = p_F^{*j}(K) = \left[\frac{2A^{-2}}{\rho}K^{-1}\right]^{1/(1+\sigma)}\left[\alpha_j IP_H^{\sigma-1} + \alpha^* I^* P_F^{\sigma-1}\right]^{1/(1+\sigma)}. \quad (5)$$

Given demand realization α_j, total output for a type K Home firm under exporting is given by

$$y_E^j(K) = \left[\frac{2A^{-2}}{\rho}K^{-1}\right]^{-\sigma/(1+\sigma)}\left[\alpha_j IP_H^{\sigma-1} + \alpha^* I^* P_F^{\sigma-1}\right]^{1/(1+\sigma)}. \quad (6)$$

Should the firm choose not to export, then its pricing problem is as defined in Eq. (1) above. Its output is

$$y^j(K) = \left[\frac{2A^{-2}}{\rho}K^{-1}\right]^{-\sigma/(1+\sigma)}\left[\alpha_j IP_H^{\sigma-1}\right]^{1/(1+\sigma)}. \quad (7)$$

A firm chooses to export if the extra variable profits it obtains from exporting more than cover the exporting cost, E. For a given realization of α_j, the difference in variable profits between exporting and not for a type K Home firm is given by $\Delta\pi_H^j(K) = (1-.5\rho)[R_x^j(K) - R_H^j(K)] > 0$, where $R_x^j(K)$ gives revenues of a type K Home firm that sells at Home and also exports to Foreign under demand realization α_j while $R_H^j(K)$ gives revenues if that firm sells only in Home. It is straightforward to check that $\Delta^j\pi_H(K)$ is increasing in K. Therefore, for any realization of α_j, the firms with large capacity export while the firms with small capacity do not. For future reference, we define the marginal exporting firm in Home as $K_H(E,\alpha_j)$ and the marginal exporting firm in Foreign as $K_F(E,\alpha_j)$. In the case that $\alpha_j = \alpha_2$, $K_F(E,\alpha_2) = K_H(E,\alpha_2)$.

[10] Note that these price indices can contain prices for both Home and Foreign firm products.

When $\alpha_j = \alpha_1$, the price index in Home is given implicitly by[11]:

$$P_H^{1-\sigma} = \left[\frac{2A^{-2}}{\rho}\right]^{\frac{1-\sigma}{1+\sigma}}\left\{\left[\alpha_1 IP_H^{\sigma-1}\right]^{\frac{1-\sigma}{1+\sigma}}\int_{K'}^{K_H} K^{\frac{\sigma-1}{1+\sigma}}g(K)dK + \left[\alpha_1 IP_H^{\sigma-1} + \alpha^* I^* P_F^{\sigma-1}\right]^{\frac{1-\sigma}{1+\sigma}}\left[\int_{K_H}^{K''} K^{\frac{\sigma-1}{1+\sigma}}g(K)dK + \int_{K_F}^{K''} K^{\frac{\sigma-1}{1+\sigma}}g^*(K)dK\right]\right\}. \quad (8)$$

The price index for Foreign when $\alpha_j = \alpha_1$ is given implicitly by

$$P_F^{1-\sigma} = \left[\frac{2A^{-2}}{\rho}\right]^{\frac{1-\sigma}{1+\sigma}}\left\{\left[\alpha^* IP_F^{\sigma-1}\right]^{\frac{1-\sigma}{1+\sigma}}\int_{K'}^{K_F} K^{\frac{\sigma-1}{1+\sigma}}g(K)dK + \left[\alpha_1 IP_H^{\sigma-1} + \alpha^* I^* P_F^{\sigma-1}\right]^{\frac{1-\sigma}{1+\sigma}}\left[\int_{K_H}^{K''} K^{\frac{\sigma-1}{1+\sigma}}g(K)dK + \int_{K_F}^{K''} K^{\frac{\sigma-1}{1+\sigma}}g^*(K)dK\right]\right\}. \quad (9)$$

Finally, the value of income for Home, I and for Foreign, I^*, are defined implicitly by

$$I = \bar{L} + \int \pi_H(K)g(K)dK, \quad I^* = \bar{L}^* + \int \pi_F(K)g^*(K)dK \quad (10)$$

where profits for exporting firms include profits from both Home and Foreign sales.

The equilibrium prices of the model when $\alpha_j = \alpha_1$ are defined by Eq. (5) for exporting firms and Eq. (1) for non-exporting firms. The equilibrium price indices are given by Eqs. (8) and (9), with the equilibrium values of $K_H(E,\alpha)$ and $K_F(E,\alpha)$ given by

$$(1-.5\rho)\left[R_x^j(K_H) - R_H^j(K_H)\right] = E \quad (11)$$

$$(1-.5\rho)\left[R_x^j(K_F) - R_H^j(K_F)\right] = E. \quad (12)$$

Equilibrium income is defined by Eq. (10). Finally equilibrium Home and Foreign outputs for an exporting firm in H are given by

$$y_H^1(K) = \alpha_1 IP_H^{\sigma-1}\left[\frac{2A^{-2}}{\rho}\right]^{-\sigma/(1+\sigma)}K^{\sigma/(1+\sigma)}\left(\alpha_1 IP_H^{\sigma-1} + \alpha^* I^* P_F^{\sigma-1}\right)^{-\sigma/(1+\sigma)} \quad (13)$$

and

$$y_F^1(K) = \alpha^* I^* P_F^{\sigma-1}\left[\frac{2A^{-2}}{\rho}\right]^{-\sigma/(1+\sigma)}K^{\sigma/(1+\sigma)}\left(\alpha_1 IP_H^{\sigma-1} + \alpha^* I^* P_F^{\sigma-1}\right)^{-\sigma/(1+\sigma)} \quad (14)$$

(analogous equations apply for an exporting firm in F); output for a non-exporting firm in H is given by Eq. (7).

The issue of interest is how a domestic demand shock affects equilibrium outcomes, specifically, the levels of domestic sales by Home firms, the level of exports by Home firms and the set of Home firms that export. We address this question by examining the impact on equilibrium outcomes of a small decrease in α in the neighborhood of α^*. We prove in the Online Appendix the following Proposition:

Proposition 1. *For any α_1 in a neighborhood of α^* such that $\alpha_1 < \alpha_2 = \alpha^*$, a demand shift from α_2 to α_1 results in i) an increase in export participation among Country H firms and ii) among new exporters, a reduction in domestic sales relative to the situation in which these firms do not export.*

[11] The price index in Home (and Foreign) when $\alpha_j = \alpha_2$ is given by the expression: $P_H(\alpha_2) = P_F(\alpha_2) = \left[\frac{2A^{-2}}{\rho}\alpha_2 I\right]^{.5}\left[\int_{K'}^{K_H(E,\alpha_2)} K^{\frac{(\sigma-1)}{(1+\sigma)}}g(K)dK + 2^{\frac{2}{(1+\sigma)}}\int_{K_H(E,\alpha_2)}^{K''} K^{\frac{(\sigma-1)}{(1+\sigma)}}g(K)dK\right]^{\frac{(1+\sigma)}{2(1-\sigma)}}$.

This reduction is larger, in percentage terms, than the reduction in sales of continuing non-exporters.

The intuition for these results is as follows. The negative demand shock in H reduces the profitability of Country H sales: marginal revenue from H is less than marginal cost at existing output levels. Country H firms and exporters from Country F respond by reducing sales to H. This causes a decline in marginal cost thereby enhancing the profitability of selling in Country F: marginal revenue from F sales exceeds marginal cost. Country H exporting firms respond by increasing export sales. In addition, those firms in H not exporting find Country F more attractive now. As a result, participation in exporting among H firms increases. These firms substitute export sales for domestic sales and so domestic sales fall relative to the case in which they would not be exporting. This substitution toward export sales for new exporters also implies that the percentage reduction in domestic sales caused by the negative demand shock is larger for these firms than for continuing non-exporters.

Notice that these predictions depend crucially on the fact that firms have increasing marginal cost. With constant marginal cost, a negative Y-sector demand shock in H has either no impact or a negative impact on both export sales to F and H firm export participation. Note also that these results capture the basic features of the data documented in the previous section. Specifically, the model implies that, when domestic demand is high, domestic firms who are marginal exporters exit exporting; when domestic demand returns to the low state, these firms re-enter exporting, with the same product to the same destination.

3.3. Endogenous capital investments

So far, the distribution of capital across firms has been taken as exogenous. Imagine now that, prior to demand realizations, firms in both H and F must make a once-for-all capital investment decision. As in Melitz and others, firms now are assumed to be heterogeneous in terms of the productivity parameter A. Specifically, we assume that productivity for a firm in either H or F is determined by a draw from the probability distribution $\Gamma(A)$ with related density $\gamma(A)$. Once firms have obtained their productivity draw but prior to demand realization, they make a capital investment in the amount K. The cost per unit of capital is given by r. The value of r is determined endogenously as part of the equilibrium. In both H and F, demand is stochastic and can take on values of either α_1 or $\alpha_2 > \alpha_1$. A world demand realization is a pair $(\alpha = \alpha_i, \alpha^* = \alpha_j)$, $i,j = 1,2$. The joint probability of a particular world demand realization is given by $\lambda(\alpha_i,\alpha_j)$ with marginal distribution $\lambda(\alpha_i)$ for H and $\lambda^*(\alpha_j)$ for F. We assume that the joint distribution is such that $\lambda(\alpha_i) = \lambda^*(\alpha_j)$.

This setting essentially reproduces the setting in previous sections: the distribution of capital will be identical across countries and given by a cdf $G(K)$ determined by the function $\Gamma(A)$. The lower bound of the support of $G(K)$ will be determined by a zero expected profit condition and the upper bound by the upper bound of the support of $\Gamma(A)$. The value of r will be determined so as to clear the capital market given endowment $\overline{K}$.

Expected profits for a firm in Country H with productivity A_m and capital level K are

$$\pi_H(A_m,K) = \sum_j \sum_i \lambda\left(\alpha_i,\alpha_j\right)\left[p\left(K,\alpha_i,\alpha_j\right)y\left(K,\alpha_i,\alpha_j\right) - \frac{1}{A_m^2 K}\left(y\left(K,\alpha_i,\alpha_j\right)\right)^2\right] - rK$$

where $p(K,\alpha_i,\alpha_j)$ and $y(K,\alpha_i,\alpha_j)$ are price and total output respectively for a firm facing demand realization α_i in Country H and α_j in Country F. The profit maximizing capital investment is given by the condition

$$A_i^{-2}\sum_j \sum_i \lambda\left(\alpha_i,\alpha_j\right)\left(y\left(K,\alpha_i,\alpha_j\right)\right)^2 = rK^2.$$

Since all outputs are proportional to A_i and K, firms with larger values of A invest in more capital. The value of r (r^*) is determined to clear the capital market in Home (Foreign).

Once capital is determined, the model is exactly as described above and so the results above hold. Specifically, the results in Proposition 1 describe the trading equilibria for the asymmetric demand cases. For the symmetric demand cases, (α_1,α_1) or (α_2,α_2), $K_H = K_F$, $P_H = P_F$ and $I = I^*$. The results in the Online Appendix can be used to show that $K_H(E,\alpha_1) > K_H(E,\alpha_2)$, $P_H(\alpha_1) < P_H(\alpha_2)$ and $I(\alpha_1) < I(\alpha_2)$.

These results allow us to characterize various features of the model under different demand realizations for Home and Foreign. For instance, we can consider the export entry and exit behavior of Home firms by comparing the measure of Home firms exporting in the equilibrium with demand realization (α_2,α_2) with the measure of Home firms exporting in the equilibrium with demand realization (α_1,α_2). From the Proposition, we know that the measure of Home firms exporting in the latter case is larger than in the former case. The same will be true if we compare the measure of Home firms exporting in the equilibrium with demand realization (α_1,α_1) to the measure of Home firms exporting in the equilibrium with either demand realization (α_1,α_2) or (α_2,α_2). Similar results can be derived for all of the other possible demand realization comparisons. The chart below summarizes the full set of results. In it, the first column gives the initial point and the first row the transition point.

	(α_1,α_1)	(α_2,α_2)	(α_1,α_2)	(α_2,α_1)
(α_1,α_1)	0	+	+	−
(α_2,α_2)	−	0	+	−
(α_1,α_2)	−	−	0	−
(α_2,α_1)	+	+	+	0

We can say more by exploiting the fact that the equilibrium outcomes are continuous functions of (α_i,α_j). Specifically, we know that when only Home experiences a negative demand shock – a transition from (α_2,α_2) to (α_1,α_2) or from (α_2,α_1) to (α_1,α_1) – Home firms enter exporting. By continuity, the same will be true for any α^* in a small left neighborhood of its initial point; that is, if both Home and Foreign experience a negative demand shock but the Foreign shock is small relative to the Home shock, then Home firms will enter exporting. A similar logic implies that, if Home and Foreign experience a positive demand shock but the Foreign shock is small relative to the Home shock, then Home firms exit exporting. The reverse will be true if both have a positive shock but the Home shock is larger in magnitude.

We turn next to the predicted changes in domestic sales of firms that enter exporting. When a firm from Country H, say, moves into exporting in response to some demand shock, it adjusts domestic sales as part of its overall output strategy. Since entry into exporting raises marginal cost, all else equal, the firm optimally reduces domestic sales relative to the level it would choose were it to remain a non-exporting firm. This is true whether the demand shock(s) induce domestic sales of non-exporting firms to fall – as in the case of a negative domestic demand shock – or to rise, as in the case of a positive domestic demand shock. In either case, as in the Proposition, sales of the new exporter either decrease by a larger percentage than those of continuing non-exporters or increase by a smaller percentage than those of continuing non exporters.

4. Evidence on implications of the model

Besides capturing the entry and exit behavior documented in Section 2, our model also makes other predictions about export entry and exit and the characteristics of occasional exporters. This section shows evidence on these predictions.

Table 7
Characteristics of occasional vs. perennial exporters.

	Log (capital stock)	Log (employment)	Log (domestic sales)	Log (avg. wages)	Log (share white collar)	White-blue wage premium
$D=1$ (occasional)	−0.974*,**,***	−0.967***	−1.026***	−0.240***	−0.00138	−0.214
	[−5.30]	[−6.17]	[−5.23]	[−3.36]	[−0.02]	[−0.62]
Constant	14.16***	5.068***	14.44***	7.844***	−1.819***	1.608***
	[176.49]	[87.95]	[131.36]	[301.08]	[−61.41]	[4.18]
ISIC4 fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.423	0.322	0.363	0.366	0.359	0.084
Firm-year obs.	4,198	4,331	4,250	4,331	4,310	2,173
Number of firms	455	456	452	456	454	425

Notes: t-statistics in brackets; $D=1$ if the firm is classified as an occasional exporter and $D=0$ if it is classified as a perennial exporter.
*** $p<0.01$.

4.1. Data description

The data set we use in this section comes from a survey of Chilean manufacturing plants conducted by Chile's Statistical Agency (INE). The survey – labeled ENIA – covers all manufacturing plants that employ at least 10 workers. Although the first ENIA survey was conducted in 1979, export activities have only been reported since 1990. Our sample covers the 1992–2005 period. For each plant, the data set provides information on annual nominal output, sales, exports, total employment in blue and white collar occupations, age (number of years since first appearance in the survey) and investment. The investment data are used to compute a measure of real capital stock.[12] Output and sales are deflated using 3-digit industry deflators while investment and wages are deflated using aggregate deflators, both compiled by the Chilean Central Bank. Each plant in the survey is associated with a 4-digit ISIC Rev.3 classification. For single-product plants, this code is the one for the product the plant produces; for multi-product plants, this code is the one for the plant's main product. In our analysis we look at plants/firms that are surveyed in every year since first appearance in the sample and that operate until the last year of the sample. Table B1 in the Online Appendix reports summary statistics on the ENIA sample. There are around 10,000 plants and firms in the sample but fewer than half survive until 2005. Around 25% of plants/firms export in at least one year of the sample and almost half of all exporters survive until 2005.[13]

4.2. Model implications

A first and basic implication of our model is that we should expect to observe two different types of exporters: the "occasional exporter" that enters and exits exporting depending on demand shocks and the "perennial exporter" that continues exporting despite demand shocks. Occasional exporters have smaller capital levels and so lower domestic sales and employment than perennial exporters. To take this insight to the data, we need first to classify firms as either occasional or perennial exporters. Among the subset of exporting firms that survive to the end of the sample, we define occasional exporters as firms in the ENIA sample with two or more exporting spells between 1992 and 2005, provided that none of the spells span over more than three calendar years and that the last exporting spell was not censored in 2005. We define perennial exporters as firms in the ENIA sample that export continually from the date of entry through the end of the sample, provided that they export for at least 4 years. According to these definitions, 67 firms in the sample are occasional exporters and 389 are perennial exporters. Of the perennial exporters, 209 start exporting during the sample period; 180 export in every year of the sample.[14]

Table 7 shows firm characteristics of occasional and perennial exporters. The variable labeled "$D=1$ (Occasional)" is equal to one if the firm is classified as an occasional exporter and is equal to zero if it is classified as a perennial exporter. This table shows that, as predicted by the model, after controlling for year and industry fixed effects, occasional exporters are significantly smaller in terms of capital stock, employment, and domestic sales than are perennial exporters. Occasional exporters also pay lower wages.[15]

In addition to this basic feature, our model has several testable predictions that are directly related to our increasing cost assumption. The first is that, given its fixed investment, a firm that enters exporting reduces its domestic sales by a larger percentage amount than do firms that continue as non-exporters. Defining the index function, E_{jit}, such that $E_{jit}=1$ if firm j in industry i enters into exporting in period t, and $E_{jit}=0$ if it continues to sell domestically only, and defining $\Delta\log(S^d_{jit})$ to be log-changes in domestic sales of firm j in industry i at period t, we take this prediction to data by estimating the following equation:

$$\Delta \log\left(S^d_{jit}\right) = \theta_{it} + \theta_j + \varphi E_{jit} + \xi_{jit}. \tag{15}$$

In Eq. (15), ISIC4 industry-year fixed effects (θ_{it}) capture industry and year specific data variation, such as changes in domestic or foreign demand, while firm fixed effects (θ_j) control for the possibility that new exporters and non-exporters have different trends in domestic sales. The coefficient φ measures the average change in domestic sales observed for firms that enter into exporting, relative to the typical change in the domestic sales of firms that continued as non-exporters in the same industry and year. The first three columns of Table 8 show results for all new exporters, for new occasional exporters, and for new perennial exporters, respectively, and confirm the prediction firms reduce domestic sales when entering into exporting.[16]

While the above test provides evidence consistent with a model of increasing marginal cost and fixed export entry costs, it does not provide evidence on the claimed source of variation in exporting

[12] We use the methodology described in Harberger (1972) to build capital stocks for each three-digit industry in the first year of the sample. The capital stock of each plant in 1992 is determined by that plant's share of industry employment. For subsequent years, capital stocks are obtained from adding plant-level investment, using a 7.5% annual depreciation rate.

[13] We can identify manufacturing firms in the customs data and confirm that the patterns described in Section 2 largely hold in the subsample of Chilean exporters in the ENIA survey. The notable exception is that ENIA firms are less likely to have a single export transaction or be single-year exporters.

[14] We use a strict definition to minimize misclassification error. Results are robust to changes in the definition.

[15] Occasional exporters are larger than non-exporters in all dimensions.

[16] We use the methodology developed in Klepper and Leamer (1984) to bound the true value of the φ parameter, and find that the result that firms reduce domestic sales when entering into exporting is robust to the presence of measurement error in the data. Also, we find that one year after entering into exporting firms' domestic sales growth is not statistically different than the average sales growth of non-exporters in the same industry.

Table 8
Predictions of the model.

Dependent variable:	Changes in log-domestic sales of firm j			Firm-level export dummy (I_{jit})	
	(1)	(2)	(3)	(4)	(5)
	All exporters	Occasional exporters	Perennial exporters	Arellano & Bond	
$E_{jit}=1$ (firm that enter exporting)	−0.08***	−0.08	−0.13***		
	[−4.55]	[−1.64]	[−2.98]		
Log-change in industry domestic sales				−0.056***	−0.0054
				[−3.20]	[−0.63]
Log-change in foreign demand				0.001	0.001
				[0.26]	[0.29]
Lagged export dummy				0.310***	0.313***
				[6.32]	[6.28]
Log (capital stock)					0.002
					[0.11]
$D=1$ (occasional)*(log-change industry domestic sales)					−0.311***
					[−3.99]
Constant	−0.47***	−0.30***	−0.33***	0.540**	0.538**
	[−4.49]	[−4.74]	[−3.39]	[2.54]	[2.56]
Year effects	No	No	No	Yes	Yes
ISIC4-year effects	Yes	Yes	Yes	No	No
Firm effects	Yes	Yes	Yes	Yes	Yes
R-squared	0.15	0.15	0.15	–	–
Obs.	21,855	21,210	21,154	4,017	4,017

*** p<0.01.
** p<0.05.
* p<0.1.

decisions: demand shocks and fixed investments. To provide confirmation on the role these elements play, one would like to have exogenous measures of the demand shocks faced by plants, the analogue of changes in the α parameters of the model in the previous section. With such a measure, one could investigate a key prediction of the model; namely, that demand shocks for products in industry i affect the decision of firms in that industry to enter/exit foreign markets. One way to proxy for domestic demand shocks faced by firms in industry i is to use a measure of changes in industry i's aggregate domestic sales. To ensure exogeneity of the measure, we define the demand shock faced by firm j in industry i as the change in industry i's domestic sales less the change in the firm j's domestic sales. To test our prediction, we employ the empirical strategy of Roberts and Tybout (1997). In particular, we define an index function, I_{jit}, such that $I_{jit}=1$ if firm j in industry i exports in period t and zero otherwise. The export entry rule in Eqs. (11) and (12) implies:

$$P\left(I_{jit}=1\right)=g\left[\theta_j+\theta_t+\alpha_0 D_{jit}+\lambda I_{jit-1}+\beta K_{jit}+\gamma F_{it}\right]+\epsilon_{jit} \quad (16)$$

where θ_j are firm fixed effects and capture firm-specific characteristics that affect export decisions and do not vary over time. The variables θ_t are time fixed effects and control for shocks that are common to all firms in a given year. These effects may capture, for example, changes in exchange rates. D_{jit} measures log-changes in domestic sales at the ISIC4 industry, discounted by changes in the domestic sales of firm j, while K_{jit} measures the firm's capital stock, which varies over time. If foreign demand shocks are common to all industries, the time fixed effects θ_t control for them. However, if foreign demand shocks are industry specific, the entry decision rule in Eqs. (11) and (12) indicates that Eq. (16) needs to control for them. The variable F_{it} proxies for changes in foreign demand by measuring the weighted average real GDP growth of Chile's export partners, with weights measuring each partner's share of Chilean exports by ISIC 4-digit industry.[17] Finally, we also allow the decision to export to depend on whether or not the firm exported in the previous period.

We estimate the probability function in Eq. (16) using a linear probability model, with lagged dependent variables in levels and differences serving as instruments (Arellano and Bond, 1991). The result is shown in column 4 of Table 8. Column 5 shows results when the specification includes an interaction term between D_{jit} and the dummy variable identifying occasional and perennial exporters. This interaction term allows us to capture the (possibly) different effect of domestic demand shocks on occasional and perennial exporters. In both specifications the effect goes in the way predicted by the model: firms are more likely to enter into exporting during times of reductions in domestic demand.[18] Also, domestic demand shocks affect the exporting decisions of occasional exporters but not of perennial exporters. This is as predicted by the model: the marginal firms move in and out of exporting with demand shocks while the inframarginal firms just adjust sales levels.[19]

5. Conclusion

In this paper we argue that increasing marginal costs and stochastic demand can help explain the observed export entry and exit behavior of occasional exporters. While not explored here, a multi-country generalization of the model can be used to explain the observation that perennial exporters enter and exit particular export destinations. There are, of course, other mechanisms that may also be at play here producing entry and exit from export markets. Firms may be learning about the profitability of exporting in general and/or the profitability of exporting to specific destinations. The observation that many firms export for a brief period of time and then exit exporting would be consistent with a learning story. It may also be that firms export occasionally to maintain foreign market relationships, thus providing these occasional exporters the option of becoming perennial exporters subsequently. We observe few but not many instances of this outcome in the data.

[17] See the Online Appendix for a detailed discussion on the construction of our proxy for foreign demand, and summary statistics.

[18] In both specifications foreign demand is not statistically significant once we control for firm and year fixed-effects.

[19] We obtain similar results if we instrument for the dummy variable identifying occasional and perennial exporters with firm capital. We also find similar results if we exclude the 10% largest firms in each industry from the computation of the industry domestic demand and from the estimation of Eq. (16).

Appendix A. Supplementary data

Supplementary data to this article can be found online at http://dx.doi.org/10.1016/j.jinteco.2012.11.002.

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