Learning in Firms: Evidence and Implications

Eric Verhoogen

IGC and Columbia University

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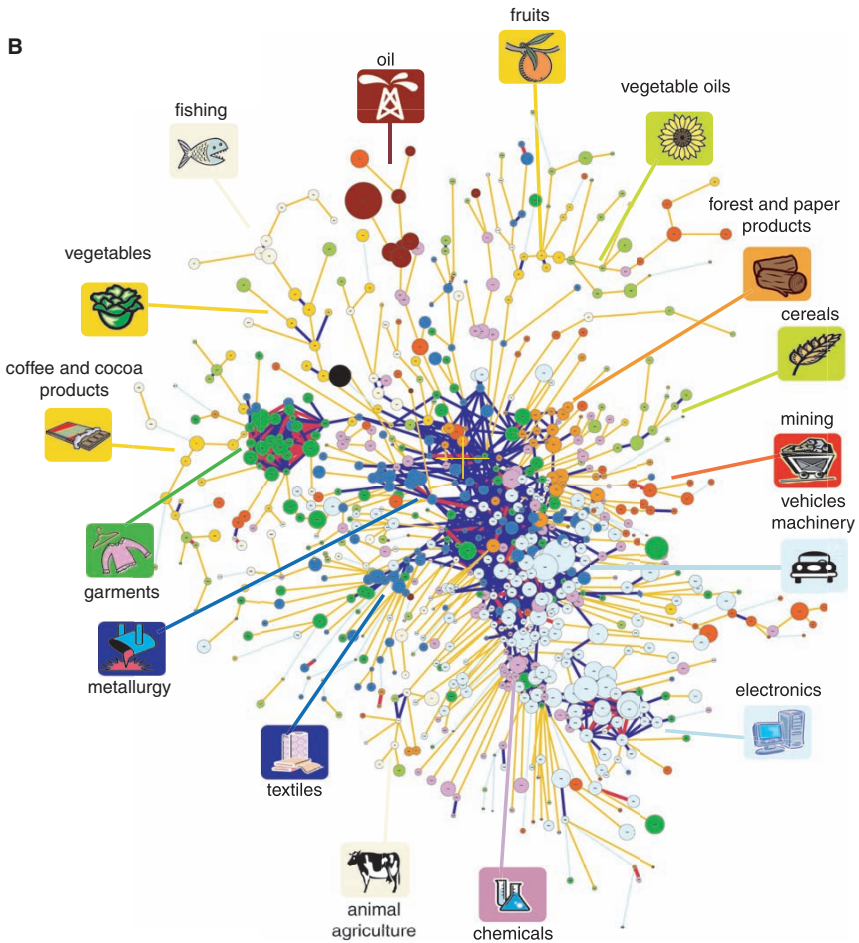
Introduction

- To be sustainable over the long run, growth has to be based on increasing productivity.
- Learning by firms is a key source of productivity improvement.
- A primary task of industrial policy, done well, is to promote learning.
- The $64,000 question: How?

Introduction (cont.)

- Traditional view:
  - Some sectors inherently generate more learning than others.
  - The learning is partly external. Firms under-invest on their own.
  - The government should subsidize/promote activities generating learning externalities.
- Modern incarnation: Hidalgo, Klinger, Barabási and Hausmann (2007) on monkeys and trees.

The Product Space (Hidalgo et al., 2007)

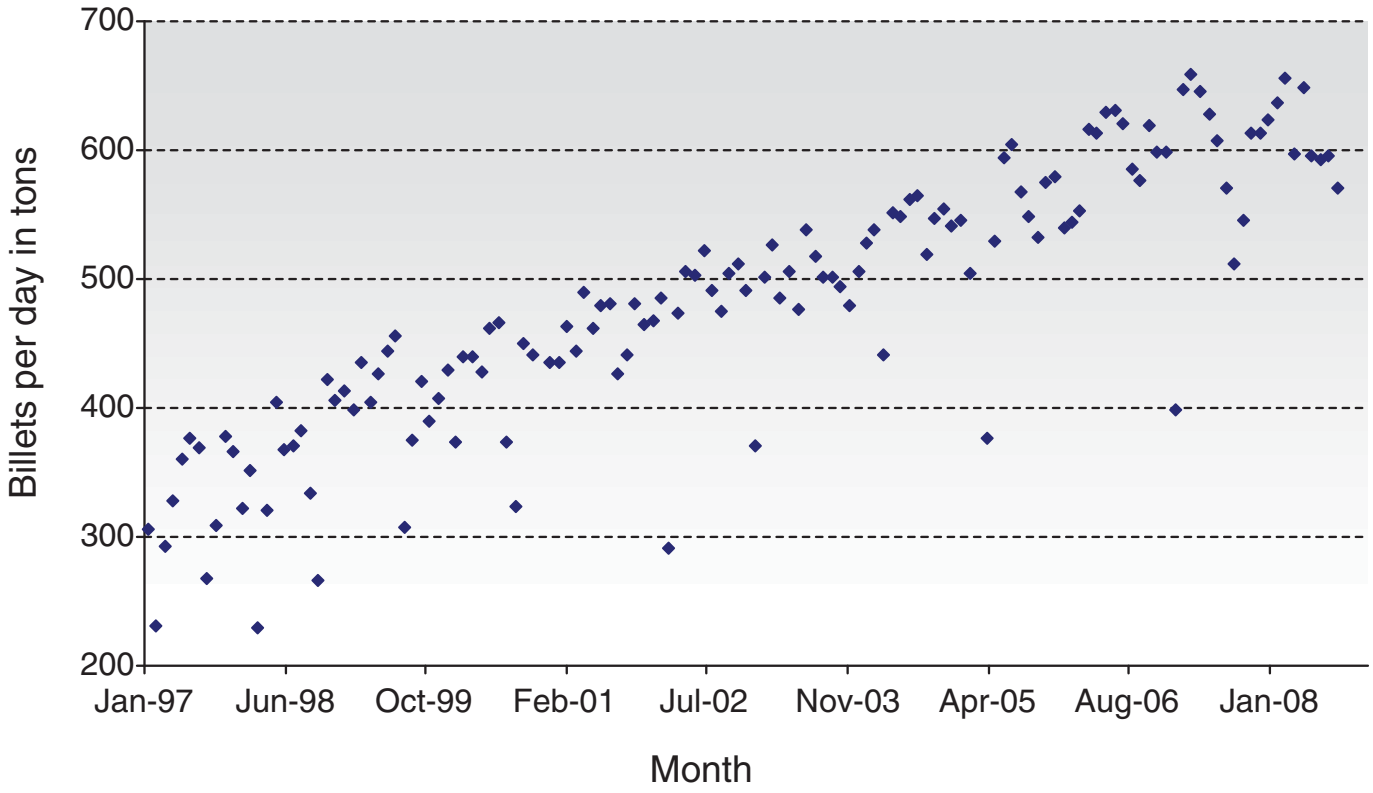


- Goods=trees, entrepreneurs=monkeys. "What trees you have monkeys on today determines where your monkeys will be tomorrow."

Introduction (cont.)

- Both the traditional view and, arguably, the Hausmann et al view see learning as *a function of output in particular sectors*.
- Policy implication: get a steel, or auto, or electronics, or [fill in the blank] sector.
  - Learning will happen pretty much automatically.
- This talk: I will review some recent research on the learning process in firms and argue that the above view is too simple.
  - Learning is not automatic, and we need to think carefully about the circumstances under which it occurs and fails to occur.

Learning Gains (Potentially) Large

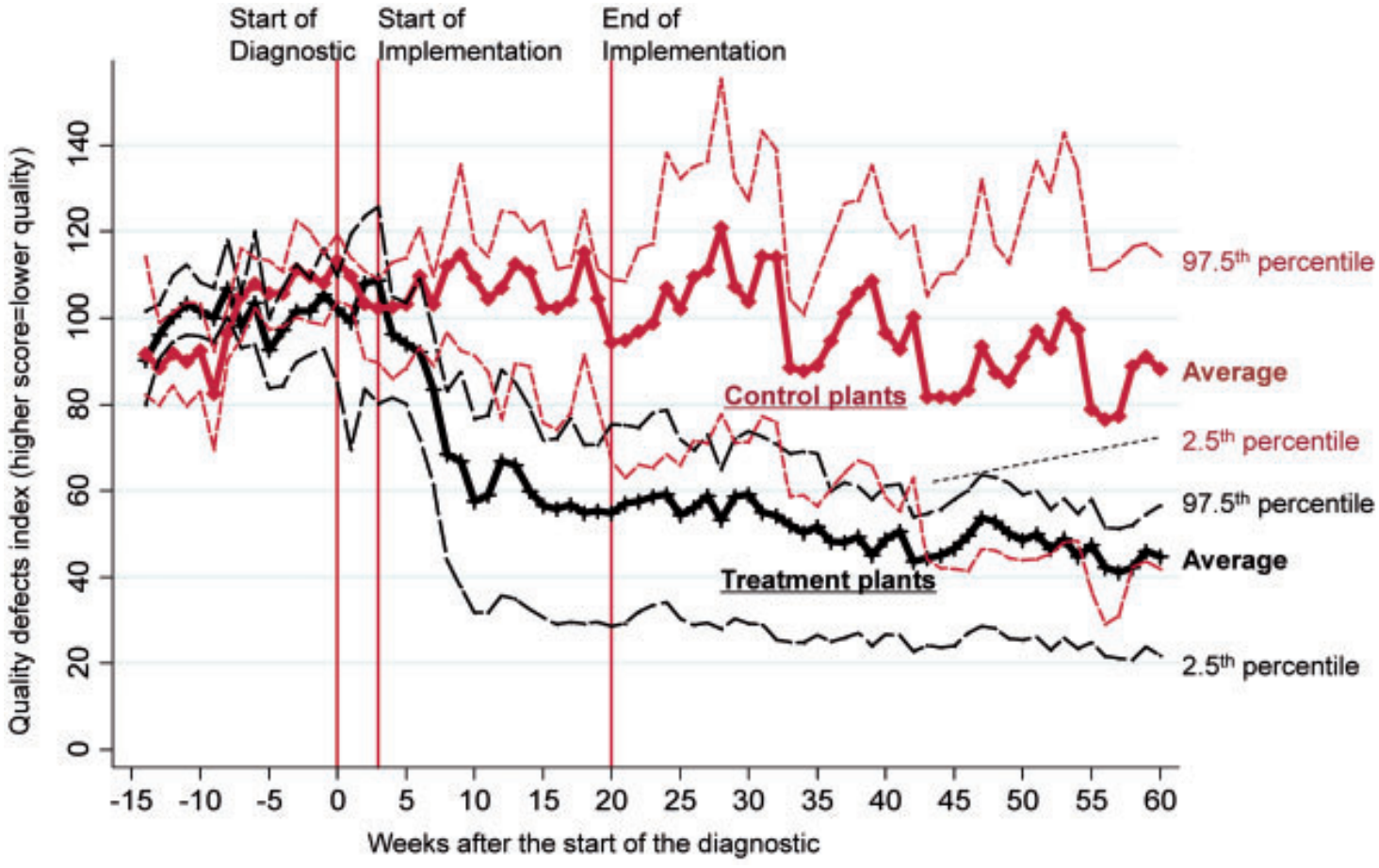


- Hendel and Spiegel (2014): steel mini-mill doubled output over 11 years *with same capital and a familiar technology.*
- Mostly not explained by observables.
- Their story: tweaking/experimentation by workforce.

But They Are Not Always Realized

- Bloom, Eifert, Mahajan, McKenzie and Roberts (2013): Large, mature textile firms in India had not implemented basic management practices (e.g. labelling inventory).

Intensive Consulting Can Help



- But question remains: why hadn't firms adopted basic practices on their own?

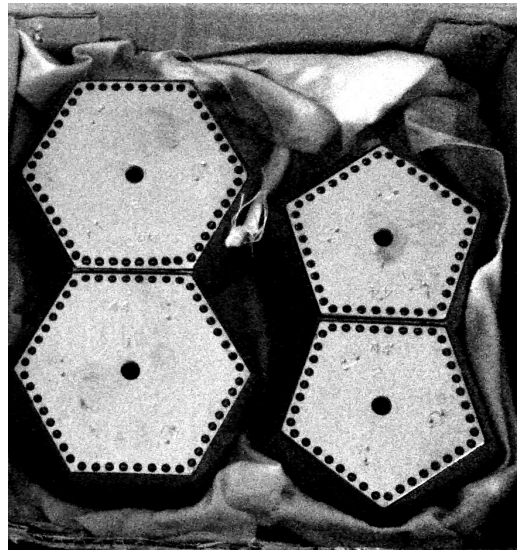
Barrier to Learning: Organizational Frictions

- Atkin, Chaudhry, Chaudry, Khandelwal and Verhoogen (forth.)

Barrier to Learning: Organizational Frictions (cont.)

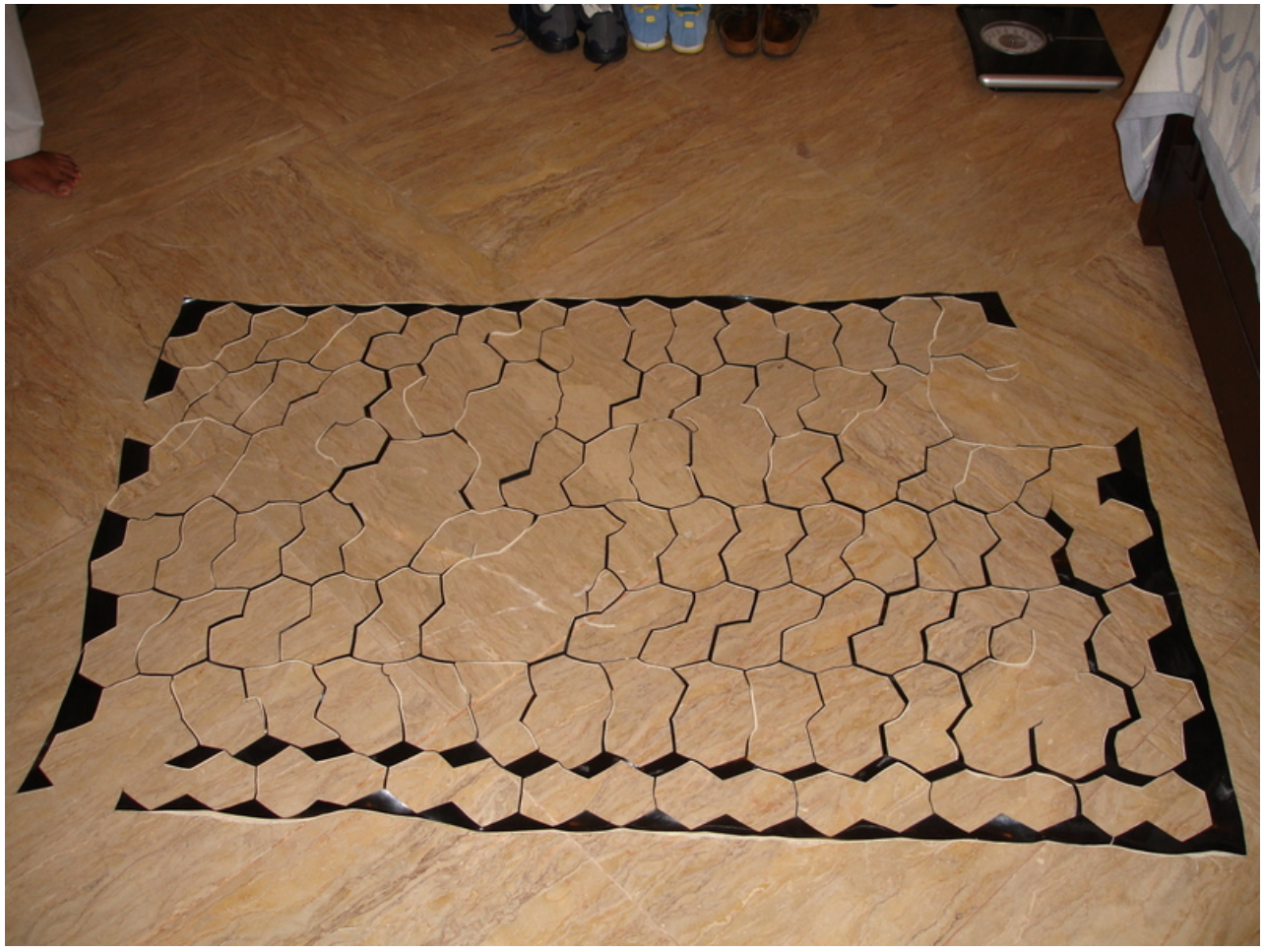
Standard "buckyball" design: 20 hexagons, 12 pentagons.

For standard ball, almost all firms use 2-hexagon and 2-pentagon "flush" dies.



Barrier to Learning: Organizational Frictions (cont.)

Hexagons tessellate. $\sim 8\%$ of rexine wasted.



Barrier to Learning: Organizational Frictions (cont.)

Pentagons don't. $\sim$ 20-24% of rexine wasted.

Barrier to Learning: Organizational Frictions (cont.)

In a YouTube video of a Chinese factory producing the Adidas Jabulani ball, I noticed a different layout of pentagons.

Barrier to Learning: Organizational Frictions (cont.)

I could also have gone to: G. Kuperberg and W. Kuperberg, "Double-Lattice Packings of Convex Bodies in the Plane," *Discrete & Computational Geometry*, 5: 389-397, 1990.

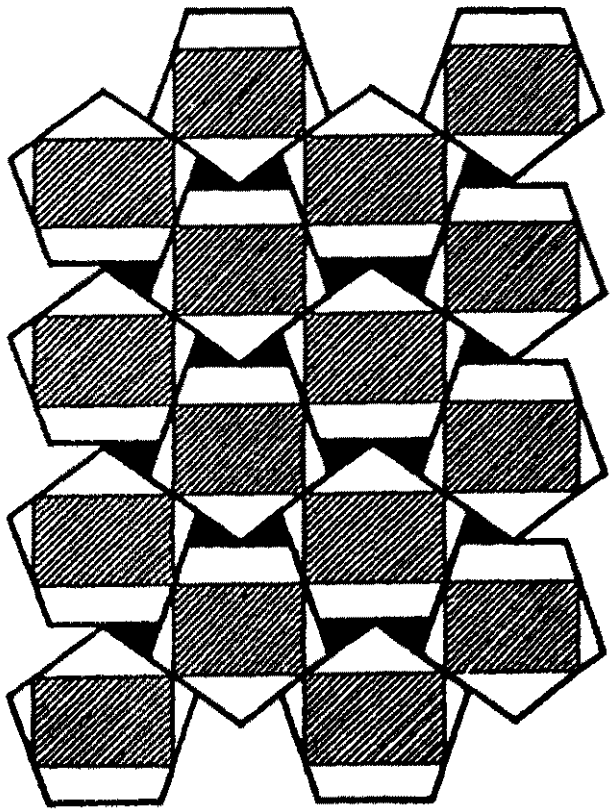
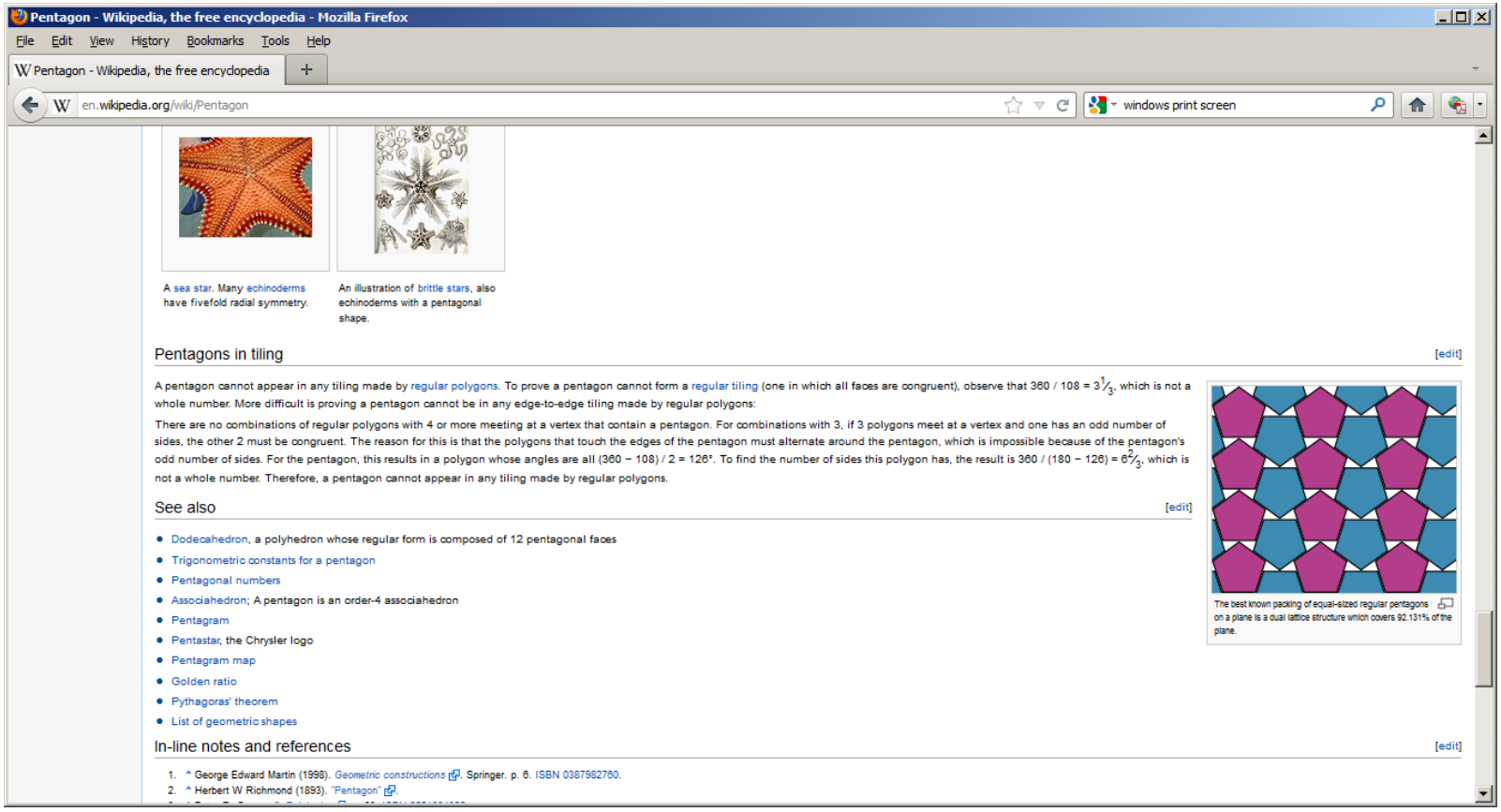


Fig. 7. Maximum density double-lattice packing with regular pentagons.

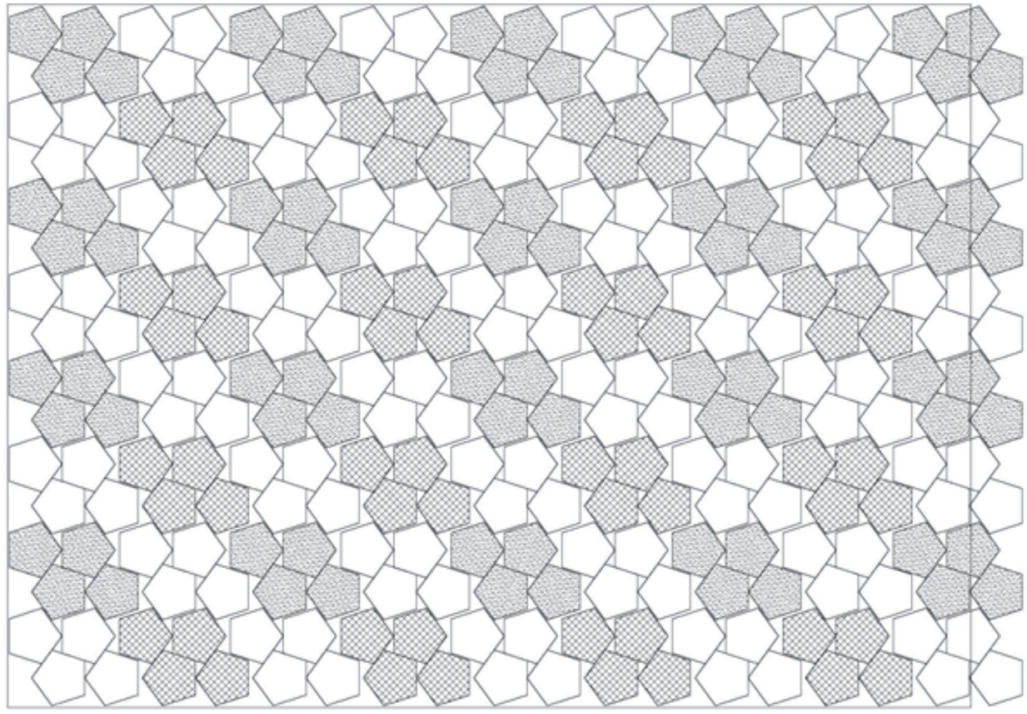
Barrier to Learning: Organizational Frictions (cont.)

Or the Wikipedia Pentagons page:



Barrier to Learning: Organizational Frictions (cont.)

Annalisa Guzzini (an architect, my wife) and I developed a blueprint based on optimal packing.



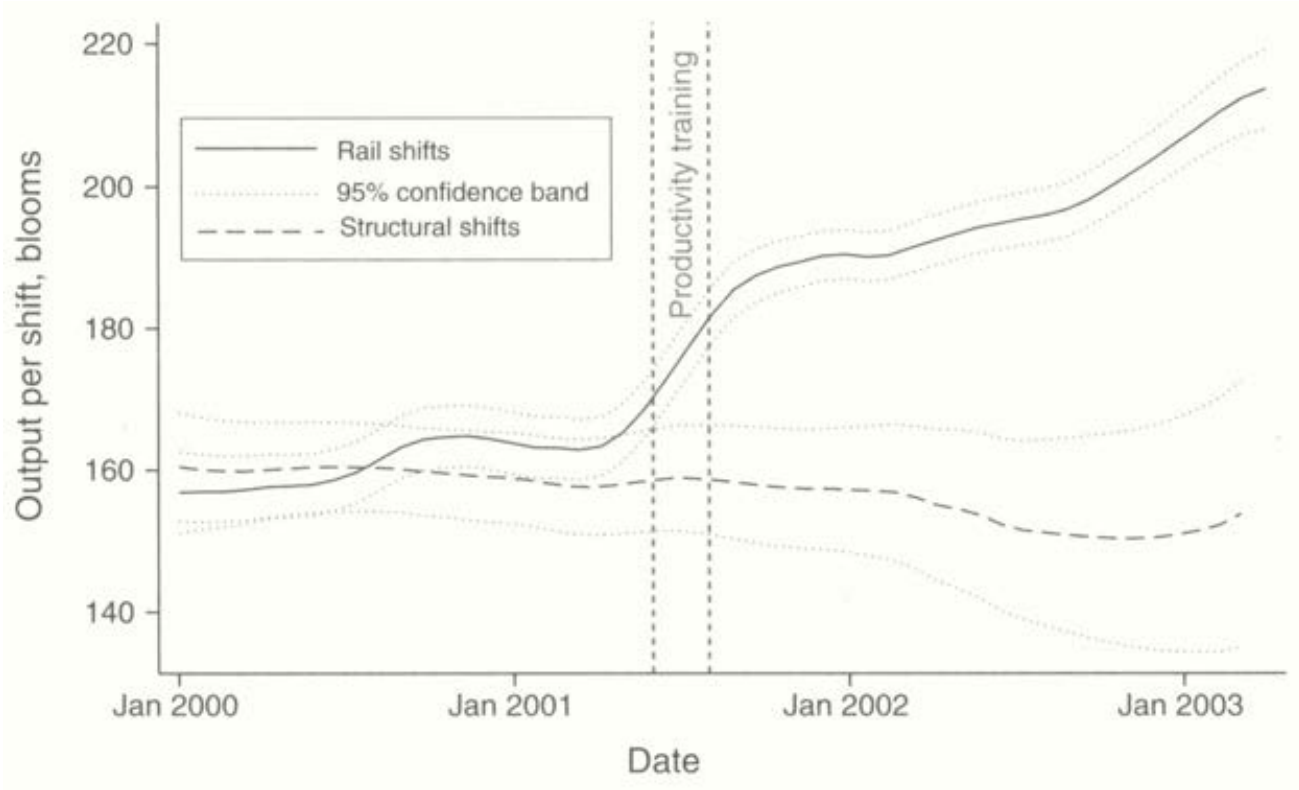
- 44mm-edge pentagons: ∼250 with old die vs. 272 with ours.
- 43.5mm-edge pentagons: ∼258 vs. 280.

Barrier to Learning: Organizational Frictions (cont.)

Barrier to Learning: Organizational Frictions (cont.)

- Quick summary:
  - We gave out the new dies to a random subset of firms.
  - A few adopted, most did not.
  - Cutters didn't like the die.
    - They are paid piece rates, with no incentive to reduce waste, and the new die was slowing them down.
    - They told owners it didn't work.
  - We did a second experiment.
    - Offered bonus of one month's pay to show owners that dies work.
    - Workers accepted and about 50% of affected firms adopted.
- Moral of the story: conflict of interest within the firm can prevent adoption of a "no-brainer" technology.

Competition Can Raise Productivity Within Firms



- Das, Krishna, Lychagin and Somanathan (2013): Bhilai Rail Mill in India, owned by public-sector company, had monopoly.
- Private firm threatened to enter in Nov. 1999 and April 2001.

Exports Stimulate Quality Upgrading and Learning

- Atkin, Khandelwal and Osman (forth.) randomized initial export contacts among Egyptian rug producers.

Exports ⇒ Quality Upgrading and Learning (cont.)

	Control Mean	ITT (1)	TOT (2)
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)

- The initial contacts led firms to improve quality on various dimensions (consistent with previous quasi-experimental research).

Exports ⇒ Quality Upgrading and Learning (cont.)

	Control Mean	ITT (1A)	TOT (1B)
Length Accuracy	-4.51	1.43 ***	2.09 ***
		(0.51)	(0.71)
Width Accuracy	-2.29	0.17	0.25
		(0.29)	(0.41)
Weight Accuracy	-221.0	89.1 ***	131.0 ***
		(20.3)	(29.6)
Time (in minutes)	247.0	-5.67	-8.3
		(6.6)	(9.5)
R-squared		0.84	0.84
Observations		748	748

- The treated firms had better performance than control firms *even for identical-specification rugs.* Productivity improved.

Summary

- Learning is not automatic!
  - Just hosting a sector/activity should not be the goal of industrial policy.
- Factors that appear to support learning in firms:
  - Labor "contracts" that encourage information-sharing.
    - Not clear how policy can bring these about, unfortunately.
  - Competition.
    - Could be in domestic market, from imports, or on export market.
  - Exporting.
    - Exposure to demanding rich-country consumers seems to stimulate productivity improvements as well as quality upgrading.

References I

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