[Not for publication]

Online Appendix for "Sequential Exporting"

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Abstract

This Online Appendix contains proofs and extensions of the model described in the main text, as well as additional empirical results.

A-1 Proof of Proposition 1

Proposition 1 *There are numbers F^{Sq} and F^{Sm}, with $F^{Sq} > F^{Sm} \geq 0$, such that at $t = 1$ the firm enters both markets A and B if $F < F^{Sm}$, enters only market A if $F \in [F^{Sm}, F^{Sq}]$, and enters neither market if $F > F^{Sq}$. Moreover, $F^{Sm} > 0$ iff $E\mu > \tau^B$. When $F \in [F^{Sm}, F^{Sq}]$, at $t = 2$ the firm enters market B if it learns that $\mu \geq 2F^{1/2} + \tau^B$.*

Proof of Proposition 1. Recall from the main text that the firm's entry strategy is fully characterized by conditions :

$$e_1^A(\tau^A, \tau^B) = 1 \Leftrightarrow F \leq \Psi(\tau^A) + W(\tau^B; F), \tag{A-1}$$

$$e_1^B(\tau^B) = 1 \Leftrightarrow F < \Psi(\tau^B) - W(\tau^B; F). \tag{A-2}$$

Rewrite condition (A-2) for $e_1^B = 1$ as

$$F + W(\tau^B; F) < \Psi(\tau^B). \tag{A-3}$$

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The right-hand side of (A-3) is independent of F, whereas the left-hand side is strictly increasing in F. To see that, use Leibniz's rule to find that

$$\begin{aligned} \frac{\partial\left[F+W(\tau^B;F)\right]}{\partial F} &= 1-\int_{2F^{1/2}+\tau^B}^{\overline{\mu}} dG(\mu) \\ &= G(2F^{1/2}+\tau^B) > 0. \end{aligned} \tag{A-4}$$

Defining F^{Sm} as the F that would turn (A-3) into an equality, $e_1^B = 1$ if $F < F^{Sm}$. However, $F^{Sm} = 0$ if $E\mu \leq \tau^B$, since in that case (A-3) becomes

$$F + \int_{2F^{1/2}+\tau^B}^{\overline{\mu}} \left[\left(\frac{\mu-\tau^B}{2}\right)^2 - F\right] dG(\mu) < \int_{\tau^B}^{\overline{\mu}} \left(\frac{\mu-\tau^B}{2}\right)^2 dG(\mu).$$

This expression becomes an equality when $F = 0$. Given (A-4), it follows that it does not hold for any $F > 0$.

Next rewrite condition (A-1) for $e_1^A = 1$ as

$$F - W(\tau^B;F) \leq \Psi(\tau^A). \tag{A-5}$$

The right-hand side of (A-5) is independent of F, whereas it is straightforward to see that the left-hand side is strictly increasing in F. Thus, defining F^{Sq} as the F that solves (A-5) with equality, $e_1^A = 1$ if $F \leq F^{Sq}$. Since F^{Sm} is the value of F that leaves the firm indifferent between a sequential and a simultaneous entry strategy [i.e. $\Pi^{Sq}(F^{Sm}) = \Pi^{Sm}(F^{Sm}) > 0$], while F^{Sq} is the value of F that leaves the firm indifferent between sequential entry and no entry [i.e. $\Pi^{Sq}(F^{Sq}) = 0$], because profits are decreasing in the value of the sunk entry cost, $\partial\Pi^{Sq}(F)/\partial F = G(2F^{1/2}+\tau^B) - 2 < 0$, it follows that $F^{Sq} > F^{Sm}$.

Finally, since the firm learns μ at $t = 1$ when $F \in [F^{Sm}, F^{Sq}]$, $\mu \geq 2F^{1/2} + \tau^B$ and it enters market B at $t = 2$. ■

A-2 Model Extension: Differences in Productivity

To allow for differences in productivity, define a firm's unit costs as $\frac{1}{\varphi} + c$, where $\varphi \in [0, \infty)$ denotes the firm's (known) efficiency in production (i.e. its measure of productivity) and c again reflects its (unknown) unit export cost. It is easy to see, for example, that more productive firms will sell larger quantities (and expect higher profits) in the destinations they serve. More important for our purposes is how differences in productivity affect entry patterns in foreign markets. The following proposition shows that the more productive a firm is, the less stringent the start-up fixed entry thresholds F^{Sq} and F^{Sm} become.

Proposition 2 *F^{Sq} and F^{Sm} are increasing in productivity φ.*

Proof of Proposition 2. Rewrite condition (A-2) for $e_1^B = 1$ as

$$F < \Psi(\tau^B + \frac{1}{\varphi}) - W(\tau^B + \frac{1}{\varphi}; F). \tag{A-6}$$

Analogously to Proposition 1, $F^{Sm} = 0$ if $E\mu \leq \tau^B + \frac{1}{\varphi}$, in which case $\frac{dF^{Sm}}{d\varphi} = 0$. Otherwise, the expression above rewritten as an equality defines F^{Sm} implicitly:

$$F^{Sm} = \left[\Psi(\tau^B + \frac{1}{\varphi}) - W(\tau^B + \frac{1}{\varphi}; F^{Sm})\right],$$

or equivalently,

$$F^{Sm} = \left(\frac{E\mu - \tau^B - \frac{1}{\varphi}}{2}\right)^2 + \int_{\tau^B+\frac{1}{\varphi}}^{\overline{\mu}} \left(\frac{\mu - \tau^B - \frac{1}{\varphi}}{2}\right)^2 dG(\mu) \\ - \int_{2(F^{Sm})^{1/2}+\tau^B+\frac{1}{\varphi}}^{\overline{\mu}} \left[\left(\frac{\mu - \tau^B - \frac{1}{\varphi}}{2}\right)^2 - F^{Sm}\right] dG(\mu).$$

Totally differentiating this expression and manipulating it, we find

$$\begin{aligned} \frac{dF^{Sm}}{d\varphi} &= \frac{\partial\Psi(\tau^B + \frac{1}{\varphi})/\partial\varphi - \partial W(\tau^B + \frac{1}{\varphi}; F^{Sm})/\partial\varphi}{1 + \partial W(\tau^B + \frac{1}{\varphi}; F^{Sm})/\partial F} \\ &= \frac{(E\mu - \tau^B - \frac{1}{\varphi}) + \int_{\tau^B+\frac{1}{\varphi}}^{2[F^{Sm}]^{1/2}+\tau^B+\frac{1}{\varphi}} (\mu - \tau^B - \frac{1}{\varphi}) dG(\mu)}{2\varphi^2 G(2\left[F^{Sm}\right]^{1/2} + \tau^B + \frac{1}{\varphi})} > 0. \end{aligned}$$

Next rewrite condition (A-1) for $e_1^A = 1$ as

$$F \leq \Psi(\tau^A + \frac{1}{\varphi}) + W(\tau^B + \frac{1}{\varphi}; F). \tag{A-7}$$

This expression defines F^{Sq} implicitly when it holds with equality:

$$F^{Sq} = \Psi(\tau^A + \frac{1}{\varphi}) + W(\tau^B + \frac{1}{\varphi}; F^{Sq}),$$

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or equivalently,

$$F^{Sq} = \mathbf{1}_{\{E\mu > \tau^A + \frac{1}{\varphi}\}} \left(\frac{E\mu - \tau^A - \frac{1}{\varphi}}{2} \right)^2 + \int_{\tau^A + \frac{1}{\varphi}}^{\overline{\mu}} \left(\frac{\mu - \tau^A - \frac{1}{\varphi}}{2} \right)^2 dG(\mu)$$
$$+ \int_{2(F^{Sq})^{1/2} + \tau^B + \frac{1}{\varphi}}^{\overline{\mu}} \left[\left(\frac{\mu - \tau^B - \frac{1}{\varphi}}{2} \right)^2 - F^{Sq} \right] dG(\mu).$$

Totally differentiating this expression and manipulating it, we find

$$\frac{dF^{Sq}}{d\varphi} = \frac{\partial\Psi(\tau^A + \frac{1}{\varphi})/\partial\varphi + \partial W(\tau^B + \frac{1}{\varphi}; F^{Sq})/\partial\varphi}{1 - \partial W(\tau^B + \frac{1}{\varphi}; F^{Sq})/\partial F}$$
$$= \frac{1}{2\varphi^2 \left[2 - G(2\left[F^{Sq}\right]^{1/2} + \tau^B + \frac{1}{\varphi}) \right]} \times \left[\mathbf{1}_{\{E\mu > \tau^A + \frac{1}{\varphi}\}} \left(E\mu - \tau^A - \frac{1}{\varphi} \right) + \right.$$
$$\left. + \int_{\tau^A + \frac{1}{\varphi}}^{\overline{\mu}} (\mu - \tau^A - \frac{1}{\varphi}) dG(\mu) + \int_{2[F^{Sq}]^{1/2} + \tau^B + \frac{1}{\varphi}}^{\overline{\mu}} (\mu - \tau^B - \frac{1}{\varphi}) dG(\mu) \right] > 0,$$

completing the proof. ■

Figure 1 illustrates Proposition 2. If productivity is too low ($\varphi < \frac{1}{\overline{\mu} - \tau^A}$), there is no hope of making profits through exporting, and therefore the firm does not enter any foreign market even if $F = 0$. Similarly, the firm would never enter simultaneously if it did not expect to make positive operational profits in market B (i.e. if $\varphi > \frac{1}{E\mu - \tau^B}$). By contrast, observe that as the unit production cost falls to zero (i.e. $\varphi \to \infty$), the thresholds approach those defined in Proposition 1.

A-3 Formalization of Empirical Predictions

We derive here the empirical predictions from the theoretical model in the main text. We extend it to $T > 2$ periods and $N > 2$ foreign countries, so we can derive testable predictions for the intensive and the extensive (both entry and exit) margins of exporting. We assume throughout that F is 'moderate,' so sequential exporting is optimal. We keep the convention that $\tau^A = \min\{\tau^j\}$, $j = A, ..., N$, so that market A is the first the firm enters at $t = 1$.

Our model predicts, first, that conditional on survival the growth of a firm's exports is on average highest early in its first foreign market.

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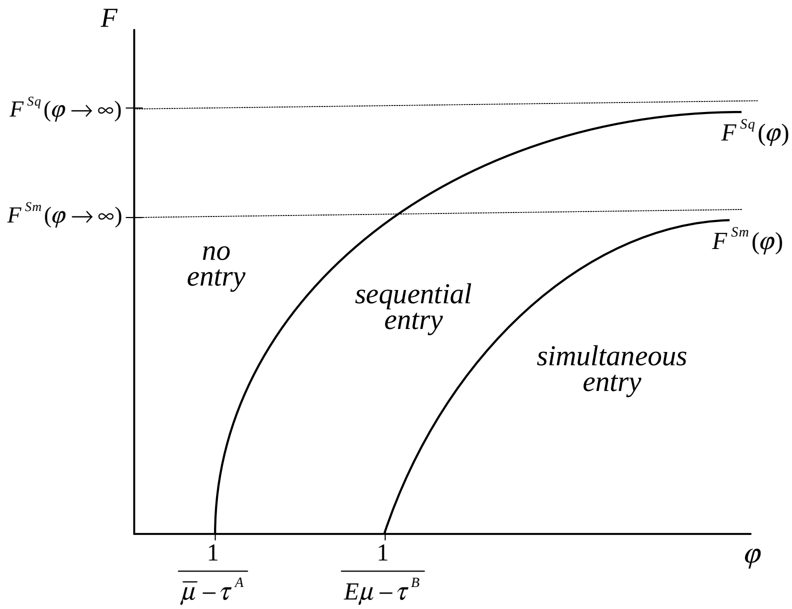

Figure 1: Optimal Entry Strategy with Varying Productivity

Prediction 1 *Conditional on survival, the growth rate of exports to a market is on average higher between the first and second periods in the first foreign market served by the firm than in subsequent markets or later in the firm's first market.*

Proof. Consider the first market, A. Conditional on entry, export volume at $t = 1$ is given by $q_1^A = \mathbf{1}_{\{E\mu>\tau^A\}}\frac{E\mu-\tau^A}{2} + \mathbf{1}_{\{E\mu\leq\tau^A\}}\varepsilon$. At $t = 2$, the firm decides to stay active there if $\mu > \tau^A$, and in that case produces $q_2^A = \frac{\mu-\tau^A}{2}$. Ex post quantities conditional on survival are distributed according to $G(\cdot|\mu > \tau^A)$. It follows that the average surviving firm will produce the ex ante expected quantity $E(q_2^A|\,\mu > \tau^A) = \frac{\int_{\tau^A}^{\bar{\mu}}\left(\frac{\mu-\tau^A}{2}\right)dG(\mu)}{1-G(\tau^A)} = \frac{E(\mu|\mu>\tau^A)-\tau^A}{2} > 0$. There are two cases. If $E\mu \leq \tau^A$, export growth from first to second year is $\sigma^A \equiv \frac{E(\mu|\mu>\tau^A)-\tau^A}{2} - \varepsilon > 0$. Otherwise, $\sigma^A = \frac{E(\mu|\mu>\tau^A)-\tau^A}{2} - \frac{E\mu-\tau^A}{2} = \frac{1}{2}[E(\mu|\,\mu > \tau^A) - E\mu]$. We now show that this inequality is strictly positive:

$$
\begin{aligned}
E(\mu|\,\mu &> \tau^A) = \int_{\tau^A}^{\overline{\mu}} \mu dG(\mu|\,\mu > \tau^A) \\
&= \int_{\tau^A}^{\overline{\mu}} \mu \frac{dG(\mu)}{1 - G(\tau^A)} \\
&= \frac{1}{1 - G(\tau^A)} \left\{ \overline{\mu} - \int_{\tau^A}^{\overline{\mu}} G(\mu) d\mu \right\} \\
&= \frac{1}{1 - G(\tau^A)} \left\{ E\mu + \int_{\underline{\mu}}^{\tau^A} G(\mu) d\mu \right\} \\
&> \left\{ E\mu + \int_{\underline{\mu}}^{\tau^A} G(\mu) d\mu \right\} \\
&> E\mu
\end{aligned}
$$

Where the third equality follows from integration by parts and the fourth from rewriting $E\mu = \overline{\mu} - \int_{\underline{\mu}}^{\tau^A} G(\mu)d\mu - \int_{\tau^A}^{\overline{\mu}} G(\mu)d\mu$ as $\overline{\mu} - \int_{\tau^A}^{\overline{\mu}} G(\mu)d\mu = E\mu + \int_{\underline{\mu}}^{\tau^A} G(\mu)d\mu$. Now if $\tau^A \in (\underline{\mu}, \overline{\mu})$ we must have that $G(\tau^A) > 0$, which is equivalent to $1 - G(\tau^A) < 1 \Leftrightarrow \frac{1}{1-G(\tau^A)} > 1$ so that the first inequality follows, and the second. Hence, conditional on survival, the firm expects to increase its export volume to market A in the second period. In all subsequent periods expected growth in market A conditional on survival is nil, since $E(\,q_t^A \big|\, \mu > \tau^A) = \frac{E(\,\mu|\mu>\tau^A) - \tau^A}{2}$ for all $t > 1$.

Consider now foreign market j, $j \neq A$. Since the firm enters market j only if $\mu > 2F^{1/2} + \tau^j$, $E(\,q_{t+1}^j \big|\, \mu > 2F^{1/2} + \tau^j) = E(\,q_t^j \big|\, \mu > 2F^{1/2} + \tau^j) = \frac{E(\,\mu|\mu>2F^{1/2}+\tau^j) - \tau^j}{2}$ for all $t \geq 1$. Thus, export growth in market j is nil in all periods. Hence, export growth is on average highest in market A between the first and second years of exporting. ■

Second, our model predicts that new exporters are more likely to enter new foreign destinations.

Prediction 2 *Conditional on survival, new exporters are more likely to enter other foreign markets than experienced ones.*

Proof. Denote the probability that a firm that has just started to export will enter a new foreign market j in the next period by $\Pr(e_2^j = 1|e_1^A = 1 \;\&\; e_1^j = 0)$, and the probability that a firm that has been an exporter for a longer period will enter market j by $\Pr(e_t^j = 1|\prod_{i=1}^{t-1} e_{t-i}^A = 1 \;\&\; e_{t-1}^j = 0)$, $t \geq 2$. The model implies that $\Pr(e_2^B = 1|e_1^A = 1 \;\&\; e_1^j = 0) = 1 - G(2F^{1/2} + \tau^j) > 0 = \Pr(e_t^j = 1|\prod_{i=1}^{t-1} e_{t-i}^A = 1 \;\&\; e_{t-1}^j = 0)$, concluding the proof. ■

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Finally, our model predicts that the probability that firm i will exit a particular export market j in period t ($Exit_{ijt} = 1$) is higher if the firm exported for the first time in $t-1$.

Prediction 3 *New exporters are more likely to exit than experienced exporters, including those that are new in a market but have export experience elsewhere.*

Proof. Let the probability of exiting a foreign market right after entering there be $\Pr(e_2^A = 0|e_1^A = 1)$ if the foreign market is the firm's first, and $\Pr(e_{t+1}^j = 0|e_t^j = 1 \ \& \ e_{t-1}^j = 1)$, $t \geq 2$, $j \neq A$, otherwise. The latter is also equal to the probability of exiting a market after being there for more than one period. The model implies that

$$\Pr(e_2^A = 0|e_1^A = 1) = G(\tau^A) > 0 = \Pr(e_{t+1}^j = 0|e_t^j = 1 \ \& \ e_{t-1}^j = 1),$$

completing the proof. ■

A-4 Additional Empirical Results

A-4.1 Results with Gravity Controls

Table A-1 reports results of our three main regressions when we introduce covariates frequently used in gravity regressions as controls, instead of destination or year-destination fixed effects. The estimated coefficients of our main variables are very similar to those estimated with the fixed effects.

Gravity variables are constructed as follows. $Border_{Arg,j}$ takes value one if country j shares a border with Argentina, and zero otherwise. $Distance_{Arg,j}$ measures the geodesic distance between Buenos Aires and the main city in country j, using the great circle method. $SameLanguage_{Arg,j}$ takes value one if Spanish is the main language in country j. Data come from CEPII. In turn, $SamePCIncomeQuartile_{Arg,J}$ takes value one if country j belongs to the same per capita income quartile as Argentina. Data are in purchasing power parity for 2010 and come from the World Bank.

A-4.2 Patterns of Entry: Extended Gravity

Table 8 in Section 3.3 reports the results of a modified entry regression, where we control for the proximity between current and past export markets ("extended gravity").

[Not for publication]

Table A-1: Main Estimations Including Gravity Variables

Dependent Variable:	$\Delta \log X_{ijt}$	$Exit_{ijt}$	$Entry_{irt}$
LPM	(1)	(2)	(3)
$FY_{ij,t-1} \times FM_{ij}$	0.123**	0.120**	
	(0.038)	(0.004)	
FM_{ij}	-0.009	0.149**	
	(0.040)	(0.003)	
$FY_{ij,t-1}$	0.253**	0.021**	
	(0.017)	(0.002)	
$FY_{i,t-1}$			0.012**
			(0.002)
GDP_j	-0.461	0.533**	0.320
	(0.424)	(0.047)	(0.180)
$Population_j$	0.258**	0.015	0.005**
	(0.087)	(0.084)	(0.001)
$Distance_{Arg,j}$	-0.687**	0.104**	-0.005**
	(0.226)	(0.048)	(0.0001)
$Border_{Arg,j}$	0.037*	0.031**	0.007**
	(0.017)	(0.002)	(0.002)
$Same\ Language_{Arg,j}$	0.011	0.017**	-0.002
	(0.016)	(0.002)	(0.001)
$Same\ PC\ Income\ Quartile_{Arg,j}$	-0.025*	-0.002	0.101**
	(0.011)	(0.002)	(0.008)
Firm FE	yes		yes
Sector FE		yes	
Number of obs	103,418	114,739	235,693
R-squared	0.096	0.135	0.094

**: significant at 1%; *: significant at 5%

Robust standard errors adjusted for clusters in firms.

[Not for publication]

The "extended gravity" variables are constructed as follows. $ExtendedBorder_{r,it}$, $ExtendedLanguage_{r,it}$ and $ExtendedPCIncomeGroup_{r,it}$ are binary variables. They take value 1 when region r shares a border, language or per capita income group, respectively, with another region in which firm i was exporting at time $t-1$. Regions are as described in Section 3.1 of the article. Data on per capita income are in purchasing power parity for 2010 and come from the World Bank. Details on the matrices of border and language indicators are available upon request.

A-4.3 Export Destination Transition Matrix

Table A-2 describes the transition probabilities between groups of export destinations in years t (columns) and $t+1$ (rows).[1] "None" describes firms that are currently not exporting, while "All" describes firms currently exporting to all possible destination groups. For instance, 12% of all non-exporters in t (column 1) start exporting to a Mercosur country only in $t+1$. The first column and the first row can be interpreted as average rates of entry and exit.

Several patterns emerge. Few firms among non-exporters (5%, column 1, rows $6-16$) start as simultaneous exporters. As noted in the text, most new exporters start serving a destination in the Mercosur or the OtherLA groups, but rarely both. Single-group exporters have significantly higher exit rates than multi-group exporters. The large values on the diagonal show persistence in the groups of destinations served.

[1] We consider a smaller number of groups than in the entry regressions in order to reduce the dimensionality of the matrix. Transition matrices with alternative country groupings are available upon request.

[Not for publication]

Table A-2: Destination Transition Matrix

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
(1) None	64	26	33	30	36	10	5	11	10	10	10	2	5	2	3	1
(2) Mercosur	12	52	2	5	4	18	11	22	2	1	3	3	4	3	0	0
(3) OECD	7	1	42	2	6	11	0	3	15	16	2	1	6	0	5	0
(4) Other LA	10	3	2	43	3	2	9	2	14	1	16	2	1	3	3	0
(5) RofW	2	0	1	1	30	1	0	7	0	7	10	0	1	1	1	0
(6) Mercosur & OECD	1	3	4	0	1	25	1	5	3	2	1	4	10	1	1	1
(7) Mercosur & Other LA	2	11	1	13	1	6	56	8	6	0	8	19	2	21	0	3
(8) Mercosur & RofW	0	1	0	0	2	1	0	20	0	0	1	0	2	2	0	0
(9) OECD & Other LA	1	0	5	3	1	3	1	1	26	2	4	4	1	2	8	1
(10) OECD & RofW	1	0	5	0	7	2	0	0	2	40	3	0	10	0	12	1
(11) OtherLA & RofW	0	0	0	1	4	0	0	1	1	1	19	0	0	3	3	0
(12) Mercosur, OECD & Other LA	0	1	1	1	0	11	9	2	10	1	2	44	5	7	5	9
(13) Mercosur, OECD & RofW	0	0	1	0	1	4	0	5	1	7	1	1	25	1	3	2
(14) Mercosur, Other LA & RofW	0	1	0	1	2	1	4	7	1	0	8	2	2	34	1	5
(15) OECD, Other LA & RofW	0	0	1	0	3	1	0	1	6	9	9	1	4	1	34	3
(16) All	0	0	1	0	1	3	2	6	3	3	5	15	24	20	19	73

Values are percentages. All Latin American countries outside Mercosur are included in "Other LA".