Exporting and Plant-Level Efficiency Gains: It's in the Measure

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Motivation

Export-related efficiency gains – 2 dimensions:

1. Trade liberalization allows productive firms to grow, while unproductive firms shrink/go bankrupt $\Rightarrow$ economy-wide efficiency rises due to reallocation *across* firms/plants
   - Strong empirical support

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- If there are indeed no (sizeable) within-plant efficiency gains then:
  - Trade liberalization would be bad news for relatively unproductive plants
  - But...

We should expect export-related within-plant efficiency gains:

- Exporters face tougher competition and larger markets $\Rightarrow$ higher returns to innovate and invest in productive technologies (Bustos, 2011)
- Management case studies report strong micro-level evidence for efficiency improvements within plants
- Access to expertise from international buyers

Key to resolve the puzzling contrast: Efficiency measures

How economists think about efficiency:

- Physical output $Y = A \cdot f(\text{capital, labor, materials...})$
  - A: "true" efficiency
  - Typically: do not observe Y but $\mathbf{p} \cdot \mathbf{Y}$ = product revenue
  - The revenue production function is then $p \cdot Y = p \cdot A \cdot f(\text{capital, labor, materials...})$

Most papers have analyzed **revenue productivity** $p \cdot A$

The Problem with Revenue Productivity Measures

- Revenue productivity is affected by output prices
  - If more efficient firms charge lower prices, then revenue productivity will be downward biased (Foster et al, 2008):

$$\text{revenue productivity} = \underbrace{p\downarrow}_{\textit{price}} \cdot \underbrace{A\uparrow}_{\textit{efficiency}}$$

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- Could the same bias explain the missing evidence for export entrants?
  - Challenge: find efficiency measure that is (i) not affected by price bias and (ii) applicable to broad set of plants and products

This Paper

Use marginal production cost as an alternative efficiency measure

- Not affected by price-bias
- Focus on *within-plant-product* trends
  - Allows for comparison of diverse set of products
- Use detailed Chilean plant panel, 1996-2005
- Previous studies have found no effects of export entry on firm efficiency for Chile, using revenue productivity

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Examine effects of

1. Export entry
2. Export expansions of established exporters

Main Results (Preview)

- Strong evidence for within-plant efficiency gains
  - Falling export tariffs in Chile over the period 1996-2005 induced 13% higher efficiency among export entrants, and 10% among established exporters
  - Initially least productive plants see highest efficiency increases
  - When looking at *revenue* productivity, these gains are reduced to 1% and 4%

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- Most likely driver of efficiency gains:
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- Most likely driver of efficiency gains:
  - Export entry/expansion provides incentives for technology investment
- Main policy implication
  - Initially relatively unproductive plants can also gain from trade
  - Combine trade liberalization with incentives to invest in modern technology

How we compute marginal costs (*MC*)

- Estimate production function at the product level ▸ Detail
- Calculate markups μ at the plant-product level (De Loecker and Warzynski, 2012) ▸ Methodology ▸ Estimated Markups
- Since we observe prices (p), marginal costs are computed as

$$MC = \frac{p}{\mu}$$

  - Methodology allows to recover *MC per product*
  - *MC* closely matches reported average costs ▸ Scatter

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- Compute also *revenue productivity* following standard methodology ▸ Detail

Data

The ENIA

- Panel of Chilean manufacturing plants, period 1996-2005
- Covers universe of manufacturing plants with $\geq$10 workers
  - 4,800 plants p/year, 20% exporters, 2/3 of all plants are small ($\leq$ 50 employees)
- Standard plant-level information (size, revenues, sector...). Plus:
  - Plant-level investment by category
  - Value and quantity of all inputs
- Product information
  - Total value and quantity for each product
  - Variable cost for each product
  - About 11,000 plant-product obs./year, 12% are exported

▸ Census details ▸ Sectors

Overview: Cross-Section

We confirm the standard results in the cross-section: Exporters are larger, more productive, pay higher wages, and charge higher markups

	(1)	(2)	(3)	(4)	(5)
	Plant Size		Productivity	Wages	Markup
Dependent Variable	ln(Workers)	ln(Sales)	ln(TFPR)	ln(Wage)	log(Markup)
Export Dummy	1.403***	2.227***	.122***	.907***	.108***
	(.0844)	(.179)	(.0307)	(.148)	(.0203)
Sector-Year FE	✓	✓	✓	✓	✓
R^2	.26	.30	.99	.18	.08
Observations	42,264	42,070	42,228	42,264	95,501

Notes: The table reports the percentage-point difference of the dependent variable between exporting plants and non-exporters in a panel of 8,500 (4,900 average per year) Chilean plants over the period 1996-2005. All regressions control for sector-year effects at the 2-digit level. Markups in column 6 are computed at the plant-product level; correspondingly, the coefficients reflect the difference in markups between exported products and those that are only sold domestically. Clustered standard errors (at the sector level) in parentheses. Key: *** significant at 1%; ** 5%; * 10%.

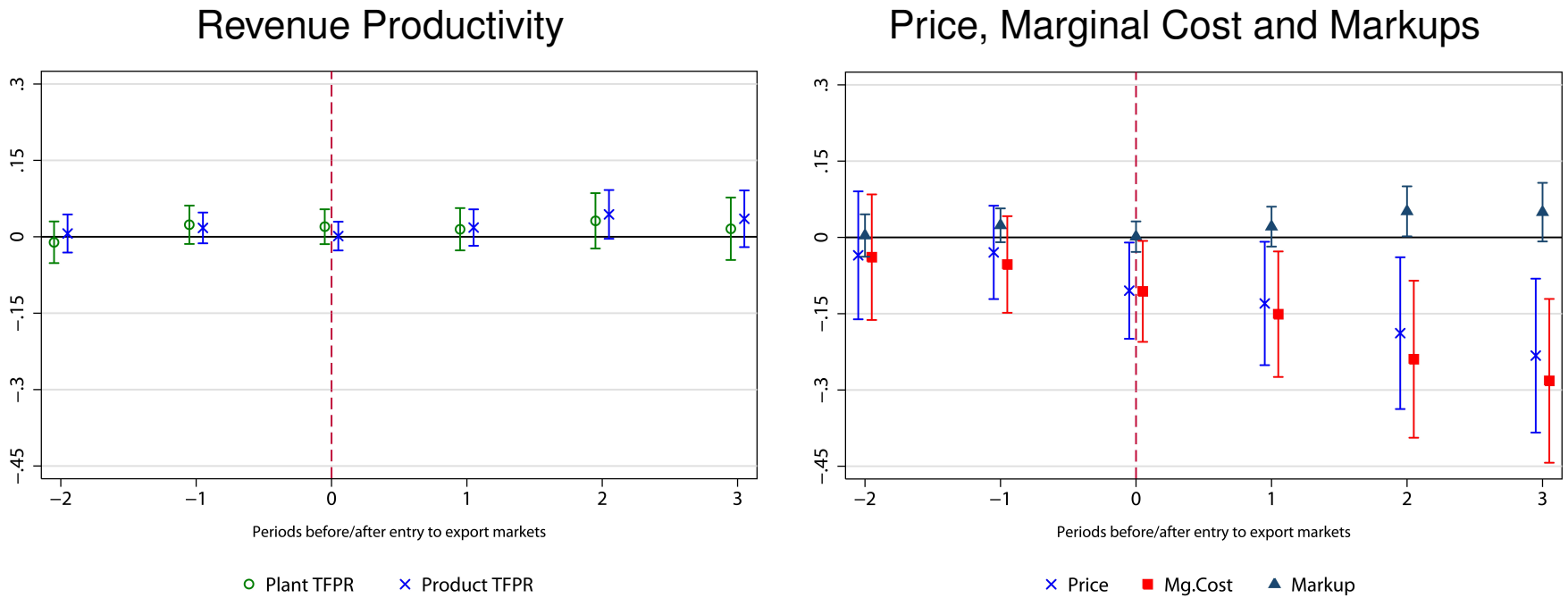
▸ Conditional on size

Roadmap

1. **Export entry**
2. Export expansions of established exporters

Efficiency trajectories for export entrants

Within-plants; Period $t = 0$ corresponds to the export entry year.



Notes: The left panel shows the estimated within plant trajectory for revenue productivity, and the right panel, for price, marginal cost and markup before and after export entry. Period $t = 0$ corresponds to the export entry year. For each plant-product, export entry occurs at period $t = 0$. A product is defined as an entrant if it is the first product exported by a plant and is sold domestically for at least one period before entry into the export market.

▸ Regressions

Channel: Exporting-Investment Complementarity

- Investment in new technology and export entry go hand-in-hand
  - Prospect of larger market $\Rightarrow$ incentives to invest
  - Data on investment support this channel ▸ Investment
- Additional check: Plants with lower initial productivity experience larger efficiency gains (Lileeva and Trefler, 2010)
  - Require larger efficiency gains to 'break even'

▸ Lileeva-Trefler MC ▸ Lileeva-Trefler AC

Further results

1. Use tariff changes to predict export entry: 13% decline in MC induced by avg. tariff drop of 5.5 percentage points 1996-2005

   ▸ Table

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1. Use tariff changes to predict export entry: 13% decline in MC induced by avg. tariff drop of 5.5 percentage points 1996-2005
   ▸ Table
2. Reported Average Costs: Results not driven by estimation of markups
   ▸ Scatter Plot ▸ Trajectory ▸ Matching
3. Balanced Panel: Larger effects already in the first periods ▸ Detail
4. Single-Product Producers: Results unchanged, but noisier ▸ Detail
5. Matching Estimation: Varying number of neighbors or size of caliper do not affect our results
6. Estimation of Prd Function: Robust to variety of specifications
   ▸ Detail

Roadmap

1. Export entry

2. **Export expansions of established exporters**

Export expansions that are driven by declining tariffs

Exploit tariff declines (5.5% on avg. 1996-2005)

- Increasing export sales driven by *permanent* declines in export tariffs
- We find strong evidence for efficiency gains: About 10% over sample period
- Channel: Investment in capital stock

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Role of efficiency measures

- Again, efficiency gains stronger when using marginal costs
- Revenue productivity now captures about 1/2 of actual efficiency gains (4%)

Table

Note: Export expansions without trade liberalization

In the absence of falling tariffs, export expansions and efficiency are not associated

- Increasing export sales within plants mostly due to *temporary* demand shocks
- Temporarily higher demand for exporting may not be sufficient to trigger technology upgrading

Concluding Remarks

- Within-plant efficiency gains after export entry
  - Previously weak evidence
- We find substantial within-plant efficiency gains based on marginal costs
  - Resolves puzzle (invest and expand w/o efficiency increases?)
  - Substantial part of efficiency gains passed on to customers

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  - Resolves puzzle (invest and expand w/o efficiency increases?)
  - Substantial part of efficiency gains passed on to customers
- Policy implications
  - Unproductive firms don't necessarily lose – they may even gain the most
  - Since within-plant gains can be substantial, and are driven by technology investment: Combine trade liberalization with incentives to invest in technology
  - Certainty about trade policy (*permanent* tariff declines) crucial for firms to undertake investment

BACKUP

Export entry driven by tariff declines

	(1)	(2)
Panel A: First Stage		
Dependent Variable:	log Exports	Export status
Industry Tariffs	-66.98***	-8.084***
	(6.934)	(1.024)
Predicted Expansion	[3.081]	[.3719]
First Stage F-Statistic	93.31	62.38
Panel B: Second Stage, log Marginal Cost		
Exports (predicted)	-.0408*	-.338*
	[.0938]	[.0938]
Predicted effect	-.126	-.126
Panel C: Second Stage, log Markup		
Exports (predicted)	-.00820	-.0679
	[.294]	[.294]
Predicted effect	-.0253	-.0253
Panel D: Second Stage, log Revenue TFP		
Exports (predicted)	-.00264	-.0219
	[.627]	[.627]
Predicted effect	-.0081	-.0081
For all regressions:		
Plant FE	✓	✓
log Sales	✓	✓
Observations	1,333	1,333

Back

Export expansions driven by tariff declines

Export Share	(1) >0%	(2) >10%	(3) >20%	(4) >30%	(5) >40%	(6) >50%
Panel A: First Stage: Tariffs and within-plant exports						
Tariffs	-.735	-1.521**	-2.087***	-1.771***	-1.345***	-.917***
	(.915)	(.627)	(.436)	(.273)	(.347)	(.289)
Predicted Expansion	.0338	.0700	.0960	.0815	.0619	.0422
First Stage F-Statistic	.645	5.876	22.87	42.20	14.99	1.07
Panel B: Second Stage, log Marginal Cost Index						
log Exports (predicted)	-2.153*	-1.297***	-1.113***	-1.170***	-1.141**	-.564
	[.0766]	[.0016]	[.0006]	[.0007]	[.0166]	[.471]
Predicted Effect	-.0728	-.0907	-.1068	-.0953	-.0706	-.0238
Panel C: Second Stage, log Average Markup						
log Exports (predicted)	.237	.568**	.478**	.576***	.477	-.364
	[.678]	[.0222]	[.0178]	[.0050]	[.152]	[.531]
Predicted Effect	.0080	.0398	.0459	.0469	.0295	-.0153
Panel D: Second Stage, log Revenue TFP						
log Exports (predicted)	.678	.613**	.456**	.590***	.571*	.126
	[.139]	[.0108]	[.0371]	[.0102]	[.0583]	[.854]
Predicted Effect	.0229	.0429	.0438	.0481	.0353	.0053
For all regressions:						
Plant FE	✓	✓	✓	✓	✓	✓
log Sales	✓	✓	✓	✓	✓	✓
Observations	4,026	2,372	1,901	1,666	1,456	1,267

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