Upgrading and Shared Prosperity:
Some Insights from Micro Research

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Introduction

▶ There is broad agreement that innovation and productivity improvements in manufacturing are a key ingredient in economic growth.

▶ Important point from Mark’s talk: not all innovation is new-to-the-world.
  ▶ All forms of upgrading and the firm level can contribute to growth.

▶ Key question 1: How can we promote upgrading?
▶ Key question 2: What are the links between upgrading and shared prosperity?
  ▶ Within sectors, firms that do more upgrading also tend to pay higher wages.
  ▶ Direction of causality unclear.

▶ Here I will talk about 5 insights into these questions from my micro research on manufacturing firms in developing countries.
Insight 1: Input quality matters for output quality

A. Output prices, hollow brick (ladrillo hueco)
log real output price, dev. from year means
slope=-0.028, s.e.=0.032

B. Input prices, common clay, paid by producers of hollow brick
log real input price, dev. from year means
slope=0.026, s.e.=0.073

Fig. 1 from Kugler & Verhoogen, RESstud 2012.
Insight 1: Input quality matters for output quality

A. Output prices, bar soap
slope=0.055, s.e.=0.025

B. Input prices, refined rendered suet, paid by producers of bar soap
slope=0.110, s.e.=0.038

C. Input prices, unrefined rendered suet, paid by producers of bar soap
slope=0.103, s.e.=0.039

Fig. 2 from Kugler & Verhoogen, REStud 2012.
Insight 1: Input quality matters for output quality

- On average, larger, more-productive firms use higher-quality inputs, produce higher-quality outputs than smaller firms.
  - Colombian manufacturing overall more like bar soap than like hollow bricks.

- Industrial upgrading requires upgrading of entire complex of final-good producers and input suppliers.

- Imported inputs tend to be higher-quality, may be important for facilitating quality upgrading of final goods (Kugler & Verhoogen, AER P&P, 2009).

- Related idea: producing new varieties of outputs may require new varieties of inputs (Goldberg et al., 2010)
Insight 2: Exports $\uparrow \rightarrow$ Quality $\uparrow$, Wages $\uparrow$

- New Beetle, almost all exported.

- Old Beetle, almost all sold domestically (produced until 2003).

Insight 2: Exports $\uparrow \rightarrow$ Quality $\uparrow$, Wages $\uparrow$
Insight 2: Exports $\uparrow \rightarrow$ Quality $\uparrow$, Wages $\uparrow$

- Técnicco: 9 yrs. education, 2003 starting wage $\sim$US$11/day.

- Especialista: 12 yrs. education, 2003 starting wage $\sim$US$18/day.
Insight 2: Exports $\uparrow \rightarrow$ Quality $\uparrow$, Wages $\uparrow$

App. Fig. IVb: Log white-collar wage

- Non-parametric regressions, variables deviated from industry-year means.
- Similar patterns hold for ISO 9000 certification.
Insight 2: Exports ↑ → Quality ↑, Wages ↑

App. Fig. Vb: Changes in log white-collar wage

- Non-parametric regressions, variables deviated from industry-year means.
- Similar patterns hold for ISO 9000 certification.
Insight 3: Exports $\uparrow \rightarrow$ Wage premia $\uparrow$

Source: Frías, Kaplan & Verhoogen, Unpub. 2011.
Insight 4: Adoption not Automatic

- Ongoing project with Atkin, Chaudhry, Chaudry and Khandelwal, 2015.
- Setting: Soccer-ball cluster in Sialkot, Pakistan
  - \( \sim 30 \) million balls/year, almost all exported.
  - 40% of world production, 70% within hand-stitched segment (WSJ, 2010).
1st Stage: Glue Cotton/Polyester to Artificial Leather
2nd Stage: Cut Hexagons and Pentagons
3rd Stage: Print Logos/Designs on Panels
4th Stage: Stitch Panels around Bladder
Existing Cutting Technology

Standard “buckyball” design: 20 hexagons, 12 pentagons.

For standard ball, almost all firms use 2-hexagon and 2-pentagon “flush” dies.
Existing Cutting Technology (cont.)

Hexagons tessellate. \( \sim 8\% \) of rexine wasted.
Existing Cutting Technology (cont.)

Pentagons don’t. ~ 20-24% of rexine wasted.
Origin of Idea

In a YouTube video of a Chinese factory producing the Adidas Jabulani ball, I noticed a different layout of pentagons.
Origin of Idea (cont.)


Fig. 7. Maximum density double-lattice packing with regular pentagons.
Origin of Idea (cont.)

Or the Wikipedia Pentagons page:
Blueprint

Annalisa Guzzini (an architect, also my wife) and I developed a blueprint for a 4-pentagon die to implement the optimal packing.

- 44mm-edge pentagons: \( \sim 250 \) with old die vs. 272 with ours.
- 43.5mm-edge pentagons: \( \sim 258 \) vs. 280.
The “Shamyla” Die
Die Purchases by Firm Z

- Second-largest by employment in Sialkot (~2,200 employees).
- No-drop group, late responder.
- As of March 2014, using offset die for ~100% of production.
Adoption as of Aug. 2013

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## Insight 5: Worker Buy-In Matters

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- Numbers indicate order of importance indicated by respondent.
- Sample is round-4 respondents who have had die in their factory but are not currently using it.
Insight 5: Worker Buy-In Matters

- Why were cutters resisting?
  - Most employees paid piece-rate and new technology slows them down, at least initially.
  - Cost savings accrue to owner.
  - In absence of changes to labor contract, effective wage falls.

- A few owners changed labor contracts, but most did not.
  - Either they simply did not realize that a change would be desirable, or
  - they found it too costly relative to expected benefits of technology.
Insight 5: Worker Buy-In Matters

- We ran a second experiment in firms we had given technology to:
  - In some firms, we offered lump-sum bonus equal to 1 month salary to cutter (and printer), if they could demonstrate competence using the technology in presence of owner.
  - Returned in one month to do test. All passed.
  - Had significant effect on adoption:
    - Half of firms that could have responded ended up adopting.
    - None in control group in short term, one in medium term.
- One generalization we think we can draw: workers need to expect to share in gains to adoption in order for adoption to be successful.
Conclusion

- Some (tentative) lessons for Brazil:
  - Quality upgrading is an important part of innovation, broadly defined, within firms.
  - Upgrading of final goods requires access to high-quality inputs, both foreign and domestic.
  - Upgrading products and productivity also requires “upgrading” the workforce:
    - In part this requires finding new higher-skilled workers.
    - But in larger part it requires motivating and training the existing workforce.
  - Labor relationships (and labor-market institutions) matter for technology adoption/productivity improvement.
Conclusion

- Direction of causality between upgrading and shared prosperity (i.e. wages, employment) still an open question.
  - Standard view: innovations arrive exogenously, change skill demand in firm.
  - Alternative view: innovations arise endogenously, in part through worker input. Workers have to have incentives to share knowledge, ideas, good will.

- Results from Mexico, Pakistan provide some evidence for alternative view. But there is still a lot of work to do.
Conclusion

This seems a promising direction for future work:

- Minimum wage study
- Evaluation of innovation-policy interventions.
  - What are effects of innovation on wages, employment at firm level?
  - Is there an interaction of policies and labor-market conditions in generating innovation?


