Darwinian effect on Firms' Export Decision.

Rushde Akbar Samiul Haque

North South University

July 2018

Motivation

- Trade economists have been trying to understand what determines firms' export decision for some time. For example: Firms' won productivity, R&D, industry spillover effect, etc.
- None, according to our knowledge, talked about how industry opportunity cost interacts with firms' export choice.
- In this paper, we look for the interaction of this effect with firms' choice and provide both theoretical and empirical justification.
- Darwinian Effect: Lower opportunity cost of an industry compared to other makes the export market more competitive via reducing the aggregate price index. This leads to lower participation in the export market.

Motivation

Industry Aggregate Productivity Improvement

Leads to 2 Opposing effects

Spillover	Darwinian
More high productive firms	Lower opportunity cost
Greater Spillover effect	Greater Darwinian effect
More likely firms to export	Less likely firms to export

- Which one of these dominates firm's export choice is still an open question.

Results

- We find, both in theory and empirics, that Darwinian effect has a negative impact on firms' export choice.
- Industry level productivity improvement implies lower opportunity cost
  - Lower opportunity cost results in lower relative aggregate price index
  - Hence, higher competitiveness in the industry
  - less profit opportunity from export
- Note that: lower Opportunity cost $\Longrightarrow$Comparative Advantage in GE.
  - CA $\Longrightarrow$ Higher industry export volume.
  - **Hence, a decrease in OC implies higher export volume at the industry level (VIA CA) but lower export probability at the firm level (VIA Darwinian Effect).**

Literature

1. Ricardian Model: Different countries adopt different technologies, as a result the opportunity cost and autarky relative price across countries are different. This provides incentive to trade for these countries.
2. Melitz (2003): Firms exhibit IRTS and compete in monopolistically competitive market. These firms are heterogenous in terms of their productivity. Hence, high productive firms self select themselves as exporters as they can increase their profit from international activity. On the contrary, less productive firms serve only domestic market.
3. Pavcnik (2002): She found evidence that growth in firms TFP can explain their exporting decision for Chilean plant level data.
4. Bernard & Jensen (2004): They studied how Spillover improves firm's export decision. They constructed different measures of this industry level variable and found strong evidence of spillover effect for US manufacturing industry.

Basic Setup

- We construct a two sector partial equilibrium setup in the spirit of Melitz.
- These sectors are indexed by 1 & 2.
- Sectors are similar in every dimension.
- Producers from both sectors take foreign aggregate price indices and income as given.
- Foreign aggregate price indices are not similar and that results in different level of competition in the market.

Demand Side

- Individuals have a Cobb-Douglas preference over all different industry' output.

$$U = Q_1^{\frac{1}{2}} Q_2^{\frac{1}{2}} \tag{1}$$

Where, Q_i is the industry output.

- Industry output is a CES aggregate over available variety in that industry.

$$Q_i = \left[\int_{\phi_i \varepsilon \Omega_i} q_i(\phi_i)^{\frac{\sigma-1}{\sigma}} d\phi_i \right]^{\frac{\sigma}{\sigma-1}} \quad \text{for } i = 1, 2 \tag{2}$$

Note that $\sigma > 1$ and is the elasticity of substitution. Ω_i pins down the mass of active firms in industry i.

Demand Side

- Lets assume that aggregate home income is R, then demand for a variety is:

$$q_i(\phi_i) = \frac{1}{2} R P_i^{\sigma-1} p_i(\phi_i)^{-\sigma} \text{ for } i = 1, 2 \tag{3}$$

- Where, P_i is the aggregate price index for industry i and is given by;

$$P_i^{1-\sigma} = \int_{\phi_i \varepsilon \Omega_i} p_i(\phi_i)^{1-\sigma} d\phi_i \text{ for } i = 1, 2 \tag{4}$$

Export Demand

- For any given aggregate foreign income (R_f) and their aggregate price index (P_{if} for i=1,2) the demand for export variety is then:

$$q_{ix}(\phi_i) = R_f P_{if}^{\sigma-1} p_{ix}(\phi_i)^{-\sigma} \text{ for } i = 1, 2 \tag{5}$$

- We assume that foreign aggregate price index is a geometric mean of home exporters and foreign domestic producers price index ($P_{if}^{\sigma-1} = (P_{ix} P_{idf})^{\frac{\sigma-1}{2}}$).
- Note, if (home exporter's price index) $P_{ix} < P_{idf}$ (foreign price index of domestic producers)$\Leftrightarrow$home exporters can can export.

Supply Side

- Firms draw their productivity ϕ_i from an identical PDF $g(\phi_i) = \frac{\alpha}{\phi_i^{\alpha+1}}$ $\forall \phi_i > 1$. If the observed productivity is high enough they can serve the export market. Otherwise, they serve only domestic market.
- Firms pay a fixed cost of production (f) to serve domestic market and a fixed cost of $(f_x > f\tau^{1-\sigma})$ for export market. $\tau > 1$ is tariff/transportation cost.
- Use labor $(l_i(\phi_i) = \frac{q_i(\phi_i)}{\phi_i} + f)$ to produce a variety $q_i(\phi_i)$.
- Firms serve in a monopolistically competitive market.

Supply Side

- Firms' set MR=MC to find their pricing strategy, $p_i(\phi_i) = \frac{\sigma}{\sigma-1}\frac{w}{\phi_i}$; where, w is the equilibrium wage.
- A firm's revenue is, $r_i(\phi_i) = \frac{1}{2}R\left(\frac{\sigma}{\sigma-1}\frac{w}{\phi_i}\right)^{1-\sigma} P_i^{\sigma-1}$ and profit is, $\pi_i(\phi_i) = \frac{r_i(\phi_i)}{\sigma} - f$. Hence, for marginal firm $\pi_i(\phi_i^*) = 0$ and $r_i(\phi_i^*) = \sigma f$.
- For export variate pricing rule is then, $p_{ix}(\phi_{ix}) = \tau p_i(\phi_i)$.
- Hence, export revenue is $(r_{ix}(\phi_i) = R_f\left(\frac{\sigma}{\sigma-1}\frac{w\tau}{\phi_i}\right)^{1-\sigma} P_{if}^{\sigma-1})$ and profit is $(\pi_{ix}(\phi_i) = \frac{r_{ix}(\phi_i)}{\sigma} - f_x)$. Hence, for marginal exporter $\pi_{ix}(\phi_{ix}^*) = 0$ and $r_{ix}(\phi_{ix}^*) = \sigma f_x$.

Supply Side

- The aggregate price index with equilibrium distribution is
$$P_i^{1-\sigma} = \int_{\phi^*}^{\infty} M_i p_i(\phi)^{1-\sigma} \frac{\alpha \phi^{*\alpha}}{\phi^{a+1}} d\phi.$$
- $M_i = \frac{\frac{1}{2}R}{r_i(\widetilde{\phi}_i)}$, is the mass of active firms and can be obtained by market clearing condition.
- $\mu(\phi) = \frac{\alpha \phi^{*\alpha}}{\phi^{a+1}} \ \forall \phi > \phi^*$, is the equilibrium distribution.

Supply Side

- Hence, the exporters' price index with equilibrium distribution is
$$P_{ix}^{1-\sigma} = \int_{\phi_{ix}^*}^{\infty} M_{ix} p_{ix}(\phi)^{1-\sigma} \frac{\alpha \phi_{xi}^{*\alpha}}{\phi^{a+1}} d\phi.$$
- $M_{ix} = p_{xi} M_i$ is the mass of active firms and $p_{xi} = \left(\frac{\phi_i^*}{\phi_{xi}^*}\right)^{\alpha}$ is the probability of someone being an exporter given it survives local market competition.
- $\mu_x(\phi) = \frac{g(\phi)}{1-G(\phi_x^*)} = \frac{\alpha \phi_x^{*\alpha}}{\phi^{a+1}}$ for all $\phi > \phi_x^* > \phi^*$, is the equilibrium distribution.

Darwinian Effect

- Consider 2 identical firms ($\phi_1 = \phi_2 = \overline{\phi}$) and they serve in different industries' export market.
- They charge same price, $p_{1x}(\overline{\phi}) = p_{2x}(\overline{\phi}) = \frac{\sigma}{\sigma-1}\frac{w\tau}{\overline{\phi}}$
- Under this condition, it is possible to show that their relative revenue depends on the relative industry average productivities,

$$\frac{r_{1x}(\overline{\phi})}{r_{2x}(\overline{\phi})} = \left[\frac{P_{1df}}{P_{2df}}\right]^{\frac{(\sigma-1)^2}{(\sigma-1)+\alpha}} \left(\frac{\widetilde{\phi}_1}{\widetilde{\phi}_2}\right)^{\frac{\alpha(1-\sigma)}{(\sigma-1)+\alpha}}.$$

- Henceforth, it is possible to show that their relative revenue decreases with an increase of relative industry average productivity (decrease in industry opportunity cost).

Testable Hypothesis

Proposition: *If 2 firms observe identical productivity level and they serve in different industries, then under Pareto distribution the relative revenue of these firms decrease with a decrease in industry opportunity cost.*

- We test this proposition with Chilean and Colombian Plant level data.

Empirical Methodology

- Estimate firms' TFP using OP regression.
- Use linear probability and logit model with fixed effects to estimate firm's export probability

$$\Pr(EX_{ijt} = 1) = f(TFP_{ijt}, OC_{jt}, Spill_{jt}, \delta_{it}, \gamma_{jt}) \tag{6}$$

Where, TFP_{ijt} =firm's productivity serving industry "j" at time "t".

- $OC_{jt} = \frac{\text{Average jth industry productivity}}{\text{Rest of the economy wide average productivity}}$
- $Spill_{jt} =$ portion of industry output that is exported from similar area code.
- $\delta_{it} =$ other firm specific characteristics; such as: relative rank of the firm in the industry.
- $\gamma_{jt} =$ is the industry specific determinants; such as: industry dummies, a shape parameter of the Pareto distribution.

Data

- We collect data on Chilean manufacturing industries from 1979-96 and Colombian plants from 1977-91.
- They are both unbalanced panel of 10,927 plants (for Chile) and 17,763 plants (Colombia) serving in 9 industries.

Table 1

2 digit code and description of the industry	
2 digit code	2 digit industry description
31	Food, Beverages and Tobacco
32	Textile, Wearing Apparel and Leather Industries
33	Wood and Wood Products, Including Furniture
34	Paper and Paper Products, Printing and Publishing
35	Chemicals and Chemical, Petroleum, Coal, Rubber and Plastic Products
36	Non-Metallic Mineral Products, (except of Petroleum and Coal)
37	Basic Metal Industries
38	Fabricated Metal Products, Machinery and Equipment
39	Other Manufacturing Industries

Results (Aggregate)

Table 2

Aggregate Estimation Results

	Chile		Colombia	
VARIABLES	Logit Fe	LPM Fe	Logit Fe	LPM Fe
TFP	0.396*	0.0215**	0.747***	0.0285***
	(0.227)	(0.010)	(0.052)	(0.002)
OC	-2.772***	-0.108***	-1.679**	-0.0463**
	(0.870)	(0.028)	(0.708)	(0.023)
Spillover	0.157***	0.00508***	0.150***	0.00578***
	(0.039)	(0.001)	(0.009)	(0.0002)
Shape	-12.93***	-0.718***	-11.17***	-0.462***
	(2.703)	(0.111)	(2.470)	(0.076)
Relative rank	3.44e-13 ***	1.03e-14***	0.170**	0.0134***
	(6.87e-14)	(2.42e-15)	(0.071)	(0.003)
Import of Input	7.03e-11*	5.76e-13	3.49e-07	1.64E-08
	(4.13e-11)	(5.96e-13)	(5.22e-07)	(1.06e-08)
Skilled	9.136	0.966***	9.192**	0.832***
	(6.752)	(0.308)	(4.286)	(0.118)
Unskilled	-9.733*	-0.636***	-19.07***	-1.234***
	(5.476)	(0.240)	(5.759)	(0.187)
Tax			1.99e-06	9.47e-08***
			(1.66e-06)	(3.27e-08)
Observations	3,334	16,574	11,149	68,734
Number of id	500	2,726	1,445	14,260

Note: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Conclusion

- As relative TFP of an industry increases/OC falls, that makes the export market more competitive.
- This results in lower profit opportunity in the export market and less participation in the export market.
- We find both theoretical and empirical justification for this effect (Darwinian Effect).

Questions

- Questions?
- Suggestions?