Firm-Level Trade Empirics

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International Trade II, Chapter 7

Introduction

- Hallak and Levinsohn (2005): “Countries don’t trade. Firms trade.”
- Since around 1990, trade economists have increasingly used data from individual firms in order to better understand:
  - Why countries trade.
  - The mechanisms of adjustment to trade liberalization: mark-ups, entry, exit, productivity changes, factor price changes.
  - How important trade liberalization is for economic welfare.
  - Who are the winners and losers of trade liberalization (across firms)?
- This has been an extremely influential development for the field. These are all new and interesting questions that a firm-level approach has enabled access to.

Outline

I - Stylized Facts: Trade at the Firm-level

I - Firm-level Responses to Trade Liberalization

Stylized Facts about Trade at the Firm-Level

- Exporting is extremely rare.
- Exporters are different:
  - They are larger.
  - They are more productive.
  - They use factors differently.
  - They pay higher wages.
- We will go through some of these findings first.

Exporting is Rare

- Two papers provide a clear characterization of just how rare exporting activity is among firms:
  1. Bernard, Jensen, Redding and Schott (JEP, 2007) on US manufacturing.
  2. Eaton, Kortum and Kramarz (2008) on French manufacturing. (much to learn from this paper)

BJRS (2007)

Table 7

Exporting and Importing by U.S. Manufacturing Firms, 1997

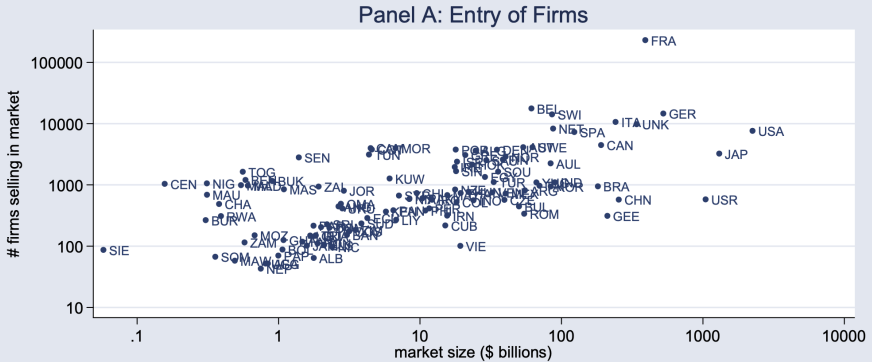
NAICS industry	Percent of all firms	Percent of firms that export	Percent of firms that import	Percent of firms that import & export
311 Food Manufacturing	7	17	10	7
312 Beverage and Tobacco Product	1	28	19	13
313 Textile Mills	1	47	31	24
314 Textile Product Mills	2	19	13	9
315 Apparel Manufacturing	6	16	15	9
316 Leather and Allied Product	0	43	43	30
321 Wood Product Manufacturing	5	15	5	3
322 Paper Manufacturing	1	42	18	15
323 Printing and Related Support	13	10	3	2
324 Petroleum and Coal Products	0	32	17	14
325 Chemical Manufacturing	3	56	30	26
326 Plastics and Rubber Products	5	42	20	16
327 Nonmetallic Mineral Product	4	16	11	7
331 Primary Metal Manufacturing	1	51	23	21
332 Fabricated Metal Product	20	21	8	6
333 Machinery Manufacturing	9	47	22	19
334 Computer and Electronic Product	4	65	40	37
335 Electrical Equipment, Appliance	2	58	35	30
336 Transportation Equipment	3	40	22	18
337 Furniture and Related Product	6	13	8	5
339 Miscellaneous Manufacturing	7	31	19	15
Aggregate manufacturing	**100**	**27**	**14**	**11**

Sources: Data are for 1997 and are for firms that appear in both the U.S. Census of Manufactures and the Linked-Longitudinal Firm Trade Transaction Database (LFTTD).
Notes: The first column of numbers summarizes the distribution of manufacturing firms across three-digit NAICS industries. Remaining columns report the percent of firms in each industry that export, import, and do both.

EKK (2011)

Out of 229,9000 French manufacturing firms, only 34,035 sell abroad

Figure 1: Entry and Sales by Market Size



Exporters are Different

- The most influential findings about exporting and intra-industry heterogeneity have been related to:
  - Exporters being larger.
  - Exporters being more productive.
- There are other ‘exporter premia’ too.
- Selection versus causation? A fundamental question of this literature (for policy and for testing theory).
  - Melitz (2003): selection
  - De Loecker (2011, 2013) etc: learning
  - For now, focus on stylized facts on export premia

Exporter Premia in the United States

BJRS (JEP, 2007)

Table 8

Trading Premia in U.S. Manufacturing, 1997

	(1) Exporter premia	*(2) Importer premia*	*(3) Exporter & importer premia*
Log employment	1.50	1.40	1.75
Log shipments	0.29	0.26	0.31
Log value-added per worker	0.23	0.23	0.25
Log TFP	0.07	0.12	0.07
Log wage	0.29	0.23	0.33
Log capital per worker	0.17	0.13	0.20
Log skill per worker	0.04	0.06	0.03

Sources: Data are for 1997 and are for firms that appear in both the U.S. Census of Manufacturers and the Linked-Longitudinal Firm Trade Transaction Database (LFTTD).
Notes: All results are from bivariate ordinary least squares regressions of the firm characteristic listed on the left on a dummy variable noted at the top of each column as well as industry fixed effects and firm employment as additional controls. Employment regressions omit firm employment as a covariate. Total factor productivity (TFP) is computed as in Caves, Christensen, and Diewert (1982).

The Exporter Premium: Productivity

Bernard, Eaton, Jensen and Kortum (AER, 2003) on USA

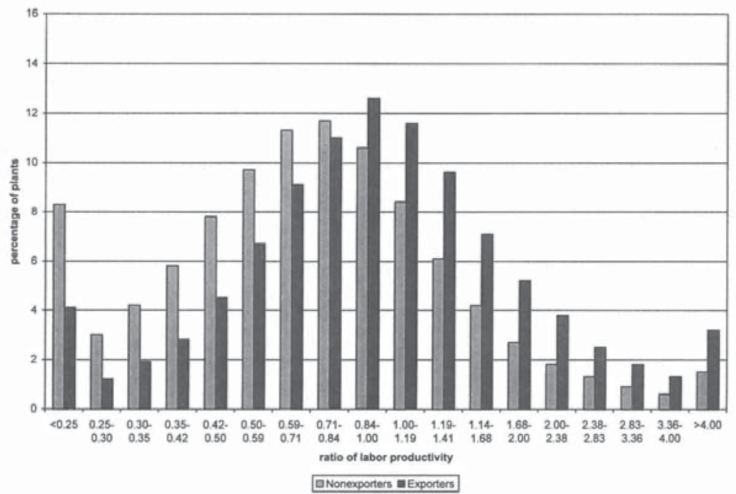
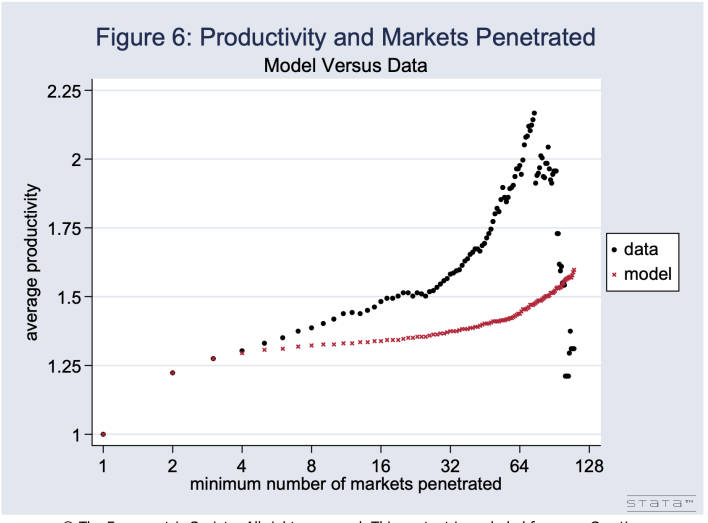


FIGURE 2A. RATIO OF PLANT LABOR PRODUCTIVITY TO OVERALL MEAN

Bernard, Andrew B., Jonathan Eaton, et al. *American Economic Review* 93, no. 4 (2003): 1268-90. Courtesy of American Economic Association. Used with permission.

The Exporter Premium: Productivity

EKK (2011) on France



Other Exporter Premia

- Examples of other exporter premia seen in the data:
  - Produce more products: BJRS (2007) and Bernard, Redding and Schott (2009)
  - Higher Wages: Frias, Kaplan and Verhoogen (2009) using employer-employee linked data from Mexico (ie, when a given worker moves from a purely domestic firm to an exporting firm, his/her wage rises).
  - More expensive ('higher quality'?) material inputs: Kugler and Verhoogen (2008) using very detailed data on inputs used by Colombian firms.
  - Innovate more: Aw, Roberts and Xu (2008).
  - Pollute less: Halladay (2008)

Premia: Selection or Treatment Effects?

- Consider the ‘exporter productivity premium’, which has been found in many, many datasets.
- A key question is obviously whether these patterns in the data are driven by:
  - Selection: All firms have the opportunity to export, but only the more productive ones choose to do so due to the fixed exporting cost (e.g., Melitz 2003)
  - Treatment: The very act of exporting raises firm productivity. Why?
    - Adding a foreign market allows a firm to exploit economies of scale.
    - Learning by exporting.
    - Some exporting occurs through multinational firms, who may have incentives to teach their foreign affiliates how to be more productive.
    - Focus on ‘core competency’ products (i.e. productivity rise is just selection effect within firm).
- Of course, both of these two effects could be at work.

Premia: Selection or Treatment Effects?

- An important literature has tried to distinguish between these two effects:
  - Clerides, Lach, and Tybout (QJE, 1997)
  - Bernard and Jensen (JIE, 1998)

- These studies conclude that the effect is predominantly selection.
  - We cover two papers: Pavcnik (Restud, 2002) and Bernard, Jensen and Schott (JME, 2006) on evidence of selection.
  - However, many studies also show that firms become more productive after trade liberalization.
  - More recent work: Trefler and Lileeva (QJE, 2009) and de Loecker (Ecta, 2011) improve upon the methods used in the above papers and find evidence for a treatment effect of exporting on productivity.
  - Atkin, Khandelwal and Osman (2017): studying how exporting affects firm performance using a randomized experiment

Firm-level Responses to Trade Liberalization

Firm-level Responses to Trade Liberalization

A Side

- An enormous literature has used firm-level panel datasets to explore how firms respond to trade liberalization episodes.

- This has been important for policy, as well as for the development of theory.
  - Interestingly, the first available data (and the largest and most plausibly exogenous trade liberalization episodes) were from developing countries
  - So using firm-level panel data to study trade issues has become an important sub-field in Development Economics (indeed surprisingly, there aren't that many questions that firm-level data are used to look at in Development other than trade issues!)

Aggregate Industry Productivity

A Side

- Most of these studies have been concerned with the effects of trade liberalization on aggregate industry productivity.
- Unfortunately, one often cares about much more than this.
  - Consumers may care about some industries more than others.
  - Within industries, consumers may care about some firms' varieties more
  - Trade also changes the set of available varieties, and this effect is not counted at all in measured productivity.
  - Not all inputs are fully measured, so what one observes as productivity in the data (eg Y/L or TFP) is not true productivity.
  - Relatedly, there are probably uncounted adjustment costs behind any liberalization episode.

Aggregate Industry Productivity: A Decomposition I

- A helpful way of thinking about the effects of trade liberalization on aggregate industry productivity is due to Tybout and Westbrook (1995) among others.
- Notation:
  - Output of firm i: Y_{it}
  - Output share: $S_{it} = Y_{it}/Y_t$
  - Output per unit input bundle: $B_{it} = Y_{it}/F_{it} = M_{it}\gamma(F_{it})$, where F_{it} is some constant-returns homothetic function of the input vector.

Aggregate Industry Productivity: A Decomposition II

- Then the change in industry-wide average productivity (or specifically output per unit input, $B_t = \sum_i S_{it} B_{it}$) can be decomposed to:

$$\frac{dB_t}{B_t} = \underbrace{\sum_i \left(\frac{dF_{it}}{F_{it}}\right)(\eta_{it} - 1)\left(\frac{S_{it}B_{it}}{B_t}\right)}_{\text{Scale effects}} + \underbrace{\sum_i \left(\frac{dS_{it}}{S_{it}}\right)\left(\frac{S_{it}B_{it}}{B_t}\right)}_{\text{Between-firm reallocation effects}} + \underbrace{\sum_i \left(\frac{dM_{it}}{M_{it}}\right)\left(\frac{S_{it}B_{it}}{B_t}\right)}_{\text{Within-firm TFP effects}}$$

  Here $\eta_{it} = dlnY_{it}/dlnF_{it}$ measures returns to scale at the i-th plant.

- The literature here has looked at the extent to which each of these terms responds to a liberalization of trade policy.

Trade Liberalization: Scale Effects

- Not much work on this.
- But Tybout (2001, Handbook chapter) argues that since exporting plants are already big it is unlikely that there is a large potential for trade to expand underexploited scale economies.
- Likewise, since the bulk of production in any industry is concentrated on already-large firms, the scope for the ‘scale effects’ term to matter in terms of changes is small.
- Your view on this?

Trade Liberalization: Within- and Between-Firm Effects

- This is where the bulk of work has been done.
- The finding of significant aggregate productivity gains from between-firm reallocations was an important impetus for work on heterogeneous firm models in trade.
  - The empirical finding that reallocations of factors (and market share) from low-B_{it} to high-B_{it} firms was taken by some as evidence for 'another' source of *welfare* gains from trade.
  - Though this is really just Ricardian gains from trade at work within an industry rather than across industries.

FRTL - Evidence on Selection

Empirical evidence

Papers:
Pavcnik (Restud, 2002) and Bernard, Jensen and Schott (JME, 2006)

General questions:

- Trade-induced reallocation: are some plants growing, some exiting?
- If there are productivity gains, where do they come from?
- Short-run pains, long-run gains

Empirical evidence: Pavcnik (2002)

Pavcnik (2002)

- Looks at the effect of trade liberalization on plant exit and productivity improvements in Chile
- Why is Chile a good case study? Massive trade liberalization during the late 70s and early 80s
- How has sectoral productivity evolved during this period? Through which channels?

Empirical evidence: Pavcnik (2002)

- Plant-level data, 1979-1986
- Tariffs have fallen in the same way in every sector
- Characterizes sectors as
  - **export-oriented** (more than 15% of its total output is exported)
  - **import-competing** (ratio import over total output larger than 15%)
  - non-traded goods (others)

Empirical evidence: Pavcnik (2002)

For each industry we want to know

1. How has evolved aggregate productivity over the liberalization period?
2. Do variations in productivity come from resources reallocations from the least to the most efficient firms?

Empirical evidence: Pavcnik (2002)

$$W_t = \sum_i s_{it} pr_{it} = \widetilde{pr}_t + \sum_i (s_{it} - \widetilde{s}_t)(pr_{it} - \widetilde{pr}_t),$$

Where

- W_t is aggregate weighted productivity
- $\widetilde{pr}_t$ is unweighted aggregate productivity (within firm gains?)
- $\sum_i (s_{it} - \widetilde{s}_t)(pr_{it} - \widetilde{pr}_t)$: total covariance between a plant's share of the industry output and its productivity (positive values of the covariance means that more output produced by more efficient plants)

Melitz (2003) predicts that this covariance should be positive and increasing over time

Empirical evidence: Pavcnik (2002)

All industries

Year	Aggregate productivity	Unweighted productivity	Covariance
79	0.000	0.000	0.000
80	-0.010	0.018	-0.027
81	0.051	0.054	-0.003
82	0.329	0.048	0.281
83	0.174	0.010	0.160
84	0.117	0.025	0.092
85	0.120	-0.003	0.123
86	0.193	0.066	0.127
The reported growth figures are relative to 1979			

Empirical evidence: Pavcnik (2002)

Import competing industries (Pavcnik, 2002)

Year	Aggregate productivity	Unweighted productivity	Covariance
79	0.000	0.000	0.000
80	-0.063	0.027	-0.090
81	0.032	0.092	-0.061
82	0.088	0.066	0.022
83	0.077	0.034	0.043
84	0.089	0.059	0.030
85	0.095	0.061	0.034
86	0.319	0.107	0.213
The reported growth figures are relative to 1979			

Empirical evidence: Pavcnik (2002)

Export oriented industries (Pavcnik, 2002)

Year	Aggregate productivity	Unweighted productivity	Covariance
79	0.000	0.000	0.000
80	-0.059	-0.038	-0.021
81	-0.048	-0.054	0.006
82	0.591	0.040	0.551
83	0.326	0.015	0.311
84	0.178	0.049	0.129
85	0.203	-0.011	0.214
86	0.254	0.087	0.166
The reported growth figures are relative to 1979			

Empirical evidence: Pavcnik (2002)

- Important reallocation effects following trade liberalization
- Those firms which exit are not only less productive, but also have other characteristics: less capital intensive, skill intensive, etc. Useful to understand the short run effects of trade liberalization among groups

Empirical evidence: Bernard, Jensen and Schott (2006)

Link plant-level U.S. manufacturing data with industry measures of tariffs and transportation costs

As trade costs fall

- Industry productivity increases
- Higher probability of plant death
- Higher probability of successful exports
- Existing exporters increase their export shipments

Empirical evidence: Bernard, Jensen and Schott (2006)

Regressor	Change in TFP	Change in TFP
Change in Trade Cost	-0.152 *	-0.190 *
	(0.079)	(0.104)
Year Fixed Effects	Yes	Yes
Industry Fixed Effects	No	Yes
Observations	1,153	1,153
R^2	0.00	0.02

Notes: Industry-level OLS regression results. Robust standard errors adjusted for clustering at the four-digit SIC level are in parentheses. Industry fixed effects are for two-digit SICs. Dependent variable is the average annualized change in Bartelsman, Becker and Gray (2000) five-factor total factor productivity from years t+1 to t+5.. Regressor is the change in total trade costs between years t-5 and t. Regressions cover 1972 to 1996. ***Significant at the 1% level; **Significant at the 5% level; *Significant at the 10% level. Coefficients for the regression constant and dummy variables are suppressed.

Table 2: Industry Productivity Growth, 1982-97

Empirical evidence: Bernard, Jensen and Schott (2006)

Regressor	Logit Plant Death	Logit Plant Death	Logit Plant Death
Change in Trade Cost	-5.664 *	-6.388 **	-6.669 **
	(3.148)	(2.782)	(2.937)
Relative Productivity		-0.221 ***	-0.202 ***
		(0.059)	(0.053)
x Change in Trade Cost			12.178 **
			(6.012)
Industry Fixed Effects	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes
Observations	210,664	210,665	210,666
Log likelihood	-115,329	-109,734	-109,713

Notes: Plant-level logistic regression results. Robust standard errors adjusted for clustering at the four-digit SIC level are in parentheses. Industry fixed effects are for two-digit SICs. Dependent variable indicates plant death between years t and t+5. First regressor is the change in total trade costs between years t-5 and t. Regressions cover two panels: 1982 to 1987 and 1987 to 1992. ***Significant at the 1% level; **Significant at the 5% level; *Significant at the 10% level. Coefficients for the regression constant and dummy variables are suppressed.

Empirical evidence: Bernard, Jensen and Schott (2006)

Regressor	OLS TFP Growth	OLS TFP Growth	OLS TFP Growth	OLS TFP Growth	OLS TFP Growth
Change in Trade Cost	-1.027	-1.494 *	-1.902 *	-1.924 *	-2.321 *
	(0.733)	(0.854)	(1.008)	(1.025)	(1.228)
Relative Productivity			-0.545 ***	-0.545 ***	-0.545 ***
			(0.016)	(0.016)	(0.016)
x Change in Trade Cost				0.559	0.545
				(1.389)	(1.360)
Exporter		-0.143 ***	0.007	0.007	0.008
		(0.005)	(0.007)	(0.007)	(0.007)
x Change in Trade Cost					1.182
					(0.913)
Industry Fixed Effects	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes
Observations	119,918	119,918	119,918	119,918	119,918
R^2	0.01	0.11	0.26	0.26	0.26

Notes: Plant-level OLS regression results. Robust standard errors adjusted for clustering at the four-digit SIC level are in parentheses. Industry fixed effects are for two-digit SICs. Dependent variable indicates change in plant TFP between years t and t+5. First regressor is the change in total trade costs between years t-5 and t. Regressions cover two panels: 1982 to 1987 and 1987 to 1992. ***Significant at the 1% level; **Significant at the 5% level; *Significant at the 10% level. Coefficients for the regression constant and dummy variables are suppressed.

FRTL - Evidence on Learning

Reduced-form Evidence

Trade leads to within-firm gains (although not directly on learning)

- Topalova, Petia, and Amit Khandelwal. ”Trade liberalization and firm productivity: The case of India.” Review of economics and statistics 93.3 (2011): 995-1009.
- Bustos, Paula. ”Trade liberalization, exports, and technology upgrading: Evidence on the impact of MERCOSUR on Argentinian firms.” American economic review 101.1 (2011): 304-340.
- Lileeva, Alla, and Daniel Trefler. ”Improved access to foreign markets raises plant-level productivity... for some plants.” The Quarterly journal of economics 125.3 (2010): 1051-1099.
- Javorcik, Beata Smarzynska. ”Does foreign direct investment increase the productivity of domestic firms? In search of spillovers through backward linkages.” American economic review 94.3 (2004): 605-627.
- Goldberg, Pinelopi, et al. ”Trade liberalization and new imported inputs.” American economic review 99.2 (2009): 494-500.

IO Approach

- De Loecker, Jan. ”Do exports generate higher productivity? Evidence from Slovenia.” Journal of international economics 73.1 (2007): 69-98.
  - Use matched sampling to self-selection into export markets
  - Find export entrants become more productive once they start exporting
- De Loecker, Jan. ”Product differentiation, multiproduct firms, and estimating the impact of trade liberalization on productivity.” Econometrica 79.5 (2011): 1407-1451.
  - Take Meliz (2003), correct for unobserved prices and demand shocks when estimating productivity
  - Positive effect, but correcting for unobservables leads to lower productivity gains
- Loecker, Jan De. ”Detecting learning by exporting.” American Economic Journal: Microeconomics 5.3 (2013): 1-21.
  - Include export status into productivity estimation equations
  - Find the positive effect of export status on productivity evolution

Random Control Trials

Atkin, David, Amit K. Khandelwal, and Adam Osman. ”Exporting and firm performance: Evidence from a randomized experiment.” The quarterly journal of economics 132.2 (2017): 551-615.

Overview of Study

- First randomized experiment: focus on rug producers in Egypt to study the impact of exporting.
- Exogenous variation in access to high-income markets provided to treatment firms.
- Causal identification of exporting effects: key performance metrics through detailed regular firm surveys

Atkin, Khandelwal and Osman (2017)

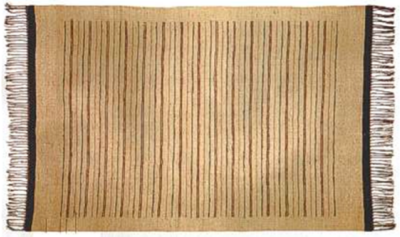
Experimental Design

- Treatment:
  - Hamis Carpets offers an *initial* order to each treatment firm.
  - An order of 110m^2 (about 11 weeks of work).
    - Firms receive market price (set by intermediary) for these rug types.
- Post-Treatment: What about follow-up orders?
  - Hamis Carpets may optimally allocate *future* orders within the treatment group (based on firm quality, reliability, etc.).
    - Mimics a normal buyer-seller relationship.
- Summary:
  - The treatment is the opportunity to export to high-income countries.
  - Only a small fraction of firms had knowingly exported at baseline.

Atkin, Khandelwal and Osman (2017)

Rugs and Production Technology

Flat-weave “Dubs” Rug

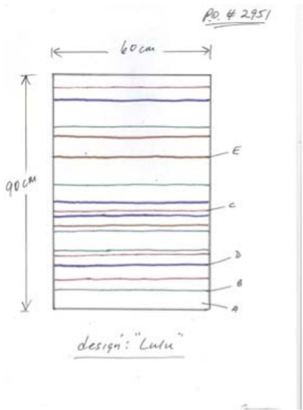


Wooden Foot-Treadle Loom

Atkin, Khandelwal and Osman (2017)

Order Specifications

- Example of codifiable specifications:



samples

Purchase Order No. 2951
Delivery deadline: 10 Oct. 2011
Order Date: 22 Aug. 2011

QUALITY: Plain Cotton flatweave
DESIGN: LuLu
COLOR: V3

SIZE	Rug No.
60cm × 90cm	7828
60cm × 90cm	7829

2 pcs.

Colors:

A = V3
B = V103
C = V195
D = V122
E = V139

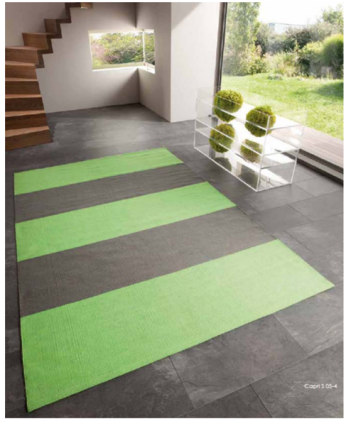
⇒ Plain ends (bound) No fringe.

Artwork attached for design and color placement.

Atkin, Khandelwal and Osman (2017)

Generating Export Orders

- ATA would display rugs at large trade shows, and use US-based rug intermediaries to match Hamis Carpets to retailers in high-income markets



Foreign buyers demand higher *quality*

- Designs have more demanding *specifications* (difficult patterns, thread count, better inputs etc.)
- Also demand higher quality along hard to codify dimensions that depend on firm's *skill*:

Less waviness	Sharp corners
Consistent sizes	Design accuracy
Softer to touch	Etc.

Atkin, Khandelwal and Osman (2017)

Findings

- Firms provided with the opportunity to export have 16–26% higher profits.
- Sources of rise in profits:
  - Prices net of input costs rise, labor inputs rise, but quantities (m^2 rug) fall.
  - Quality rises, productivity measures not adjusting for rug specifications fall (e.g., m^2/hour).
- Two potential explanations:
  - *No Learning:* Price of quality rises, firms upgrade specifications and hence quality (movement along the PPF).
  - *Learning-by-exporting:* Export-induced changes in technical efficiency.

Atkin, Khandelwal and Osman (2017)

Findings

Guided by a simple framework, five pieces of evidence for the presence of LBE:

- Conditional on rug specifications, output/hour & quality rise relative to control.
- On identical rugs, treatment has higher quality despite not taking longer to manufacture.
- Learning curves observed over time in treatment firms.
- Quality improves most along the dimensions discussed with the intermediary.
- Rule out alternative investment hypotheses.

Acknowledgment

Slides of this course are inspired by those taught by N.Berman, T. Chaney, M. Crozet, D. Donaldson, T. Mayer, I. Mejean