Firm-Level Upgrading in Developing Countries

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Introduction

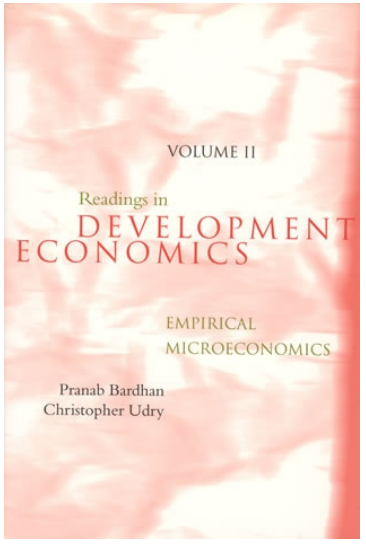
- My topic today is upgrading by firms in developing countries and its determinants.
- By upgrading I mean innovative behavior, but in a broader-than-usual sense.
  - Innovation is often understood to refer to things that are new to the world.
    - The empirics of innovation in rich countries relies heavily on patents, R&D spending.
  - But LDC firms mainly aim to catch up to the world frontier, rather than push it forward.
    - Measures of patents and R&D spending are less informative in such contexts.
  - Upgrading encompasses this sort of catching-up, as well as new-to-the-world innovation.

Introduction (cont.)

- Adopting a technology or product that already exists seems easier than inventing a new one.
  - Gerschenkron (1962): "advantages of backwardness."
- But for many developing-country firms, these advantages have remained elusive.
- What is getting in the way?
- Restated in a positive way: What are the drivers of upgrading at the firm level?

Introduction (cont.)

- This seems like a first-order question for development.
  - It is hard to imagine sustained increases in living standards in the absence of such firm-level upgrading.
- But for many years, even as micro-empirical work gained steam, the question was not a core focus of the development-economics community, outside of agriculture.
  - One (salient to me) illustration:



Introduction (cont.)

- Why not? Some possible answers:
  1. Firm-level data hard to come by.
  2. Few links to natural policy audience.
     - Reaction against ISI, interventionist development policy ("Washington Consensus").
  3. Challenging to do work on firms that is "credible" by modern applied-micro standards.
     - Costly to run experiments, especially with non-micro firms.
     - Outcomes hard to measure well.
     - Firms have few fixed characteristics. What are the Xs to control for?
- Non-ag firm-level empirical work was mainly being done in other fields — trade, macro, some IO.

Introduction (cont.)

- Some messages today:
  - Some of the skepticism in point 3 is well-placed.
    - Existing measures of productivity, the most common metric for upgrading, have issues.
  - But a lot of progress has been made.
    - Direct measures of upgrading.
    - Experiments/quasi-experiments.
    - Some robust lessons (and some not so robust).
  - This is fertile ground for development researchers.
    - Important questions.
    - Data frontier expanding rapidly.
    - Increasing support from policy-makers, funders, firms for experiments.
    - Shoe leather costs, understanding context crucial.
- I'll draw on a new review (Verhoogen, forthcoming).
  - Focuses on non-micro, non-agricultural firms, and within-firm upgrading.

Roadmap

- Introduction
- What is upgrading?
  - Conceptual framework
  - Measurement issues
- Evidence on drivers of upgrading
  - Output-side drivers
  - Input-side drivers
  - Drivers of know-how
- Closing thoughts

Conceptual Framework

- Goal: framework/notation that can accommodate main mechanisms that have been highlighted in the literature.
  - Too general to make falsifiable predictions.
- Firm-product-technique-level production function:

$$Y_{ijkt} = F_{ijk}(\vec{M}_{ijkt}, \lambda_{ijkt})$$

  - i, j, k, t index firms, products, techniques, time.
  - $\vec{M}_{ijkt}$: vector of inputs.
  - λ_{ijkt}: "capability", has to be "home-grown" (Gibbons, 2010; Dessein and Prat, forthcoming).
  - Different quality varieties considered different outputs/inputs; products; let φ_{ijt}, $\vec{\alpha}_{ijkt}$ be output/input quality.
- Let J_{it}, K_{it} be sets of products, techniques for which the firm knows $F_{ijk}(\cdot)$.
- Refer to $\Lambda_{it} := \{\lambda_{ijkt}\}$, J_{it}, and K_{it} together as "know-how."

Conceptual Framework (cont.)

- Destination markets indexed by b.
- Fixed costs: f_{ijkt}, f_{ijbt}, f_{ijt}, f_{ibt}, f_{it},
- Investments in know-how: $\mathcal{I}^{\Lambda}_{it}$, $\mathcal{I}^{J}_{it}$, $\mathcal{I}^{K}_{it}$.
- Inverse output-demand curve: $P_{ijbt} = D_{jb}(Y_{ijbt}, \varphi_{ijt}; \vec{\Gamma}^{y}_{bt})$.
  - $\vec{\Gamma}^{y}_{bt}$: external-to-the-firm factors.
- Inverse input-supply curve: $\vec{W}_{ijkt} = S_{jk}(\vec{M}_{ijkt}, \vec{\alpha}_{ijkt}; \vec{\Gamma}^{m}_{t})$.
- Firm's problem is to maximize the PDV of profits:

$$\Pi_{i\tau} = \sum_{t=\tau}^{\infty} \delta_t \left\{ \sum_{b \in B^*_{it}} \left[\sum_{j \in J^*_{ibt}} \left(P_{ijbt} F_{ijk}(\vec{M}_{ijkt}, \lambda_{ijkt}) - \vec{W}'_{ijkt} \vec{M}_{ijkt} - f_{ijkt} - f_{ijbt} - f_{ijt} \right) - f_{ibt} \right] - f_{it} - \mathcal{I}^{\Lambda}_{it} - \mathcal{I}^{J}_{it} - \mathcal{I}^{K}_{it} \right\}$$

  - Firm chooses destinations B^*_{it}, products J^*_{ibt}, technique k^*_{ijt} for each $j \in J^*_{ibt}$, inputs $(\vec{M}_{ijkt})$, $\mathcal{I}^{\Lambda}_{it}$, $\mathcal{I}^{J}_{it}$, $\mathcal{I}^{K}_{it}$ for each t.

Conceptual Framework (cont.)

- Four main dimensions of upgrading highlighted in literature:
  1. Learning.
     - Gains of know-how: capability (for some $\lambda_{ijkt} \in \Lambda_{it}$), knowledge of products (J_{it}) or techniques (K_{ijt}).
  2. Quality upgrading.
     - Increase in average quality $\overline{\varphi}_{it}$, where

$$\overline{\varphi}_{it} = \sum_{b \in B^*_{it}} \sum_{j \in J^*_{ijbt}} \nu_{ijbt}\, \varphi_{ijt}, \qquad \nu_{ijbt} = \frac{Y_{ijbt}}{\sum_{b' \in B^*_{it}} \sum_{j' \in J^*_{ij'b't}} Y_{ij'b't}}$$

  3. Product innovation.
     - Production of a new product, $j \notin J^*_{ibt-s}\ \forall\, b \in B^*_{it-s}, s > 0$.
  4. Technology adoption.
     - Use of new technique, $k^*_{ijt} \notin K^*_{ijt-s}\ \forall\, s > 0$.
- Dimensions are related but distinct.
  - Can have quality upgrading without product innovation, technology adoption without learning etc.

Conceptual Framework (cont.)

- LDC firms face different conditions than firms in rich countries.
  - Different product demand curves/prices.
    - e.g. Poorer consumers, less willing to pay for quality.
  - Different input supply curves/prices.
    - e.g. High-quality inputs, high-skill workers expensive.
  - Different levels of know-how.
- Upgrading may or may not be optimal.
  - Foster and Rosenzweig (2010):
    "[I]t cannot be inferred from the observation that farmers using high levels of fertilizer earn substantially higher profits than farmers who use little fertilizer that more farmers should use more fertilizer."
  - Know-how is unambiguously good for the firm, but also costly to acquire.

Conceptual Framework (cont.)

- "Management" encompasses three distinct things:
  - Know-how, including entrepreneurial ability.
  - Skill of employed managers (a purchased input).
  - Management practices.
    - Practices should be thought of like any other technique (Van Reenen, 2011; Bloom et al., 2011).
- Question: can practices be ranked?
  - "Vertical" view: some practices better than others across contexts (Van Reenen, 2011; Bloom et al., 2014).
    - Claim is that $\Pi_{i\tau}(k,\cdot) > \Pi_{i\tau}(k',\cdot)$ for all $D_{bj}(\cdot)$, $S_{jk}(\cdot)$, Λ_{it}, J_{it}.
  - "Horizontal" / "contingency" view: which is best depends on the context (market conditions, know-how).
  - Ultimately an empirical question, not yet resolved.
  - Normally, if we see firms using different technologies, we don't assume that some are making mistakes.
    - We should ask what constraints firms are facing that lead them to make the choices they do.

Measurement Issues

- Main ways researchers have attempted to capture upgrading empirically:
  - Patents/R&D expenditures.
    - Manipulable (Chen et al., 2021).
    - Unlikely to capture catching-up.
  - Total factor productivity (TFP).
    - Plus: aims directly to estimate $\{\lambda_{ijkt}\}$.
    - Minus: methods require strong structural assumptions, have various biases (coming next).
  - Direct measures of quality upgrading, product innovation, technology adoption (including management practices).
    - Minus: upgrading on these dimensions is not necessarily optimal.
    - Minus: typicaly they can be observed directly only in specific (special?) sectors.
    - Plus: Don't require strong theoretical assumptions.
  - Indirect measures of quality, based on inferences from prices, market shares.

TFP – Proxy Variables

- TFP methods have issues, some familiar, some less so.
- Issue #1: monotonicity assumption for proxy-variable strategy.
  - Standard model: Cobb-Douglas (in logs).

$$y_{it} = \vec{z}_{it}'\vec{\beta} + \{ \underbrace{\omega_{it}}_{\text{“ex ante”}} + \underbrace{\varepsilon_{it}}_{\text{“ex post”}} \} \tag{1}$$

    where $\vec{z}_{it} = (k_{it}\ \ell_{it}\ m_{it})'$, $\vec{\beta} = (\beta_k\ \beta_\ell\ \beta_m)'$.
  - Transmission bias: m_{it}, ℓ_{it} chosen after firm observes ω_{it}.
  - Proxy-variable strategies require monotonicity with scalar ω_{it}:
    - $\iota_{it} = \iota(k_{it}, \omega_{it}) \Rightarrow \omega_{it} = \iota^{-1}(k_{it}, \iota_{it})$ (Olley and Pakes, 1996).
    - $m_{it} = m(k_{it}, \omega_{it}) \Rightarrow \omega_{it} = m^{-1}(k_{it}, m_{it})$ (Levinsohn and Petrin, 2003).
  - Gandhi et al. (2020): not non-parametrically identified.
    - Use FOC for choice of inputs as additional restriction.
  - Monotonicity assumption is very strong.
    - Invalidated e.g. by hetereogeneity in credit constraints, input-market frictions, or just firm fixed effects.
    - Particularly unlikely to hold in LDCs.

TFP – Price Biases

- Issue #2: output/input price biases (De Loecker and Goldberg, 2014).
  - It is rare to observe physical quantities. More common to observe revenues ($r_{it} = y_{it} + p_{it}$), expenditures ($\vec{e}_{it} = \vec{z}_{it} + \vec{w}_{it}$).
  - Suppose:

$$p_{it} = \overline{p}_t + \breve{p}_{it}$$

$$\vec{w}_{it} = \overrightarrow{\overline{w}}_t + \vec{\breve{w}}_{it}$$

  - Plugging into (1), the standard regression is:

$$\{r_{it} - \overline{p}_t\} = \{\vec{e}_{it} - \overrightarrow{\overline{w}}_t\}'\vec{\beta} + \{\breve{p}_{it} - \vec{\breve{w}}_{it}{}'\vec{\beta} + \omega_{it} + \varepsilon_{it}\}$$

  - $Cov(\vec{e}_{it} - \overrightarrow{\overline{w}}_t, \breve{p}_{it}) \neq 0 \Rightarrow$ output price bias.
  - $Cov(\vec{e}_{it} - \overrightarrow{\overline{w}}_t, \vec{\breve{w}}_{it}) \neq 0 \Rightarrow$ input price bias.
- Recently, quantity information is becoming available (Foster et al., 2008; Atalay, 2014). But ...

TFP – Quality/Variety Biases

- Issue #3: quality/variety biases.
  - Consider "aggregate" firm-level production function (de Roux, Eslava, Franco and Verhoogen, 2021).

$$\widetilde{Y}_{it} = \widetilde{M}_{it}^{\beta_m} L_{it}^{\beta_\ell} K_{it}^{\beta_k} e^{\omega_{it}+\eta_i+\xi_t+\epsilon_{it}} \tag{2}$$

$$\widetilde{Y}_{it} = \left[\sum_{j \in \Omega_{it}^y} \left(\varphi_{ijt} Y_{ijt} \right)^{\frac{\sigma_i^y - 1}{\sigma_i^y}} \right]^{\frac{\sigma_i^y}{\sigma_i^y - 1}}$$

$$\widetilde{M}_{it} = \left[\sum_{h \in \Omega_{it}^m} \left(\alpha_{iht} M_{iht} \right)^{\frac{\sigma_i^m - 1}{\sigma_i^m}} \right]^{\frac{\sigma_i^m}{\sigma_i^m - 1}}$$

  - CES aggregators are one way to deal with unobserved mapping from inputs to outputs.

TFP – Quality/Variety Biases (cont.)

- Using existing CES results, turns out that:

$$\underbrace{\ln\left(\frac{\widetilde{Y}_{it}}{\widetilde{Y}_{it-1}}\right)}_{\text{real output change}} = \underbrace{\sum_{j\in\Omega_{it}^{y*}} \delta_{ijt} \ln\left(\frac{Y_{ijt}}{Y_{ijt-1}}\right)}_{\text{“Sato-Vartia” quantity change}} + \underbrace{\sum_{j\in\Omega_{it}^{y*}} \delta_{ijt} \ln\left(\frac{\varphi_{ijt}}{\varphi_{ijt-1}}\right)}_{\text{quality change}} + \underbrace{\frac{\sigma_i^y}{\sigma_i^y - 1} \ln\left(\frac{\chi_{it-1,t}^y}{\chi_{it,t-1}^y}\right)}_{\text{variety change}}$$

where ($*$ means common goods):

$$S_{ijt}^y = \frac{P_{ijt}Y_{ijt}}{\sum_{j'\in\Omega_{it}^y} P_{ij't}Y_{ij't}}, \quad S_{ijt,t-1}^{y*} = \frac{P_{ijt}Y_{ijt}}{\sum_{j'\in\Omega_{it,t-1}^{y*}} P_{ij't}Y_{ij't}}, \quad S_{ijt-1,t}^{y*} = \frac{P_{ijt-1}Y_{ijt-1}}{\sum_{j'\in\Omega_{it,t-1}^{y*}} P_{ij't-1}Y_{ij't-1}}$$

$$\delta_{ijt} = \frac{\left(\frac{S_{ijt,t-1}^{y*} - S_{ijt-1,t}^{y*}}{\ln S_{ijt,t-1}^{y*} - \ln S_{ijt-1,t}^{y*}}\right)}{\sum_{j\in\Omega_{it}^{y*}} \left(\frac{S_{ijt,t-1}^{y*} - S_{ijt-1,t}^{y*}}{\ln S_{ijt,t-1}^{y*} - \ln S_{ijt-1,t}^{y*}}\right)}, \quad \chi_{it,t-1}^y = \sum_{j\in\Omega_{it,t-1}^{y*}} S_{ijt}^y, \quad \chi_{it-1,t}^y = \sum_{j\in\Omega_{it,t-1}^{y*}} S_{ijt-1}^y$$

- Summing across periods with initial normalization (in logs):

$$\boxed{\widetilde{y}_{it} = \widetilde{y}_{it}^{SV} + q_{it}^y + v_{it}^y} \tag{3}$$

TFP – Quality/Variety Biases (cont.)

- Similarly on input side:

$$\underbrace{\ln\left(\frac{\widetilde{W}_{it}}{\widetilde{W}_{it-1}}\right)}_{\text{real mat. input change}} = \underbrace{\sum_{h\in\Omega^{m*}_{it,t-1}} \psi_{iht} \ln\left(\frac{W_{iht}}{W_{iht-1}}\right)}_{\text{“Sato-Vartia” quantity change}} - \underbrace{\sum_{h\in\Omega^{m*}_{it,t-1}} \psi_{iht} \ln\left(\frac{\alpha_{iht}}{\alpha_{iht-1}}\right)}_{\text{quality change}} - \underbrace{\frac{1}{\sigma^m_i - 1} \ln\left(\frac{\chi^m_{it-1,t}}{\chi^m_{it,t-1}}\right)}_{\text{variety change}}$$

$$s^m_{iht} = \frac{W_{iht}M_{iht}}{\sum_{h'\in\Omega^m_{it}} W_{ih't}M_{ih't}}, \quad s^{m*}_{iht,t-1} = \frac{W_{iht}M_{iht}}{\sum_{h'\in\Omega^{m*}_{it,t-1}} W_{ih't}M_{ih't}}, \quad s^{m*}_{iht-1,t} = \frac{W_{iht-1}M_{iht-1}}{\sum_{h'\in\Omega^{m*}_{it,t-1}} W_{ih't-1}M_{ih't-1}}$$

$$\psi_{iht} = \frac{\left(\frac{s^{m*}_{iht,t-1} - s^{m*}_{iht-1,t}}{\ln s^{m*}_{iht,t-1} - \ln s^{m*}_{iht-1,t}}\right)}{\sum_{h\in\Omega^{m*}_{it,t-1}} \left(\frac{s^{m*}_{iht,t-1} - s^{m*}_{iht-1,t}}{\ln s^{m*}_{iht,t-1} - \ln s^{m*}_{iht-1,t}}\right)}, \quad \chi^m_{it,t-1} = \sum_{h\in\Omega^{m*}_{it,t-1}} s^m_{iht}, \quad \chi^m_{it-1,t} = \sum_{h\in\Omega^{m*}_{it,t-1}} s^m_{iht-1}$$

- Summing across periods (again in logs):

$$\boxed{\widetilde{m}_{it} = \widetilde{m}^{SV}_{it} + q^m_{it} + v^m_{it}} \tag{4}$$

TFP – Quality/Variety Biases (cont.)

- Plug boxes (3) and (4) into production function (2):

$$\widetilde{y}_{it}^{SV} = \beta_m \widetilde{m}_{it}^{SV} + \beta_\ell \ell_{it} + \beta_k k_{it} + \eta_i + \xi_t + u_{it}$$

$$u_{it} = (\beta_m q_{it}^m - q_{it}^y) + (\beta_m v_{it}^m - v_{it}^y) + \omega_{it} + \epsilon_{it}$$

- Correlation of $\widetilde{m}_{it}^{SV}, \ell_{it}, k_{it}$ with q_{it}^m, q_{it}^y, v_{it}^m, v_{it}^y $\Rightarrow$ quality/variety biases.
  - Ex.: single-output/-input producer ($\widetilde{y}_{it}^{SV}$, $\widetilde{m}_{it}^{SV}$ are log physical quantities).
    - If higher-quality output requires more labor hours:

$$Cov(\ell_{it}, q_{it}^y) > 0 \Rightarrow \text{plim}(\widehat{\beta}_\ell^{OLS}) < \beta_\ell$$

    - If firm uses more units when input quality $\uparrow$:

$$Cov(\widetilde{m}_{it}^{SV}, q_{it}^m) > 0 \Rightarrow \text{plim}(\widehat{\beta}_m^{OLS}) > \beta_m$$

- Biases may be present even with perfect proxy for ω_{it}.
- Most sectors not homogenous, single-output/-input.
  - Quality changes especially salient in LDCs.

TFP – Quality/Variety Biases (cont.)

- de Roux et al. (2021) propose new method:
  - External instruments for $\widetilde{m}_{it}^{SV}$, ℓ_{it} using:
    - Exchange rates.
    - Minimum wages.
  - Supplemented by "internal" instruments (lagged levels or differences).
  - Jury still out on how much influence the proposal will have.
- But it seems clear that standard TFP methods are on shaky ground (for differentiated-product sectors).
  - Algebra above is for CES, but quality/variety likely to be confounders in other frameworks.
  - de Roux et al. (2021) find empirical similar results for other aggregators.
  - Quality/variety bias is not just a theoretical curiosity [evidence coming].

Measurement – The Way Forward

- Growing number of studies have paid the shoe-leather costs to get direct measures of quality, technology adoption.
  - Several mentioned below.
  - Measurement of management practices has taken off, to good effect (Bloom et al., 2014).
  - World Bank is conducting technology surveys, which will stimulate work in this area (Cirera et al., 2020, 2022).
- The way forward is to find settings that combine:
  - Credibly exogenous variation.
  - Direct measures of upgrading.
- Caveat: given that upgrading is not necessarily optimal, we need to interpret results carefully.

Roadmap

- Introduction
- What is upgrading?
  - Conceptual framework
  - Measurement issues
- Evidence on drivers of upgrading
  - **Output-side drivers**
  - Input-side drivers
  - Drivers of know-how
- Closing thoughts

Selling to Richer Consumers

- Growing evidence that selling to richer consumers ⇒ upgrading
  - directly, by exporting
  - indirectly, by selling into value chains that sell eventually to richer consumers
- Early papers:
  - TFP (with mixed results): Clerides et al. (1998), Bernard and Jensen (1999), De Loecker (2007).
  - Prices, quantities: Verhoogen (2008), Bastos and Silva (2010), Kugler and Verhoogen (2012), Manova and Zhang (2012), Brambilla et al. (2012), Bastos et al. (2018).
- Recent work is particularly convincing, has raised some important new questions.

Egyptian Rugs (Atkin, Khandelwal and Osman, 2017b)

- Randomized initial export orders among Egyptian rug producers.
- Tracked detailed quality indicators.
- Kept track of conversations between buyer (intermediary) and producers.
- Had producer weave identical rugs under laboratory conditions.

Exports ↑ ⇒ Output, Input Quality ↑

TABLE VIII

IMPACT OF EXPORTING ON QUALITY LEVELS

	Control mean	(1) ITT	(2) TOT
Panel A: Quality metrics			
Corners	2.98	1.11***	1.70***
		(0.12)	(0.11)
Waviness	2.99	1.10***	1.68***
		(0.12)	(0.10)
Weight	3.08	1.07***	1.63***
		(0.11)	(0.11)
Touch	3.12	0.40***	0.66***
		(0.06)	(0.07)
Packedness	3.11	0.89***	1.59***
		(0.11)	(0.12)
Warp thread tightness	3.05	0.83***	1.49***
		(0.10)	(0.12)
Firmness	2.98	0.87***	1.60***
		(0.11)	(0.12)
Design accuracy	3.17	0.79***	1.41***
		(0.10)	(0.12)
Warp thread packedness	3.05	1.07***	1.65***
		(0.11)	(0.11)
Inputs	3.07	0.89***	1.62***
		(0.10)	(0.12)
Loom	2.02	0.03	0.05
		(0.02)	(0.04)
R-squared		0.44	0.60
Observations		6,885	6,885
Panel B: Stacked quality metrics			
Stacked quality metrics	2.96	0.79***	1.35***
		(0.09)	(0.08)
R-squared		0.39	0.54
Observations		6,885	6,885

- Price paid for weft thread also ↑.

Exports ↑ ⇒ Profits ↑, but TFPQ ↓

TABLE V

IMPACT OF EXPORTING ON FIRM PROFITS

	Log direct profits		Log (reported revenues − reported costs)		Log (constructed revenues − constructed costs)		Log hypothetical profits	
	(1) ITT	(2) TOT	(3) ITT	(4) TOT	(5) ITT	(6) TOT	(7) ITT	(8) TOT
Panel A: Profits (in month prior to survey)								
Treatment	0.26***	0.42***	0.21***	0.37***	0.19***	0.34***	0.37***	0.68***
	(0.05)	(0.08)	(0.06)	(0.10)	(0.06)	(0.10)	(0.11)	(0.19)
R-squared	0.21	0.22	0.16	0.18	0.16	0.18	0.19	0.19
Control mean (in levels)	929	929	931	931	951	951	541	541
Observations	573	573	644	644	685	685	687	687
Panel B: Profits per owner hour (in month prior to survey)								
Treatment	0.20***	0.32***	0.17***	0.29***	0.16***	0.28***	0.25***	0.46***
	(0.05)	(0.08)	(0.05)	(0.09)	(0.05)	(0.09)	(0.07)	(0.12)
R-squared	0.14	0.14	0.12	0.13	0.13	0.13	0.19	0.18
Control mean (in levels)	3.53	3.53	3.54	3.54	3.55	3.55	5.56	5.56
Observations	573	573	637	637	684	684	687	687

TABLE IX

IMPACT OF EXPORTING ON UNADJUSTED PRODUCTIVITY

	Log unadjusted output per hour		Log unadjusted TFP	
	(1) ITT	(2) TOT	(3) ITT	(4) TOT
Treatment	−0.24***	−0.42***	−0.28***	−0.50***
	(0.09)	(0.16)	(0.09)	(0.16)
R-squared	0.18	0.16	0.26	0.24
Control mean (in levels)	0.26	0.26	0.49	0.49
Observations	687	687	674	674

Notes. Table reports treatment effects for the two productivity measures: log unadjusted output per labor hour (in $\frac{m^2}{hour}$) and log unadjusted TFP. See text and Appendix for the methodology used to obtain unadjusted TFP. The TOT specifications instrument takeup with treatment. Control group means are reported in levels. Regressions control for baseline values of the variable, round and strata fixed effects. Standard errors are clustered by firm. Significance: *.10; **.05; ***.01.

Exports ↑ ⇒ Know-how ↑

TABLE XI

QUALITY AND PRODUCTIVITY ON IDENTICAL-SPECIFICATION DOMESTIC RUGS (STEP 2)

	Master artisan			Professor		
	Control mean	(1) ITT	(2) TOT	Control mean	(3) ITT	(4) TOT
Panel A: Quality metrics						
Corners	3.23	0.72***	1.05***	3.31	0.29**	0.43**
		(0.14)	(0.17)		(0.13)	(0.18)
Waviness	3.17	0.55***	0.80***	3.31	0.25**	0.36**
		(0.14)	(0.18)		(0.12)	(0.16)
Weight	3.60	0.62***	0.91***	3.64	0.58***	0.86***
		(0.13)	(0.16)		(0.17)	(0.25)
Packedness	3.30	0.77***	1.14***	3.28	0.28**	0.42***
		(0.13)	(0.15)		(0.11)	(0.15)
Touch	3.29	0.52***	0.76***	3.27	0.36***	0.52***
		(0.11)	(0.14)		(0.12)	(0.16)
Warp thread tightness	3.00	0.51***	0.74***	3.30	0.25**	0.36**
		(0.09)	(0.11)		(0.12)	(0.16)
Firmness	3.21	0.71***	1.04***	3.23	0.29**	0.43***
		(0.14)	(0.17)		(0.12)	(0.16)
Design accuracy	3.65	0.53***	0.77***	3.45	0.27**	0.40***
		(0.11)	(0.15)		(0.11)	(0.15)
Warp thread packedness	3.05	0.87***	1.28***	3.20	0.39***	0.58***
		(0.14)	(0.17)		(0.12)	(0.16)
R-squared		0.21	0.34		0.11	0.14
Observations		1,680	1,680		1,667	1,667

	Control mean	(1) ITT	(2) TOT
Time (in minutes)	247.0	−5.67	−8.3
		(6.6)	(9.5)
R-squared		0.84	0.84
Observations		748	748

Egyptian Rugs (cont.)

- Previous work (largely for convenience) had modeled upgrading as driven by shifts in output-demand curves:

$$P_{ijbt} = D_{jb}(Y_{ijbt}, \varphi_{ijt}; \vec{\Gamma}^{y}_{bt})$$

  leading to increases in average quality ($\overline{\varphi}_{it} \uparrow$).
- But the evidence is strong that there was learning involved, i.e. an accumulation of λ_{ijkt}.
- Interesting question (not fully answered): is the gain of capability specific to particular product-techniques (jk) or more general (i.e. applicable to other products, techniques)?

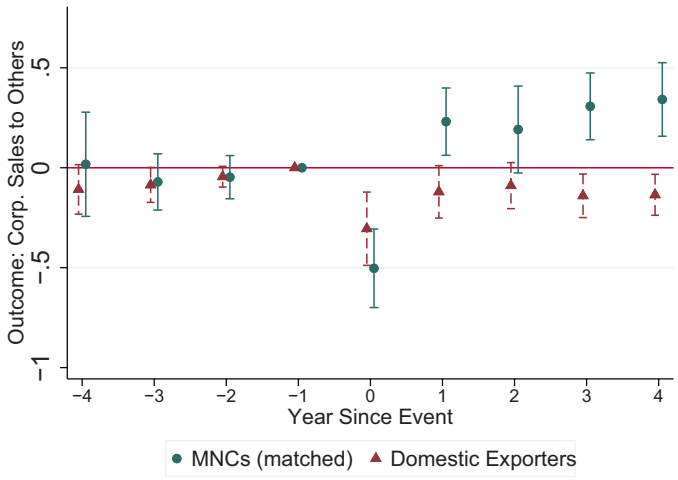
Peruvian Fishmeal (Hansman et al., 2020)

- Use quotas in main competitor countries (Denmark, Iceland, Chile) as source of variation in premium for (observed) quality.
- Positive effect on vertical integration: plants buy boats.
  - Different k (with different $\vec{M}$) to produce higher-φ j.

- Integrated boats stay closer to port, deliver smaller loads $\Rightarrow$ fresher fish.
- That firms vertically integrate suggests quality supply is an important constraint.
- Promising research direction: how contracting frictions influence upgrading decisions.
  - Information particularly asymmetric about quality.
  - Development economists well-placed to advance this agenda.

Costa Rican MNC Suppliers (Alfaro-Urena et al., 2022)

- Firm-to-firm data from tax systems opens new analytical possibilities.
- Matching design: compare suppliers to MNCs vs. suppliers to other types of firms.

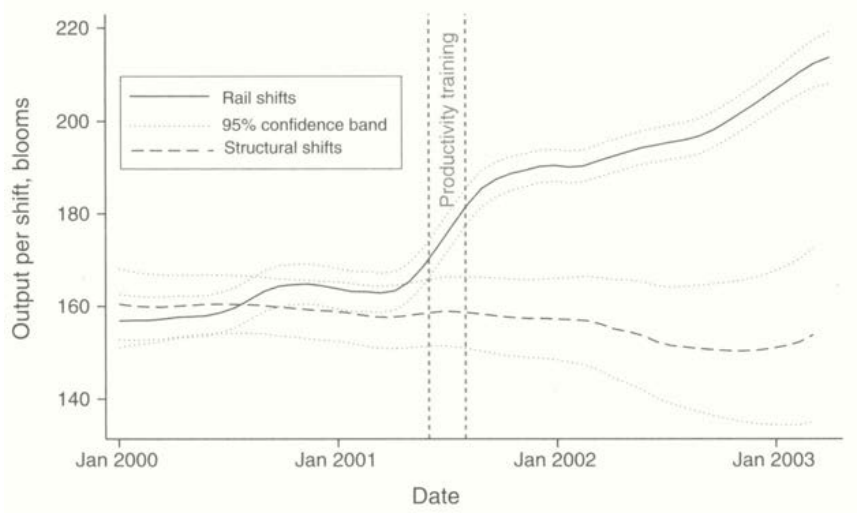


(F) Domestic Exporter, Corp Sales to Others

- Sales, employment, TFP of new MNC suppliers ↑.
- Other buyers of new MNC suppliers:
  - Larger.
  - Higher export/import shares.
  - Longer relationships with suppliers.
- Suppliers appear to learn from (and gain reputation from) MNCs.

Competition?

- Commonly considered a primary driver of upgrading, including within firms. (Bloom and Van Reenen, 2007, 2010; Bloom et al., 2016).
- Clearly matters in some cases:
  - Das et al. (2013): Public-sector firm (SAIL) long had monopoly on rails for Indian railroads.
  - Government considered allowing entry by others 1999-2001.
  - Output of rails/shift ↑ 28% (vs. non-rail items, "structurals").



- Theory not obvious: why don't firms already optimize?

Competition? (cont.)

- Evidence less than definitive.
  - Difficult to distinguish between killing off of low performers and within-firm upgrading (Holmes and Schmitz, 2010).
  - Competition may reduce scale effects (Juhász, 2018),
  - Competition may hinder relational contracts (Macchiavello and Morjaria, 2021).

TABLE III

UNPACKING COMPLEMENTARY RELATIONAL PRACTICES

Dependent variable	Received input from mill (1)	Given inputs to farmers (2)	RC pre-harvest z-score (3)	Expects to receive a second payment (4)	Has made a second payment in the past (5)	RC harvest z-score (6)	Expects to receive help/ loan (7)	Provides help/ loans to farmers (8)	RC post-Harvest z-score (9)	RC index (10)	RC index, farmer outcomes (11)	RC index, mill outcomes (12)	Placebo: short-term credit (13)
Panel A: IV													
Competition	−0.064***	−0.085**	−0.220**	−0.063***	−0.077**	−0.203***	−0.066***	−0.026	−0.180*	−0.283***	−0.237***	−0.215**	0.017
	(0.014)	(0.036)	(0.112)	(0.017)	(0.035)	(0.074)	(0.020)	(0.034)	(0.099)	(0.098)	(0.045)	(0.094)	(0.082)
Panel B: OLS													
Competition	−0.011**	−0.030**	−0.062***	−0.038***	−0.041***	−0.121***	−0.021***	−0.015	−0.065**	−0.116***	−0.086***	−0.102***	−0.041
	(0.005)	(0.012)	(0.022)	(0.006)	(0.013)	(0.038)	(0.007)	(0.014)	(0.033)	(0.029)	(0.016)	(0.029)	(0.033)
Score within 5 km of mill	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Geographic controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mill controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Farmer controls	Yes	–	–	Yes	–	–	Yes	–	–	–	Yes	–	–
Adjusted R^2	0.05	0.13	0.11	0.15	0.16	0.21	0.03	−0.01	0.00	0.10	0.07	0.12	0.04
Observations	869	176	176	869	176	176	865	175	175	175	869	176	172

  - Also find that costs rise, quality falls with competition.
  - Highlights role of contracting issues.

Roadmap

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  - **Input-side drivers**
  - Drivers of know-how
- Closing thoughts

Input-Side Drivers

- So far, we have focused on "demand pull" effects.
  - Are there "input push" effects on upgrading?
- Some existing work, mainly in trade:
  - Input quality: in China, import tariffs $\downarrow \Rightarrow$ export prices $\uparrow$, especially to/from rich countries (Bas and Strauss-Kahn, 2015; Fan et al., 2018)
  - Input variety: availability of imported inputs $\uparrow \Rightarrow$ product innovation, in India (Goldberg et al., 2010), Ecuador (Bas and Paunov, 2019).
- New project: Raza (r) Khandelwal (r) Atkin (r) Chaudhry (r) Verhoogen (r) Chaudry (2022)
  - Randomized vouchers for high-quality imported rexine (artificial leather) to soccer-ball producers in Sialkot, Pakistan.
  - Firms improved quality of other inputs, produced higher-quality balls.

Input Quality Complementarities (Preliminary)

Panel A: Non-rexine Material Characteristics

	non-rexine material quality index (1)	latex (%) (2)	layers (3)	butyl bladder (4)	imported bladder (5)
eligible rexine	2.83**	46.3*	1.88*	0.41	0.28
	(1.24)	(25.30)	(1.04)	(0.35)	(0.25)
projected subsidized share	-1.91**	-28.9	-1.56**	-0.23	-0.18
	(0.92)	(18.96)	(0.72)	(0.29)	(0.22)
baseline controls	x	x	x	x	x
non-eligible mean	-0.02	69.8	3.1	0.12	0.14
N	[181, 44]	[176, 42]	[179, 44]	[180, 44]	[180, 43]

Panel B: Non-rexine cost Breakdown

	bladder cost (1)	latex and chemicals cost (2)	layer cost (3)	stitching cost (4)	printing cost (5)	other cost (6)
eligible rexine	64.2**	26.1***	62.3	26.9	33.1***	43.3**
	(27.05)	(10.07)	(39.79)	(24.13)	(10.96)	(19.50)
projected subsidized share	-42.6**	-16.6*	-41.5	-8.12	-20.2**	-30.0**
	(20.44)	(8.73)	(30.24)	(19.95)	(8.05)	(14.13)
baseline controls	x	x	x	x	x	x
non-eligible mean	47.5	24.6	32.7	76.3	19.8	23.4
N	[172, 41]	[161, 37]	[146, 32]	[179, 43]	[145, 39]	[165, 38]

- Overall costs ↑, ball price ↑. (Pass-through is negative.)
- Inputs can push upgrading. Not seeing persistence (so far).

Supply of Capital?

- Perhaps surprisingly, relatively little evidence of effect of capital supply matters for within-firm upgrading outcomes:
  - Rotemberg (2019):
    - Expansion of subsidized credit in India had little within-firm effect on TFPQ.
  - Bau and Matray (forthcoming):
    - Loosening of restrictions on foreign investment in India had little within-firm effect on TFPQ. High-MRPK firms added products relative to low-MRPK.
  - Cai and Harrison (2021):
    - VAT reduction on capital goods in China increased investment but not product introductions or productivity.
- Concerns about TFP estimation apply here. Need more research using direct measures of upgrading.

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Drivers of Know-How

- Firms may fail to upgrade even when output-demand and input-supply conditions are favorable. Why?
- Framework points to lack of know-how: $\Lambda_{it} = \{\lambda_{ijkt}\}$, J_{it}, K_{it}.
- Factors that affect acquisition of know-how:
  - Agency issues.
  - Entrepreneurial ability/family control.
  - Learning from others (other firms, external consultants).
  - Behavioral issues?

Agency Issues

- Misalignment of incentives within firms can impede information flows, and hence learning.
- Example: soccer balls (Atkin, Chaudhry, Chaudry, Khandelwal and Verhoogen, 2017a).

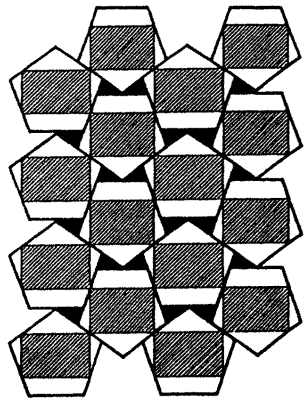
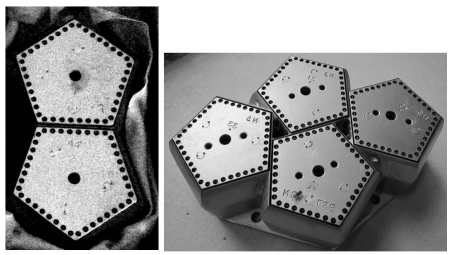


Fig. 7. Maximum density double-lattice packing with regular pentagons.



The Pre-Existing Die

The New Offset Die

- Giving cutters an incentive to share information led to adoption.

Agency Issues (cont.)

- Cai and Wang (forthcoming):
  - Chinese auto manufacturer elicited employee's evaluations of their supervisors.
  - 20% weight in promotion/salary decisions for supervisors.
  - Employees report that supervisors became nicer.
  - Turnover declined, team-level productivity increased.
  - Firm extended program to all plants ($\sim$20,000 workers).
- Evaluation system arguably increased information flow from employees to upper-level management.

Agency Issues (cont.)

- Why didn't firms figure out organizational innovations on their own? Possibilities:
  - Firms were unaware of new practice.
  - Firms were aware, but re-contracting costs outweighed expected benefits.
- Points to need for research to track what entrepreneurs know and what benefits they expect.

Entrepreneurial Ability/Family Control

- Some robust patterns:
  - CEOs/managers differ in management styles, in ways that are correlated with performance (Bertrand and Schoar, 2003; Bandiera et al., 2020; Adhvaryu et al., forthcoming).
  - Family-managed firms have worse performance (Pérez-González, 2006; Bertrand et al., 2008), less "structured" practices (Bloom and Van Reenen, 2007)
  - Child-composition IV:
    - 1st born male, or any son $\Rightarrow$ family succession $\Rightarrow$ lower profitability/worse performance (Bennedsen et al., 2007) lower management scores (Lemos and Scur, 2019).
- Then why is family control so prevalent?
  - Family control may help solve agency problems in short term.
    - Pakistani surgical firms with more brothers larger (Ilias, 2006).
    - Family have lower-powered incentives (Cai et al., 2013).
  - But it may outlive its usefulness in the longer term.

Learning from Other Firms

- Cai and Szeidl (2018):
  - Randomly assigned 2,820 Chinese managers into groups that met monthly for one year (or no-meetings control).
    - Large effects on revenues (8.1%), also positive effects on profits, management practices.
  - Randomly provided information about a government grant and savings opportunity to some participants.
    - Other participants in treated groups more likely to apply.
    - Information spread more if it was non-rival (savings opportunity, not government grant).
    - Consistent results in Hardy and McCasland (2021).

Learning from Trainers/Consultants

- Strong evidence that tailored, "high-touch" advice can have positive effects on firm performance.
  - Bloom, Eifert, Mahajan, McKenzie and Roberts (2013):
    - Randomized consulting services among 17 Indian textile firms.
    - 1-month diagnostic (all), 4-month implementation (treatment)
    - Market value of services $\sim$ \$250k.
    - Clear effects on management practices, quality defects.
  - Bruhn, Karlan and Schoar (2018):
    - Randomized consulting services, provided by private consulting firms, to SMEs in Puebla, Mexico.
    - One-on-one meetings, four hours per week for one year.
    - Moderately positive effects on productivity, return on assets, (over five years) employment.
  - Iacovone, Maloney and McKenzie (2022):
    - Group/individual consulting to Colombian autoparts suppliers.
    - Positive impacts of both, group consulting more cost-effective.

Learning from Trainers/Consultants (cont.)

- Frontier issues:
  - Are some management practices better across contexts?
    - I think we still don't know (exclusion restriction an issue in consulting experiments).
  - Better to train or encourage out-/in-sourcing?
    - Anderson and McKenzie (2022): outsourcing/insourcing marketing/finance dominate business training, are more cost-effective than consulting.
    - In framework, where is boundary between capabilities (that must be homegrown) and inputs (that can be purchased)?
  - Why are consulting/professional service markets so thin?
    - Providing info/quality ratings not sufficient (Anderson and McKenzie, 2022).

Behavioral Firms?

- I have emphasized lack of know-how as barrier to upgrading. Could also be that:
  1. Entrepreneurs hold goals besides profit-maximization.
  2. Entrepreneurs make mistakes.
- May be important! Need more evidence (Kremer et al., 2019).
- But a word of caution:
  - If behavior appears to be non-optimizing, maybe we have not understood the problems individuals face.
    - Schultz (1964) on agricultural producers: "poor but rational."
    - Update for LDC firms: "lacking know-how, but populated by rational individuals."
  - What looks like non-profit-maximizing behavior may reflect:
    - Agency/contracting/organizational issues.
    - Cost of acquiring know-how.

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Summing Up

- Should de-emphasize TFP as metric for upgrading.
  - Better to focus on things we can measure directly: quality upgrading, technology adoption, product innovation.
  - Will require focusing on particular sectors, building up slowly.
- Some drivers that seem to be important:
  - Selling to rich consumers, directly or indirectly.
  - Availability of high-quality inputs.
  - Ability to resolve contracting frictions, within and across firms.
  - Exposure to information from other firms, trainers/consultants.
- Key challenge is how to promote learning in firms.
- Notes of caution on competition, capital, behavioral firms.
- Possible to do "credible" work, even on larger non-agricultural firms.

Thoughts on the Way Forward

- Research design:
  - Find sources of exogenous variation in conditions facing firms: demand and supply conditions, information flows.
    - Experiments great, but quasi-experiments also useful.
  - Directly observable outcomes.
- Some specific research questions:
  - Does what you produce affect how fast you learn?
    - Old idea (Prebisch, 1950; Hausmann et al., 2007), ripe for investigation at the firm level.
  - How does knowledge diffuse across firms?
    - Strength relative to other channels for agglomeration effects?
  - What are effects of particular management practices?
    - Some work here (Bandiera et al., 2011; Gosnell et al., 2020) but not extensive.
  - What works and doesn't work in industrial/innovation policy when state capacity is low?

References I

Adhvaryu, Achyuta, Anant Nyshadham, and Jorge Tamayo (forthcoming) "Managerial Quality and Productivity Dynamics," *Review of Economic Studies*.

Alfaro-Urena, Alfonso, Isabela Manelici, and Jose P. Vasquez (2022) "The Effects of Joining Multinational Supply Chains: New Evidence from Firm-to-Firm Linkages," *Quarterly Journal of Economics*, 137 (3).

Anderson, Stephen J. and David McKenzie (2022) "Improving Business Practices and the Boundary of the Entrepreneur: A Randomized Experiment Comparing Training, Consulting, Insourcing, and Outsourcing," *Journal of Political Economy*, 130 (1), 157–209.

Atalay, Enghin (2014) "Materials Prices and Productivity," *Journal of the European Economic Association*, 12 (3), 575–611.

Atkin, David, Azam Chaudhry, Shamyla Chaudry, Amit K. Khandelwal, and Eric Verhoogen (2017a) "Organizational Barriers to Technology Adoption: Evidence from Soccer-Ball Producers in Pakistan," *Quarterly Journal of Economics*, 132 (3), 1101–1164.

Atkin, David, Amit K. Khandelwal, and Adam Osman (2017b) "Exporting and Firm Performance: Evidence from a Randomized Trial," *Quarterly Journal of Economics*, 132 (2), 551–615.

Bandiera, Oriana, Iwan Barankay, and Imran Rasul (2011) "Field Experiments with Firms," *Journal of Economic Perspectives*, 25 (3), 63–82.

Bandiera, Oriana, Andrea Prat, Stephen Hansen, and Raffaella Sadun (2020) "CEO Behavior and Firm Performance," *Journal of Political Economy*, 128 (4), 1325–1369.

Bas, Maria and Caroline Paunov (2019) "What Gains and Distributional Implications Result from Trade Liberalization?", UNU-WIDER working paper 2019-003.

Bas, Maria and Vanessa Strauss-Kahn (2015) "Input-Trade Liberalization, Export Prices and Quality Upgrading," *Journal of International Economics*, 95 (2), 250–262.

References II

Bastos, Paulo and Joana Silva (2010) "The Quality of a Firm's Exports: Where You Export to Matters," *Journal of International Economics*, 82 (2), 99–111.

Bastos, Paulo, Joana Silva, and Eric Verhoogen (2018) "Export Destinations and Input Prices: Evidence from Portugal," *American Economic Review*, 108 (2), 353–392.

Bau, Natalie and Adrien Matray (forthcoming) "Misallocation and Capital Market Integration: Evidence from India," *Econometrica*.

Bennedsen, Morten, Kasper M. Nielsen, Francisco Pérez-González, and Daniel Wolfenzon (2007) "Inside the Family Firm: The Role of Families in Succession Decisions and Performance," *Quarterly Journal of Economics*, 122 (2), 647–691.

Bernard, Andrew B. and J. Bradford Jensen (1999) "Exceptional Exporter Performance: Cause, Effect, or Both?" *Journal of International Economics*, 47, 1–25.

Bertrand, Marianne, Simon Johnson, Krislert Samphantharak, and Antoinette Schoar (2008) "Mixing Family with Business: A Study of Thai Business Groups and the Families Behind Them," *Journal of Financial Economics*, 88 (3), 466–498.

Bertrand, Marianne and Antoinette Schoar (2003) "Managing with Style: The Effect of Managers on Firm Policies," *Quarterly Journal of Economics*, 118 (4), 1169–1208.

Bloom, Nicholas, Mirko Draca, and John Van Reenen (2016) "Trade-Induced Technical Change? The Impact of Chinese Imports on Innovation, IT, and Productivity," *Review of Economic Studies*, 83 (1), 87–117.

Bloom, Nicholas, Benn Eifert, Aprajit Mahajan, David McKenzie, and John Roberts (2011) "Does Management Matter? Evidence from India," NBER Working Paper No. 16658.

——— (2013) "Does Management Matter? Evidence from India," *Quarterly Journal of Economics*, 128 (1), 1–51.

References III

Bloom, Nicholas, Renata Lemos, Raffaella Sadun, Daniela Scur, and John Van Reenen (2014) "The New Empirical Economics of Management," *Journal of the European Economic Association*, 12 (4), 835–876.

Bloom, Nicholas and John Van Reenen (2007) "Measuring and Explaining Management Practices Across Firms and Countries," *Quarterly Journal of Economics*, 122 (4), 1351–1408.

——— (2010) "Why Do Management Practices Differ across Firms and Countries?" *Journal of Economic Perspectives*, 24 (1), 203–24.

Brambilla, Irene, Daniel Lederman, and Guido Porto (2012) "Exports, Export Destinations and Skills," *American Economic Review*, 102 (7), 3406–3488.

Bruhn, Miriam, Dean Karlan, and Antoinette Schoar (2018) "The Impact of Consulting Services on Small and Medium Enterprises: Evidence from a Randomized Trial in Mexico," *Journal of Political Economy*, 126 (2), 635–687.

Cai, Hongbin, Hongbin Li, Albert Park, and Li-An Zhou (2013) "Family Ties and Organizational Design: Evidence from Chinese Private Firms," *Review of Economics and Statistics*, 95 (3), 850–867.

Cai, Jing and Ann Harrison (2021) "Industrial Policy in China: Some Intended or Unintended Consequences?" *ILR Review*, 74 (1), 163–198.

Cai, Jing and Adam Szeidl (2018) "Interfirm Relationships and Business Performance," *Quarterly Journal of Economics*, 133 (3), 1229–1282.

Cai, Jing and Shing-Yi Wang (forthcoming) "Improving Management Through Worker Evaluations: Evidence from Auto Manufacturing," *Quarterly Journal of Economics*.

Chen, Zhao, Zhikuo Liu, Juan Carlos Suárez Serrato, and Daniel Yi Xu (2021) "Notching R&D Investment with Corporate Income Tax Cuts in China," *American Economic Review*, 111 (7), 2065–2100.

References IV

Cirera, Xavier, Diego A Comin, Marcio Cruz, and Kyung Min Lee (2020) "Technology Within and Across Firms," NBER working paper no. 28080.

Cirera, Xavier, Diego Comin, and Marcio Cruz (2022) "Bridging the Technological Divide."

Clerides, Sofronis, Saul Lach, and James Tybout (1998) "Is Learning by Exporting Important? Micro-Dynamic Evidence from Colombia, Mexico and Morocco," *Quarterly Journal of Economics*, 113, 903–947.

Das, Sanghamitra, Kala Krishna, Sergey Lychagin, and Rohini Somanathan (2013) "Back on the Rails: Competition and Productivity in State-Owned Industry," *American Economic Journal: Applied Economics*, 5 (1), 136–162.

De Loecker, Jan (2007) "Do Exports Generate Higher Productivity? Evidence from Slovenia," *Journal of International Economics*, 69–98.

De Loecker, Jan and Pinelopi K. Goldberg (2014) "Firm Performance in a Global Market," *Annual Review of Economics*, 6 (1), 201–227.

de Roux, Nicolás, Marcela Eslava, Santiago Franco, and Eric Verhoogen (2021) "Estimating Production Functions in Differentiated-Product Industries with Quantity Information and External Instruments," NBER working paper no. 28323.

Dessein, Wouter and Andrea Prat (forthcoming) "Organizational Capital, Corporate Leadership, and Firm Dynamics," *Journal of Political Economy*.

Fan, Haichao, Yao Amber Li, and Stephen R Yeaple (2018) "On the Relationship Between Quality and Productivity: Evidence from China's Accession to the WTO," *Journal of International Economics*, 110, 28–49.

Foster, Andrew D. and Mark R Rosenzweig (2010) "Microeconomics of Technology Adoption," *Annual Review of Economics*, 2 (1), 395–424.

References V

Foster, Lucia, John Haltiwanger, and Chad Syverson (2008) "Reallocation, Firm Turnover and Efficiency: Selection on Productivity or Profitability?" *American Economic Review*, 98 (1), 394–425.

Gandhi, Amit, Salvador Navarro, and David Rivers (2020) "On the Identification of Gross Output Production Functions," *Journal of Political Economy*, 128 (8), 2973–3016.

Gerschenkron, Alexander (1962) *Economic Backwardness in Historical Perspective: A Book of Essays*: Harvard University Press.

Gibbons, Robert (2010) "Inside Organizations: Pricing, Politics, and Path Dependence," *Annual Review of Economics*, 2 (1), 337–365.

Goldberg, Pinelopi K., Amit Khandelwal, Nina Pavcnik, and Petia Topalova (2010) "Imported Intermediate Inputs and Domestic Product Growth: Evidence from India," *Quarterly Journal of Economics*, 125 (4), 1727–1767.

Gosnell, Greer K., John A. List, and Robert D. Metcalfe (2020) "The Impact of Management Practices on Employee Productivity: A Field Experiment with Airline Captains," *Journal of Political Economy*, 128 (4), 1195–1233.

Hansman, Christopher, Jonas Hjort, Gianmarco León-Ciliotta, and Matthieu Teachout (2020) "Vertical Integration, Supplier Behavior, and Quality Upgrading among Exporters," *Journal of Political Economy*, 128 (9), 3570–3625.

Hardy, Morgan and Jamie McCasland (2021) "It Takes Two: Experimental Evidence on the Determinants of Technology Diffusion," *Journal of Development Economics*, 149, 102600.

Hausmann, Ricardo, Jason Hwang, and Dani Rodrik (2007) "What You Export Matters," *Journal of Economic Growth*, 12 (1), 1–25.

Holmes, Thomas J. and James A. Schmitz (2010) "Competition and Productivity: A Review of Evidence," *Annual Review of Economics*, 2 (1), 619–642.

References VI

Iacovone, Leonardo, William Maloney, and David McKenzie (2022) "Improving Management with Individual and Group-based Consulting: Results from a Randomized Experiment in Colombia," *Review of Economic Studies*, 89 (1), 346–371.

Ilias, Nauman (2006) "Families and Firms: Agency Costs and Labor Market Imperfections in Sialkot's Surgical Industry," *Journal of Development Economics*, 80 (2), 329–349.

Juhász, Réka (2018) "Temporary Protection and Technology Adoption: Evidence from the Napoleonic Blockade," *American Economic Review*, 108 (11), 3339–76.

Kremer, Michael, Gautam Rao, and Frank Schilbach (2019) "Behavioral Development Economics," in Bernheim, B. Douglas, Stefano DellaVigna, and David Laibson eds. *Handbook of Behavioral Economics, vol. 2*: Elsevier.

Kugler, Maurice and Eric Verhoogen (2012) "Prices, Plant Size and Product Quality," *Review of Economic Studies*, 79 (1), 307–339.

Lemos, Renata and Daniela Scur (2019) "The Ties that Bind: Implicit Contracts and Management Practices in Family-Run Firms," CEPR discussion paper no. 13794.

Levinsohn, James and Amil Petrin (2003) "Estimating Production Functions Using Inputs to Control for Unobservables," *Review of Economic Studies*, 70, 317–341.

Macchiavello, Rocco and Ameet Morjaria (2021) "Competition and Relational Contracts in the Rwanda Coffee Chain," *Quarterly Journal of Economics*, 136 (2), 1089–1143.

Manova, Kalina and Zhiwei Zhang (2012) "Export Prices Across Firms and Destinations," *Quarterly Journal of Economics*, 127 (1), 379–436.

Olley, G. Steven and Ariel Pakes (1996) "The Dynamics of Productivity in the Telecommunications Industry," *Econometrica*, 64 (6), 1263–1297.

References VII

Pérez-González, Francisco (2006) "Inherited Control and Firm Performance," *American Economic Review*, 96 (5), 1559–1588.

Prebisch, Raul (1950) "The Economic Development of Latin America and its Principal Problems," New York: United Nations, Reprinted in Economic Bulletin for Latin America in 1962.

Raza, Tariq (r) Amit Khandelwal (r) David Atkin (r) Azam Chaudhry (r) Eric Verhoogen (r) Shamyla Chaudry (2022) "Input Quality Complementarities," Unpub. paper, Columbia University.

Rotemberg, Martin (2019) "Equilibrium Effects of Firm Subsidies," *American Economic Review*, 10, 3475–3513.

Schultz, T. Paul (1964) *Transforming Traditional Agriculture*, New Haven, CT: Yale University Press.

Van Reenen, John (2011) "Does Competition Raise Productivity Through Improving Management Quality?" *International Journal of Industrial Organization*, 29 (3), 306–316.

Verhoogen, Eric (2008) "Trade, Quality Upgrading, and Wage Inequality in the Mexican Manufacturing Sector," *Quarterly Journal of Economics*, 123 (2), 489–530.

——— (forthcoming) "Firm-Level Upgrading in Developing Countries," *Journal of Economic Literature*.