Should "Appropriate Technology" Be Revived?

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Should "appropriate technology" be revived?

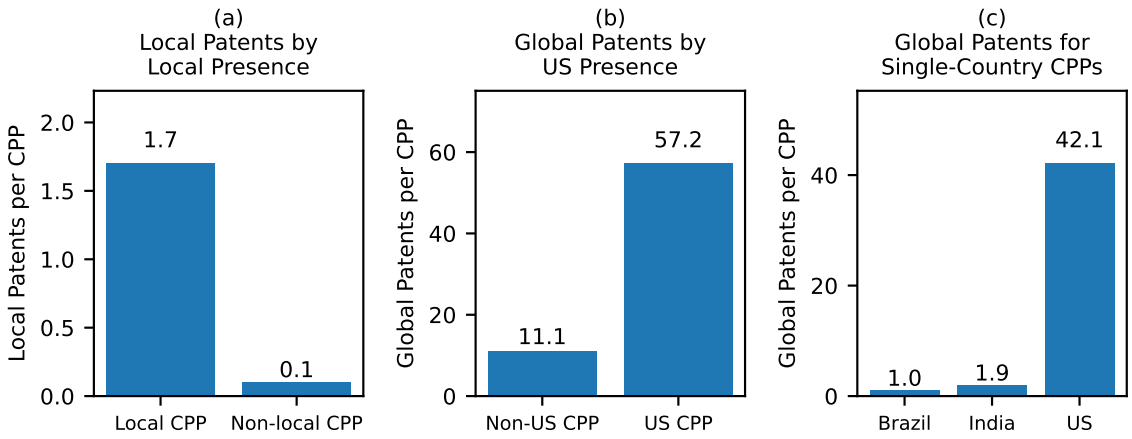
- I have a mixed answer:
  1. Much of the diagnosis in the "appropriate technology" literature still rings true, and deserves renewed attention.
  2. I am less convinced about the proposed policy remedies.

Strengths of "appropriate technology" literature

- A willingness/commitment to examine the technological details of specific industries.
- Important insights (in e.g. Stewart (1972, 1974, 1978)):
  1. Typically only a few, roughly Leontief, technologies are available in a given sector.
     - No continuous choice of techniques.
  2. Choice of technique often bundled with choice of product.
     - Higher-quality products typically require newer, more capital-intensive techniques.
  3. Technological change localized around particular factor combinations (Atkinson and Stiglitz, 1969).
  4. Frontier techniques have been invented in rich countries, and are best suited to conditions there.
- There is growing empirical evidence consistent with these views, especially 4.

Consistent evidence I

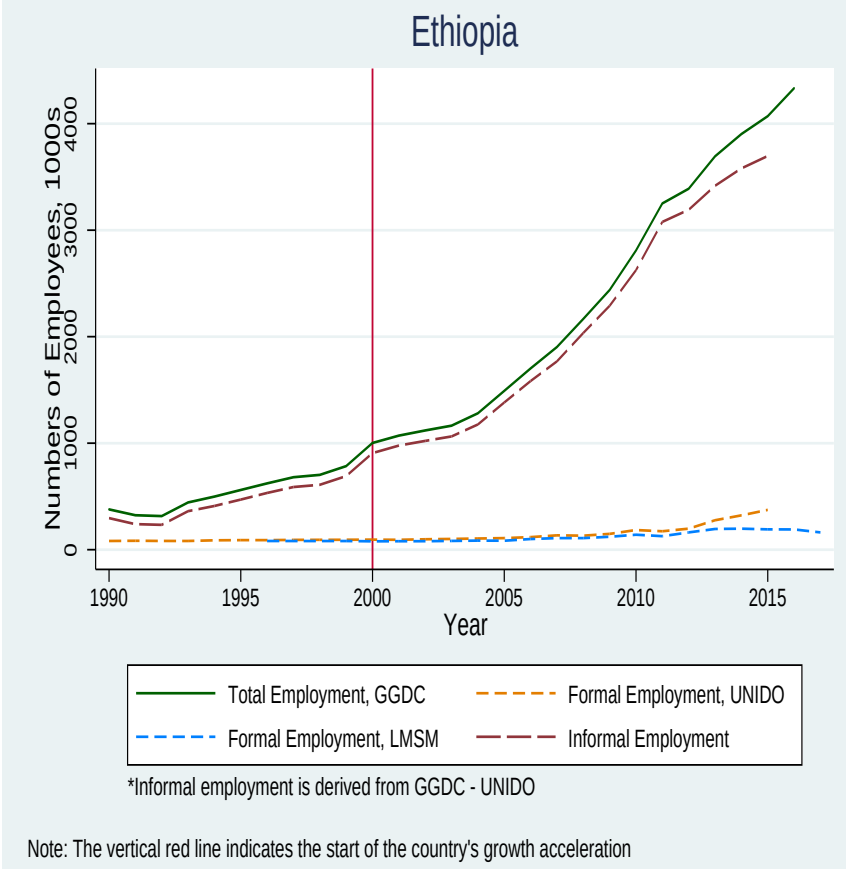
- Evidence from biotechnology to counteract crop pests and pathogens (CPPs) (Moscona and Sastry, 2021)

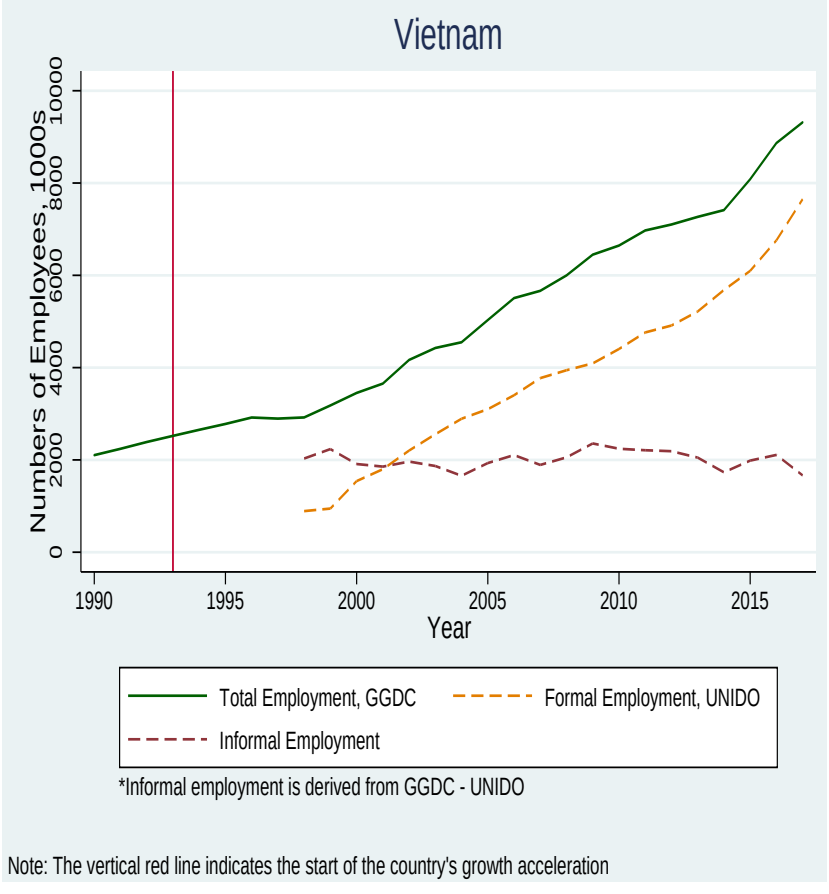


  - Have data on CPPs by country, patents that address them (with country origins), international licensing of varieties.
  - Find:
    - Most patents deal with local CPPs.
    - There are few patents for CPPs not in US, Europe.
    - "CPP distance" negatively associated with transfers of crop varieties, controlling for country and crop effects.
    - "CPP distance" negatively associated with productivity.

Consistent evidence II

- Recent output growth in Africa has not led to large employment increases in larger firms (>10 employees) in manufacturing (Diao, Ellis, McMillan and Rodrik, 2021)





Consistent evidence III

- Exporting ↑ ⇒ Within-firm wage inequality ↑ (Frías, Kaplan and Verhoogen, 2012)

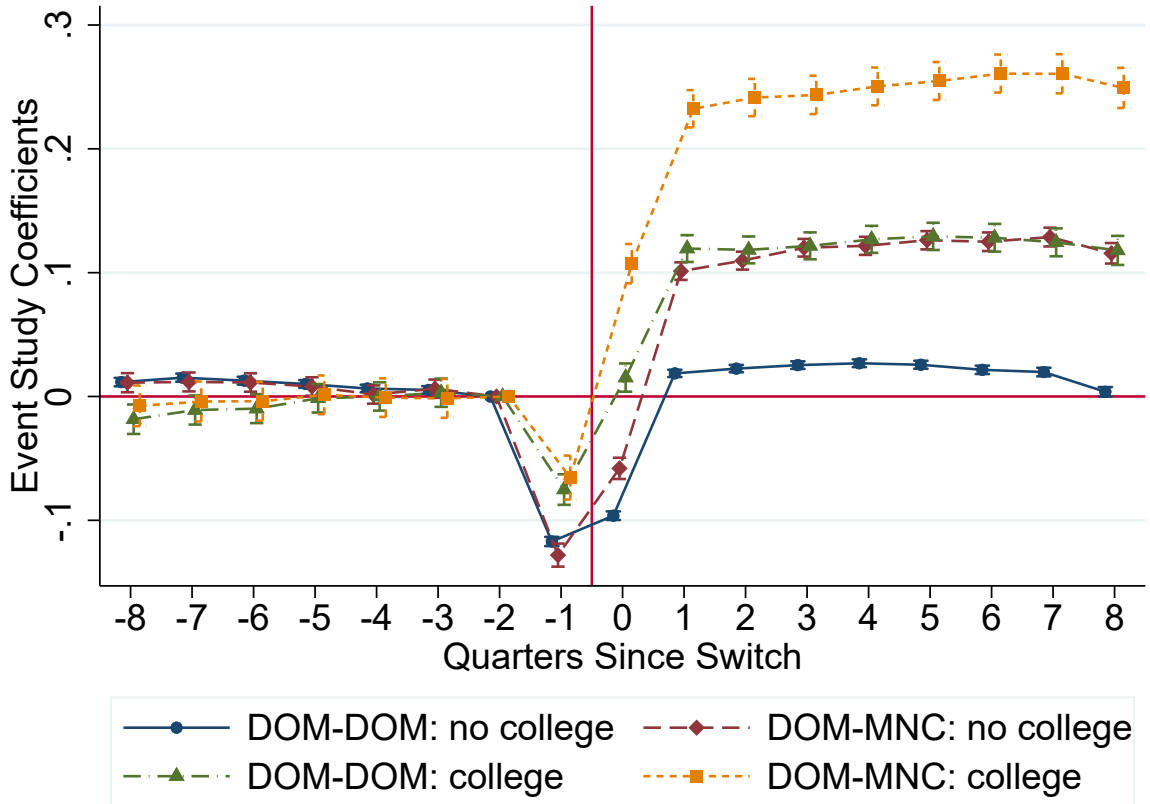
TABLE 2——CHANGES IN WAGE OUTCOMES

	Δlog mean hourly wage (EIA) (1)	Δmean log daily wage (IMSS) (2)	Δ quantiles of within-firm log wage distribution 10th (3)	25th (4)	50th (5)	75th (6)	90th (7)	Δexport share (8)
Panel C. Reduced form and first stage								
init. log emp. × $T_{93–97}$	0.032***	0.048***	−0.001	0.030***	0.048***	0.065***	0.065***	0.012***
	(0.010)	(0.007)	(0.008)	(0.009)	(0.009)	(0.010)	(0.012)	(0.004)
initial log emp.	0.016	0.021***	0.037***	0.029***	0.022**	0.015	0.024*	0.004
	(0.006)	(0.005)	(0.005)	(0.006)	(0.006)	(0.006)	(0.008)	(0.002)
Panel D. IV								
Δ export share	2.647**	3.928***	-0.058	2.455**	3.965***	5.296***	5.333***	
	(1.227)	(1.443)	(0.639)	(1.113)	(1.532)	(1.945)	(2.026)	
initial log emp.	0.006	0.007	0.037***	0.021*	0.007	−0.004	0.004	
	(0.012)	(0.014)	(0.007)	(0.011)	(0.015)	(0.019)	(0.020)	

Notes: All regressions have $N = 5{,}062$ and include six-digit industry-year effects and region (state)-year effects. Export share is fraction of total sales derived from exports. Exporter indicator takes the value 1 if export share is greater than zero, and 0 otherwise. Changes are for periods 1993–1997 or 1997–2001; initial log employment refers to employment as reported in IMSS data in first year of period (1993 or 1997). $T_{93–97}$ is indicator variable that takes the value 1 for 1993–1997 period, 0 for 1997–2001. Robust standard errors in parentheses.

Consistent evidence IV

- MNC wage premium greater for college-educated workers (Alfaro-Ureña, Manelici and Vasquez, 2021)



- More work needs to be done to track technology choices in manufacturing, but technological "mismatch" seems likely to play a role in these employment and wage patterns.

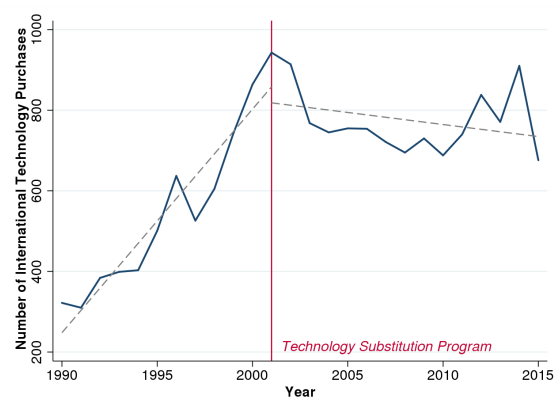
What is to be done?

- Broad types of policy proposals that have emanated from "appropriate technology" literature:
  1. Encouragement for LDC firms to use more labor-intensive technologies, from existing sets of technologies.
  2. Encouragement for development of new, more labor-intensive technologies appropriate to LDCs.
- I have concerns about both.

Concerns I

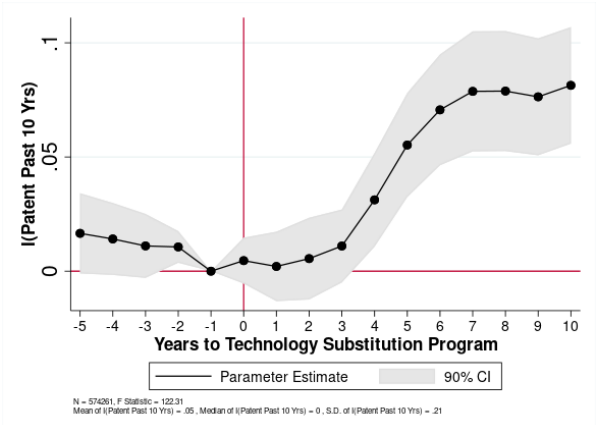
- Using more labor-intensive technologies may carry a short-term, static, productivity cost.
  - Nice recent evidence from Brazil (de Souza, 2021):

(a) Int. Technology Lease



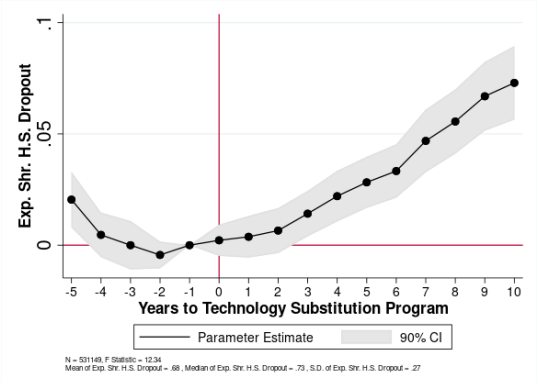
Tax on int'l licenses $\Rightarrow$ fewer licenses

(a) I(Patent Past 10 Yrs.)



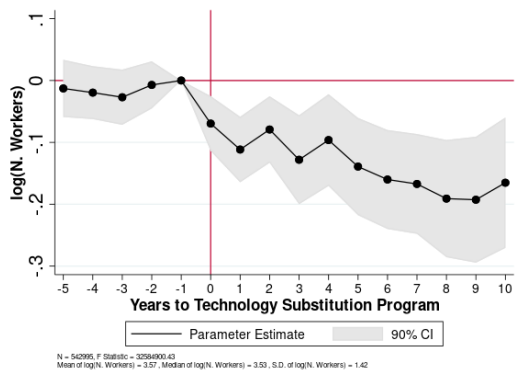
$\Rightarrow$ more domestic patents

(a) Exp. Shr. H.S. Dropout



$\Rightarrow$ less-skilled workforce

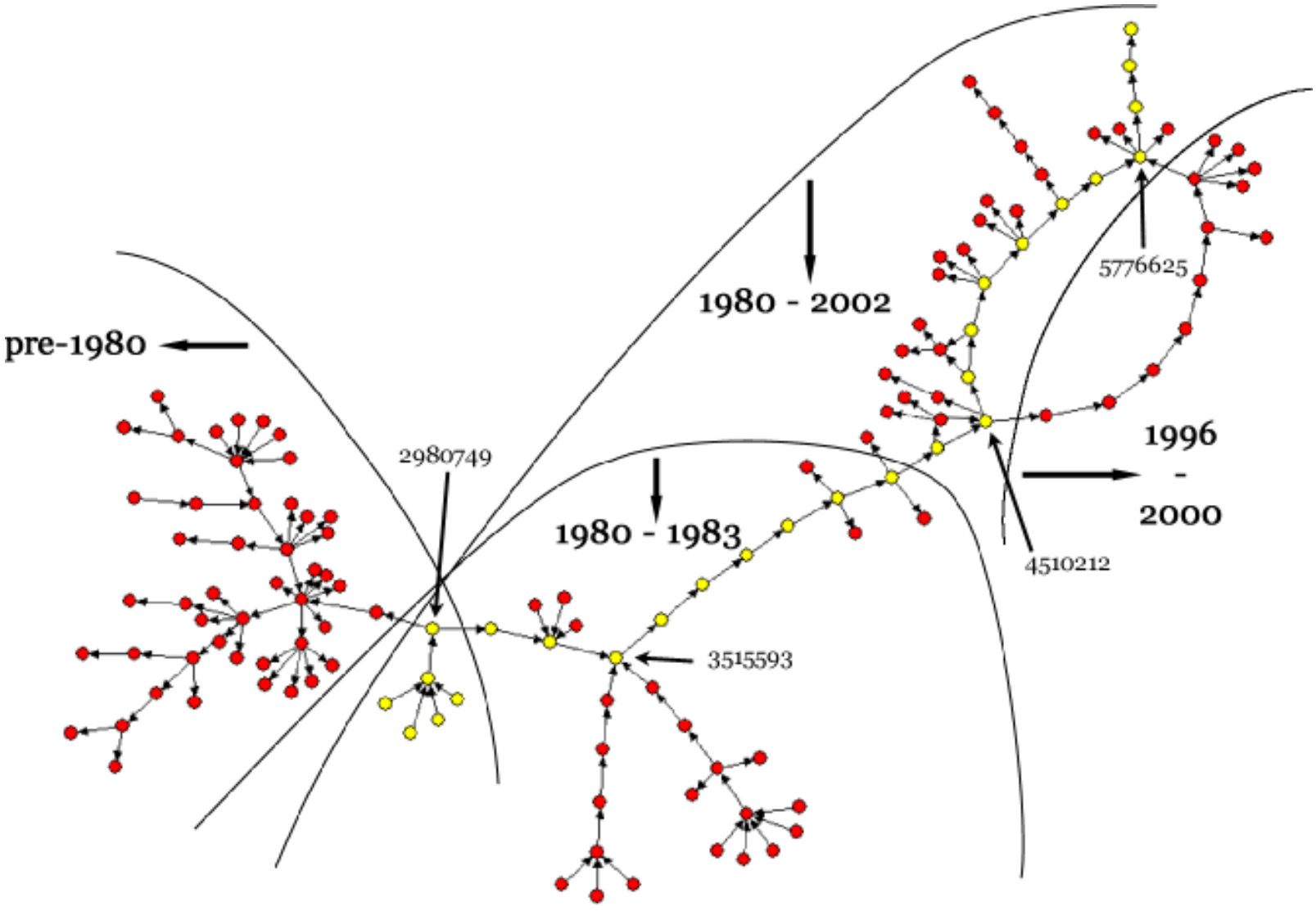
(a) log(N. Workers)



$\Rightarrow$ *lower* employment overall

Concerns II

- Technologies evolve along "trajectories" (Dosi, 1982).
  - Visualization from patents for fuel cells (Verspagen, 2007):



Concerns II (cont.)

- Coming up with an "appropriate" technological *trajectory* is not a one-shot process.
  - Trajectories involve lots of incremental steps, often by firms competing to push the frontier.
- Paths are endogenous; firms build on what has come before.
  - Very much in spirit of appropriate technology literature.
- Publicly funded R&D seems unlikely to be able to sustain an entire trajectory.
  - There are exceptions:
    - Agriculture (green revolution technologies).
    - Vaccines (e.g. through advance market commitments).
  - But would require massive investments of resources, political capital.
- In absence of such investments, I worry about encouraging industries into dead ends, or branches that are forever behind the frontier.

An anecdote: story of Midea Group

- 1968: Founded as township enterprise near Guangzhou, making bottle lids.
- 1980: Electric fans.
- 1985: Air conditioners.
- 1990: Started producing for Toshiba.
- 1993: Rice cookers.
- 1998: Purchased Toshiba AC compressor factory.
- 2001: Dishwashers, water dispensers.
- 2004: Joint venture with Toshiba.
- 2005: Vacuum cleaners.

  ... overseas expansion ...

- 2016: Purchased Toshiba's appliances business ($\sim$\$.5b) and Kuka robots ($\sim$\$5b).
- 2021: 288th on Global Fortune 500 list, revenue $>$\$40bn, $\sim$150k employees. Largest global producer of appliances.

- Company strategy has been to get to the global technology frontier for each new product as quickly as possible.

Closing thoughts

- I come back to the idea that policy should aim at promoting activities that generate learning, which tends to spill over.
  - These may not be the most unskilled-labor-intensive.
- The long-run gains would seem to outweigh the short-run lack of labor absorption.

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