Internationalization choices: an ordered probit analysis at industry-level

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12th Research Meeting of NIPFP-DEA Research Program
New Delhi – 13,14 March 2014

Motivations

- Firms in a given industry can serve foreign markets through two main channels: (i) exports and (ii) foreign direct investment (FDI)
- The theoretical literature has built models in which internationalization choices are driven by:
  - *industry and country characteristics* (Brainard, 1993, 1997)
  - *firm heterogeneity* in productivity (Melitz, 2003; Helpman et al., 2004)
- Although there is a growing empirical literature providing convincing support to the theoretical framework of Melitz (2003) and Helpman et al. (2004), to the best of our knowledge, all analyses focus on one country
- In this paper we present the results of a cross-country and cross-industry analysis of the determinants of firm internationalization

Theoretical framework

- Our theoretical framework is the model of Helpman et al. (2004), that builds on Melitz (2003) and assumes that monopolistically competitive firms:
  - draw different levels of productivity from an exogenous distribution
  - find international trade profitable only if they are productive enough to sustain the fixed costs of exporting
  - find foreign direct investment profitable only if they are productive enough to sustain the (higher) fixed costs of investing abroad
- A key feature of Helpman et al (2004), and all this class of models, is that productivity maps exactly into firm size, so that exporting firms are more productive and at the same time larger
- Therefore, a higher within-industry dispersion in firm size (and productivity) is associated with a higher incidence of sales by foreign affiliates relative to exports, because more firms are sufficiently productive to find this form internationalization profitable

Previous evidence (1)

- The empirical literature has studied firms' internationalization choices watching at:
  - the sheer fact that they export or have a foreign affiliate (the extensive margin)
  - the share of sales from foreign affiliates over total sales and the share of exports over total sales (the intensive margin)
- In both cases, the available evidence confirms that:
  - the most productive firms are multinationals and have a larger share of revenues from foreign affiliates
  - firms with intermediate level of productivity are exporters and have a larger exports
  - the least productive firms serve only the domestic market

Previous literature (2)

- The econometric framework depends on whether authors study the extensive or the intensive margin of internationalization
- In the first case, discrete choice models are typically adopted such as:
  - multinomial logit (Bougheas and Görg, 2008; Benfratello and Razzolini, 2009; Todo, 2011)
  - multinomial probit (Engel et al., 2009; Calia and Ferrante, 2010)
  - ordered probit (Basile et al., 2003; Demirbas et al., 2013)
- In the second case there is fewer evidence available, but pointing in a similar direction (Helpman et al., 2004; Oldenski, 2012; Pietrovito et al., 2014)

Aim of the paper

- We study firms' internationalization strategies focusing on firms' size dispersion at the industry level, and controlling for a host of other factors
- We build a large dataset including:
  - 24 origin countries and 91 destination countries
  - 57 manufacturing industries
  - 11 years (1994-2004)
- Given the structure of our cross-country and cross-industry data, we focus on the extensive margin of internationalization
- Consistent with the model of Helpman et al. (2004), our main hypothesis is that a higher variance in firms' size distribution is associated with higher probability of exporting and investing abroad

Intended contribution to the literature

- Our major contributions with respect to the previous literature are that:
  - we use a large sample of developed and less-developed countries
  - we control for a larger number of country and industry characteristics
- In this way we can:
  - verify if the results of the literature that uses firm-level have implications also at the industry level
  - extend the already available evidence at the industry level to a larger set of countries

Data and sources (1)

- We gather and merge information at the country and industry level from a large number of data sets

Industry-level data

- exports: UN Comtrade
- M&A: SDC Platinum
- firms' sale distribution: Worldscope
- TFP and capital intensity: UNIDO (Indstat4 2008)
- number of patents: NBER
- tariffs: TRAINS
- number of common partners in exports and M&As: UN Comtrade and SDC Platinum

Country-level data

- distance, islands, landlocked, language, religion, contiguity, colonial ties: CEPII

Data and sources (2)

Variable	Mean	Median	St. dev.	Min	25°	75th	Max
Presence abroad	0.97	1	0.38	0	1	1	2
Sales mean (ln)	11.29	11.22	1.76	4.82	10.07	12.44	18.31
Sales dispersion (ln)	0.11	0.17	0.78	-3.49	-0.27	0.64	2.06
TFP (ln)	5.07	5.17	0.71	1.61	4.75	5.47	7.79
Capital intensity	0.51	0.51	0.10	0.27	0.45	0.57	0.90
Patents (1+ln)	0.82	0	1.44	0	0	0.99	7.29
Distance (ln)	8.83	9.05	0.74	5.37	8.55	9.28	9.89
Islands	0	0	1	0	0	1	2
Common language	0	0	0	0	0	0	1
Common religion	0	0	0	0	0	0	1
Tariffs	0.11	0.09	0.09	0	0.03	0.16	0.46
Common partners in trade (1+ln)	3.73	4.08	1.07	0	3.26	4.54	4.78
Common partners in FDI (1+ln)	0.17	0	0.45	0	0	0	3.43

Data and sources (3)

Variable	Domestic		Trade		Trade and FDI	
	Mean	St. dev.	Mean	St. dev.	Mean	St. dev.
Sales mean (ln)	10.37	1.66	11.33	1.76	12.07	1.46
Sales dispersion (ln)	-0.19	0.81	0.10	0.76	0.70	0.67
TFP (ln)	4.76	0.70	5.09	0.71	5.38	0.43
Capital intensity	0.48	0.11	0.52	0.10	0.50	0.08
Patents (1+ln)	0.16	0.62	0.79	1.38	2.14	2.20
Distance (ln)	9.09	0.58	8.82	0.73	8.55	0.95
Islands	0.45	0.58	0.41	0.57	0.53	0.61
Common language	0.07	0.26	0.10	0.30	0.26	0.44
Common religion	0.25	0.33	0.19	0.29	0.20	0.25
Tariffs	0.10	0.10	0.11	0.09	0.08	0.08
Common partners in trade (1+ln)	3.59	1.06	3.69	1.07	4.55	0.42
Common partners in FDI (1+ln)	0.05	0.20	0.13	0.36	0.99	0.87
Observations	5,870		58,196		3,830	

Data and sources (4)

	Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
(1)	Foreign presence	1.00												
(2)	Sales mean (ln)	0.19	1.00											
(3)	Sales dispersion (ln)	0.20	0.27	1.00										
(4)	TFP (ln)	0.17	0.51	0.16	1.00									
(5)	Capital intensity	0.07	0.07	-0.22	0.41	1.00								
(6)	Patents (1+ln)	0.24	0.29	0.43	0.30	-0.10	1.00							
(7)	Distance (ln)	-0.14	-0.03	0.09	-0.06	-0.10	0.04	1.00						
(8)	Islands	0.02	0.10	0.09	0.18	0.10	0.08	0.07	1.00					
(9)	Common language	0.10	-0.02	0.02	-0.01	-0.08	0.04	-0.10	0.11	1.00				
(10)	Common religion	-0.04	-0.02	-0.20	-0.05	-0.01	-0.08	-0.06	-0.07	0.10	1.00			
(11)	Tariffs	-0.02	0.06	-0.01	0.03	-0.02	0.02	0.02	-0.07	0.02	-0.15	1.00		
(12)	Co. trade part. (1+ln)	0.15	-0.05	0.01	-0.08	-0.10	-0.03	-0.04	-0.03	-0.09	0.03	-0.18	1.00	
(13)	Co. FDI part. (1+ln)	0.34	0.09	0.20	0.11	0.00	0.16	-0.04	0.09	0.07	0.02	-0.23	0.30	1.00

The empirical framework

- Given the structure of our data set, we study the extensive margin of internationalization at the country and industry level
- In practice, we estimate an ordered probit model at the country and industry level, where the dependent variable takes the value of:
  - zero if there have been no trade or FDI relationships from industry *k* of *i* to country *j* during our sample period
  - one if there has been a trade relationship from industry *k* of *i* to country *j* during our sample period
  - two if there have been a trade relationship and an M&A from industry *k* of *i* to country *j* during our sample period

The econometric model (1)

- The ordered probit model for y can be derived from a latent continuous variable, y^*, related to a set of explanatory variables according to a standard linear model

$$y = \beta_0 + \beta_1 x_1 + \ldots + \beta_n x_n + \varepsilon$$

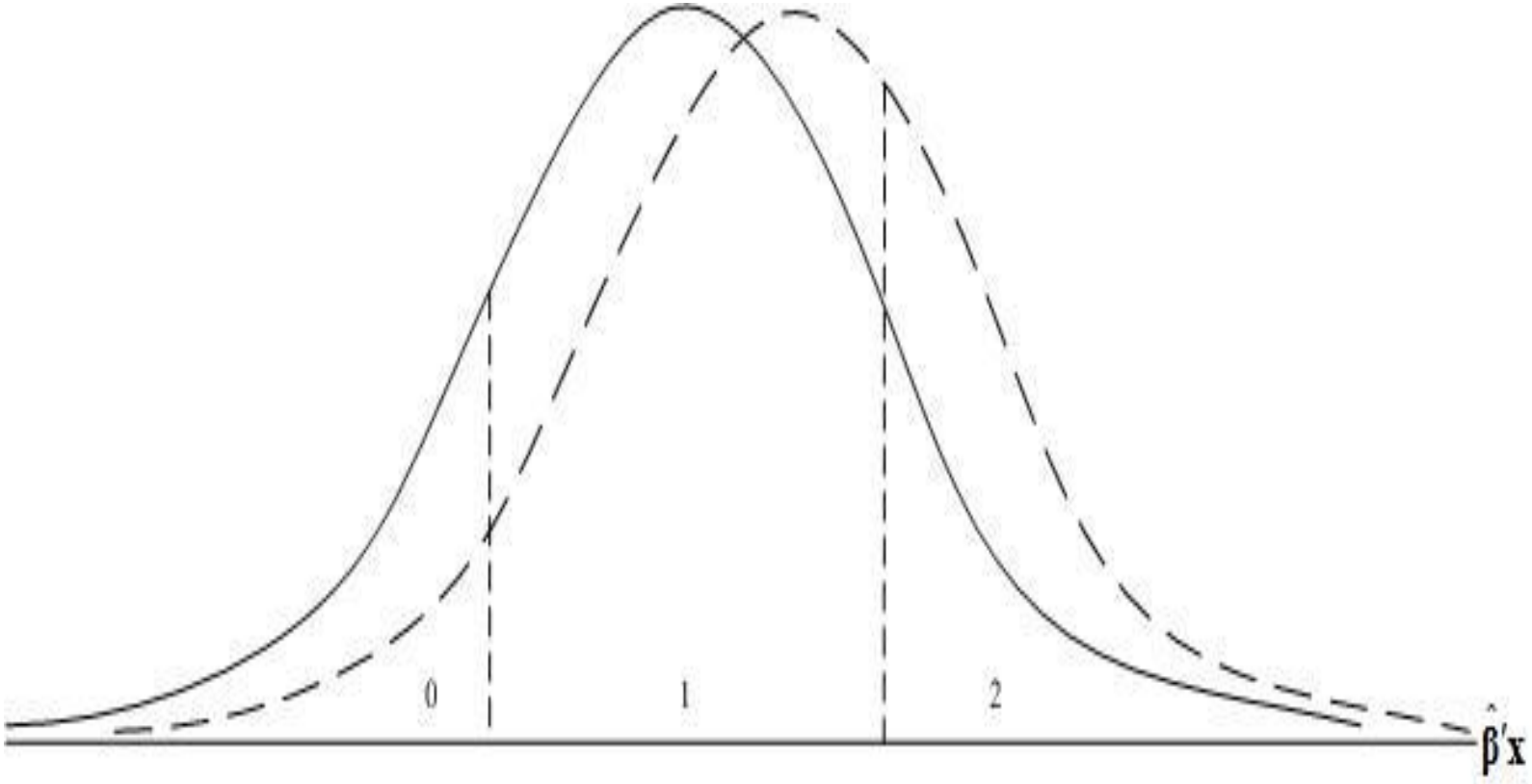
where $x_{1\ldots n}$ are the explanatory variables, $\beta_{1\ldots n}$ are the associated parameters, and ε is a random error term drawn from a standardized normal distribution

- y is observed and related to y^* by the following relationship:
  - $y = 0$ if $y^* \leq a_1$
  - $y = 1$ if $a_1 < y^* \leq a_2$
  - $y = 2$ if $y^* > a_2$

where, a_1 and a_2 are unobserved cut points to be estimated

The econometric model (2)

- Notice that in this framework, each explanatory variable can have the effect of reducing the probability that $y = 1$ either because it becomes $y = 0$ or $y = 2$



The baseline econometric specification

- Given this framework, our baseline econometric specification is the following:

$$y_{kij} = \beta_0 + \beta_1 \, firms' \, sale \, dispersion_{ki} + \beta_2 X_{ki} + \beta_3 B_{ij} + \beta_4 D_k$$

$$+ \beta_4 D_i + \beta_5 D_j + \varepsilon_{kij}$$

where:

- $firms' \, sale \, dispersion_{ki}$ is the coefficient of variation of firms' sales within each industry k of country i
- X_{ki} is a set of characteristics of industry k of country i, such as average firms' sales, average TFP, the capitall ratio or the number of patents produced
- B_{ij} is a set of characteristics of the bilateral relationship between country i and country j, such as the distance or the tariff applied
- D_k, D_i and D_j are dummies for industry k, country i and country j, respectively

Baseline results: whole sample

Regressors	Coefficients	Changes in predicted probability		
		Domestic	Trade	Trade and FDI
Sales dispersion (ln)	**0.14 *****	**-0.01**	**0.003**	**0.01**
Sales mean (ln)	0.21 ***	-0.05	0.02	0.03
TFP (ln)	1.10 ***	-0.08	0.02	0.06
Capital intensity (ln)	5.19 ***	-0.07	0.02	0.05
Patents (1 + ln)	0.19 ***	-0.02	0.01	0.01
Distance (ln)	-0.47 ***	0.03	-0.01	-0.02
Islands	0.99 ***	-0.13	-0.12	0.25
Common language	0.42 ***	-0.03	0.001	0.03
Common religion	0.31 ***	-0.03	0.004	0.02
Tariffs (1 + ln)	-0.41 ***	0.01	-0.001	-0.004
Co. trade partners (1 + ln)	0.34 ***	-0.04	0.01	0.03
Co. M&A partners (1 + ln)	0.89 ***	-0.09	0.03	0.06
cut1	7.19 ***			
cut2	11.71 ***			
Average predicted probability		0.086	0.856	0.06
Observations		67,896		

Robustness checks (1): whole sample

Regressors	Coefficients					
	Baseline	**Probit**				
Sales dispersion (ln)	**0.14**	**0.18**	**0.22**		**0.17**	**0.11**
Sales mean (ln)	0.21	0.23	0.21		0.25	0.19
TFP (ln)	1.10	1.23	1.20	1.11		
Capital intensity (ln)	5.19	5.73	5.05	4.98	5.24	2.34
Patents (1 + ln)	0.19	0.30	0.19	0.19	0.22	0.16
Distance (ln)	-0.47	-0.62	-0.46	-0.46	-0.46	-0.46
Islands	0.99	0.49	0.92	1.03	0.77	0.82
Common language	0.42	0.42	0.40	0.42	0.41	0.44
Common religion	0.31	0.46	0.31	0.26	0.27	0.32
Tariffs (1 + ln)	-0.41	-0.89	-0.37	-0.41	-0.42	-0.44
Co. trade partners (1 + ln)	0.34	0.32	0.34	0.35	0.35	0.33
Co. M&A partners (1 + ln)	0.89	0.36	0.94	0.90	0.95	0.86
Labor productivity (ln)						1.10

Robustness checks (2): whole sample

Regressors	**Coefficients**				
Sales dispersion (ln)	0.14				
# of large firms – 10th dec. (1 +ln)		**0.43**	**0.47**		
# of large firms – 9th dec. (1 +ln)		***0.004***	**0.20**		
# of large firms – 5th quint. (1 +ln)				**0.10**	**0.09**
# of large firms – 4th quint. (1 +ln)				**0.37**	**0.53**
Sales mean (ln)	0.21	0.18			
TFP (ln)	1.10	1.13	1.20	1.13	1.18
Capital intensity (ln)	5.19	5.11	5.02	5.20	5.17
Patents (1 + ln)	0.19	0.13	0.11	0.12	0.11
Distance (ln)	-0.47	-0.47	-0.46	-0.47	-0.47
Islands	0.99	0.93	0.85	0.87	0.81
Common language	0.42	0.43	0.42	0.43	0.43
Common religion	0.31	0.33	0.34	0.36	0.38
Tariffs (1 + ln)	-0.41	-0.36	-0.31	-0.36	-0.32
Co. trade partners (1 + ln)	0.34	0.35	0.35	0.35	0.35
Co. M&A partners (1 + ln)	0.89	0.85	0.87	0.84	0.84

Developed countries of origin vs. all countries

Regressors	Coefficients	Changes in predicted probability		
		Domestic	Trade	Trade and FDI
Sales dispersion (ln)	**0.13 *****	**-0.01**	**0.00**	**0.01**
Sales mean (ln)	0.08 ***	-0.01	-0.01	0.01
TFP (ln)	0.13 **	-0.003	-0.002	0.005
Capital intensity (ln)	-0.87 ***	0.004	0.004	-0.01
Patents (1 + ln)	0.06 ***	-0.01	-0.004	0.01
Distance (ln)	-0.53 ***	0.02	0.01	-0.03
Islands	1.17 ***	-0.08	-0.22	0.30
Common language	0.46 ***	-0.02	-0.03	0.04
Common religion	0.38 ***	-0.01	-0.02	0.03
Tariffs (1 + ln)	0.02 ***	-0.0001	-0.0001	0.0002
Co. trade partners (1 + ln)	0.24 ***	-0.01	-0.01	0.03
Co. M&A partners (1 + ln)	0.51 ***	-0.02	-0.02	0.04
cut1	-4.40 ***			
cut2	0.98 **			
Average predicted probability		0.03	0.03	0.08
Observations		47,521		

Within developed countries

Regressors	Coefficients		Changes in predicted probability		
			Domestic	Trade	Trade and FDI
Sales dispersion (ln)	**0.16**	*******	**-0.002**	**-0.02**	**0.02**
Sales mean (ln)	0.05	***	-0.002	-0.01	0.02
TFP (ln)	-0.09		0.001	0.01	-0.01
Capital intensity (ln)	-0.14		0.0003	0.002	-0.002
Patents (1 + ln)	0.09	***	-0.003	-0.02	0.02
Distance (ln)	-0.51	***	0.01	0.06	-0.07
Islands	1.63	***	-0.10	-0.39	0.48
Common language	0.61	***	-0.01	-0.09	0.10
Common religion	-0.38		0.01	0.04	-0.05
Tariffs (1 + ln)	1.18	**	-0.001	-0.01	0.01
Co. trade partners (1 + ln)	0.37	***	-0.002	-0.02	0.02
Co. M&A partners (1 + ln)	0.44	***	-0.01	-0.05	0.06
cut1	-7.44	***			
cut2	-2.00	**			
Average predicted probability			0.01	0.81	0.18
Observations				12,637	

Developed countries vs. less developed countries

Regressors	Coefficients		Changes in predicted probability		
			Domestic	Trade	Trade and FDI
Sales dispersion (ln)	**0.12**	***	**-0.01**	**-0.0001**	**0.01**
Sales mean (ln)	0.09	***	-0.01	0.0002	0.01
TFP (ln)	0.26	***	-0.01	0.0002	0.01
Capital intensity (ln)	-1.07	***	0.01	0.0001	-0.01
Patents (1 + ln)	0.05	***	-0.01	0.0002	0.01
Distance (ln)	-0.59	***	0.02	0.002	-0.02
Islands	0.98	***	-0.07	-0.13	0.20
Common language	0.36	***	-0.02	-0.01	0.02
Common religion	0.32	***	-0.02	-0.005	0.02
Tariffs (1 + ln)	-0.15		0.001	-0.00001	-0.001
Co. trade partners (1 + ln)	0.17	***	-0.01	-0.001	0.01
Co. M&A partners (1 + ln)	0.41	***	-0.02	0.00	0.02
cut1	-4.70	***			
cut2	0.59				
Average predicted probability			0.03	0.93	0.04
Observations			34,884		

Conclusions

- Consistent with Helpman et al.'s (2004) model, firms' size dispersion has a positive impact on internationalization, also controlling for a large set of industry and country characteristics
- Moreover, the shift towards internationalization modes that command higher fixed costs increases with:
  - the average size, productivity and capital intensity of firms within each industry
  - the degree of innovation, measured by the number of patents produced
  - sharing a common language and a common religion
  - the fact being that either the origin or the destination countries is an island
  - sharing trade and M&A partners with other countries
- On the contrary, it decreases with geographical distance and tariff restrictions