

The Returns to Public Investment in Human Capital and Infrastructure

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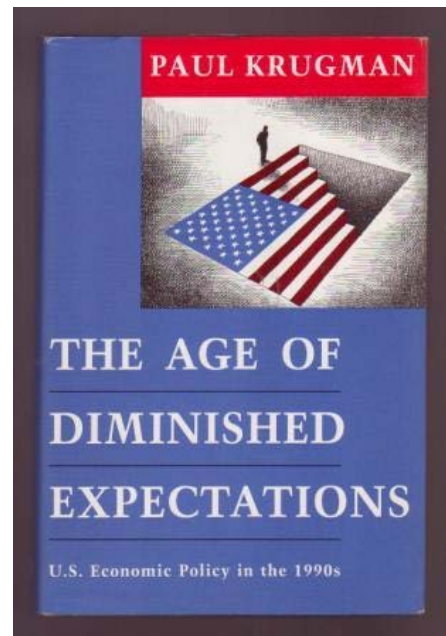
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Productivity is the long-run driver of economic growth

“Productivity isn’t everything. But in the long run, it is almost everything.”

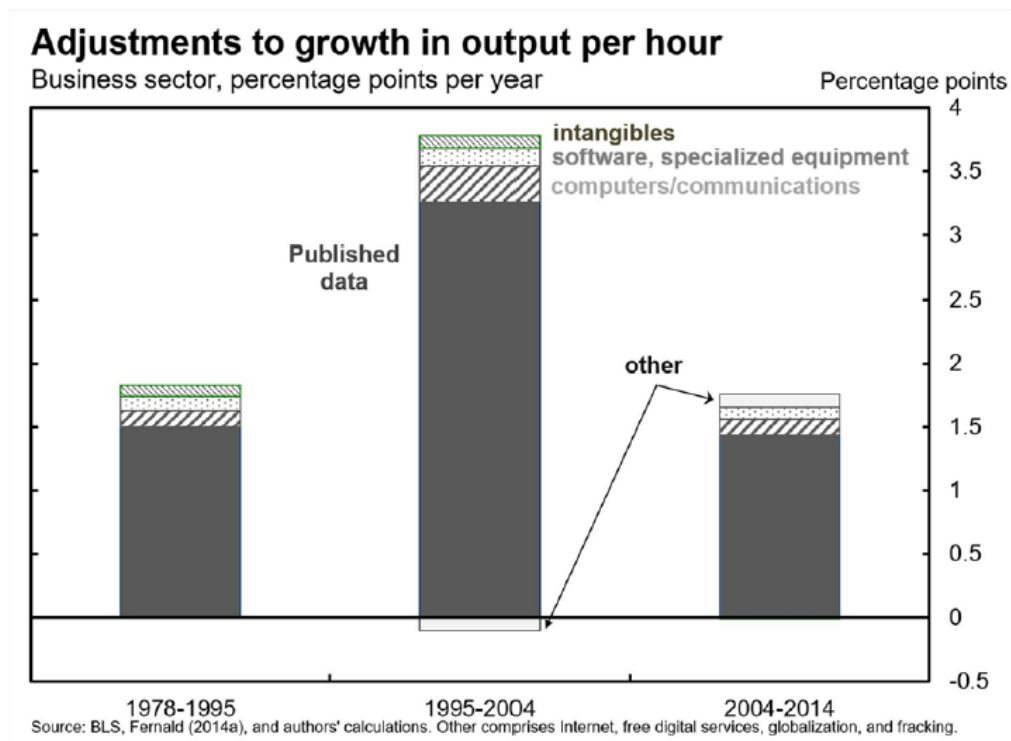


Paul Krugman,
Nobel Laureate in Economics

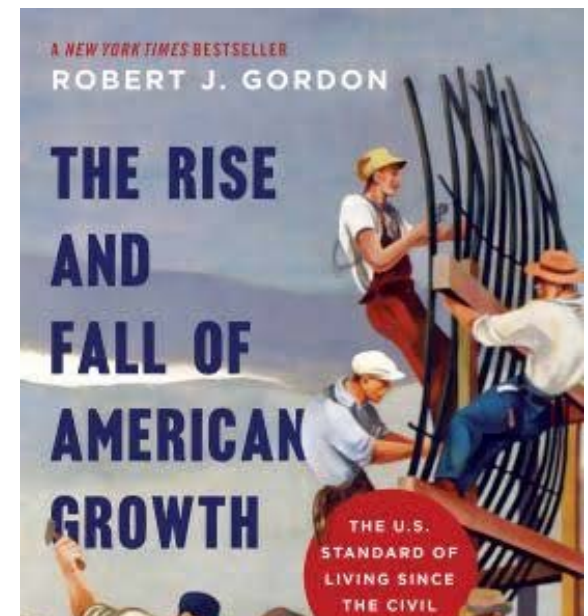


Economist Bob Gordon predicts the current productivity slowdown could persist into the indefinite future

Figure 1: Published and adjusted U.S. labor productivity



Robert J. Gordon, Professor
Northwestern University



Growth in human capital has slowed sharply in recent decades, holding back productivity growth

$$\dot{Y} - \dot{H} = \sum_j^J \alpha_j^k (\dot{K}_j - \dot{H}) + \alpha^L \dot{q} + MFP$$

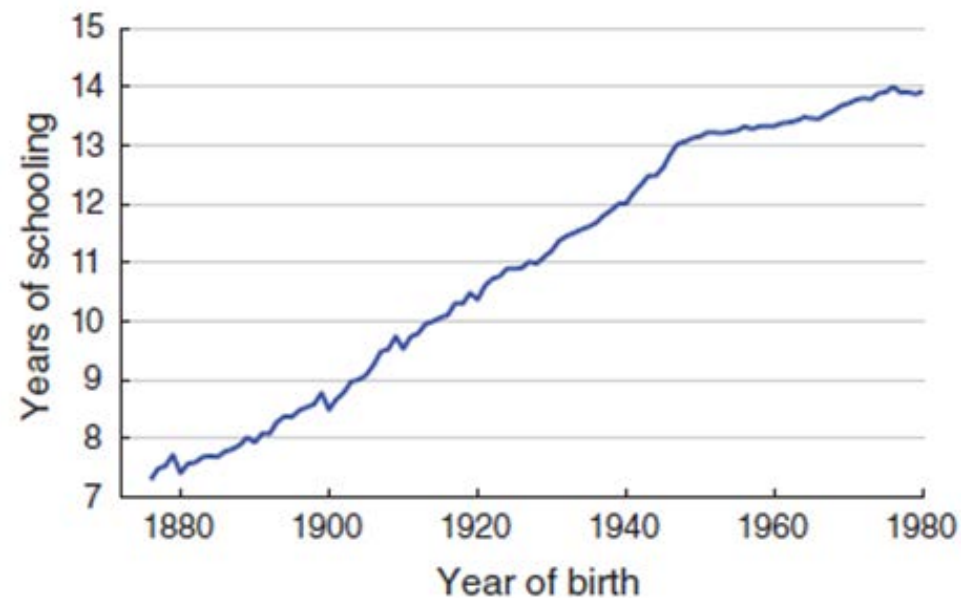
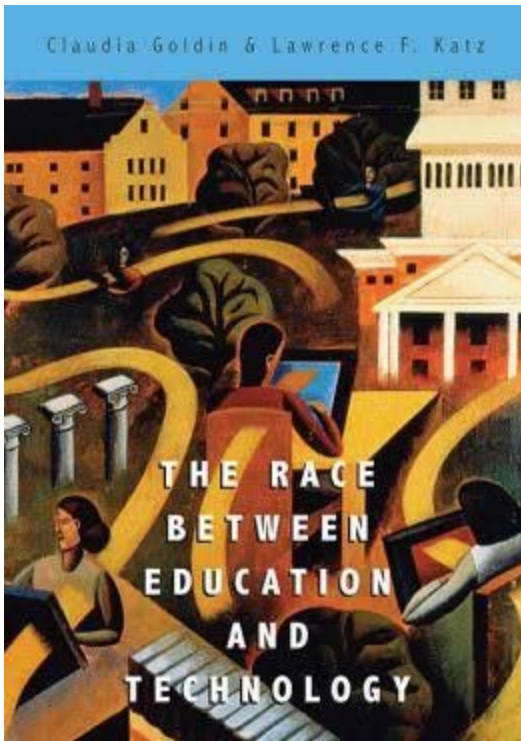


FIGURE 3. EDUCATIONAL ATTAINMENT BY BIRTH COHORT

Source: Goldin and Katz (2008).

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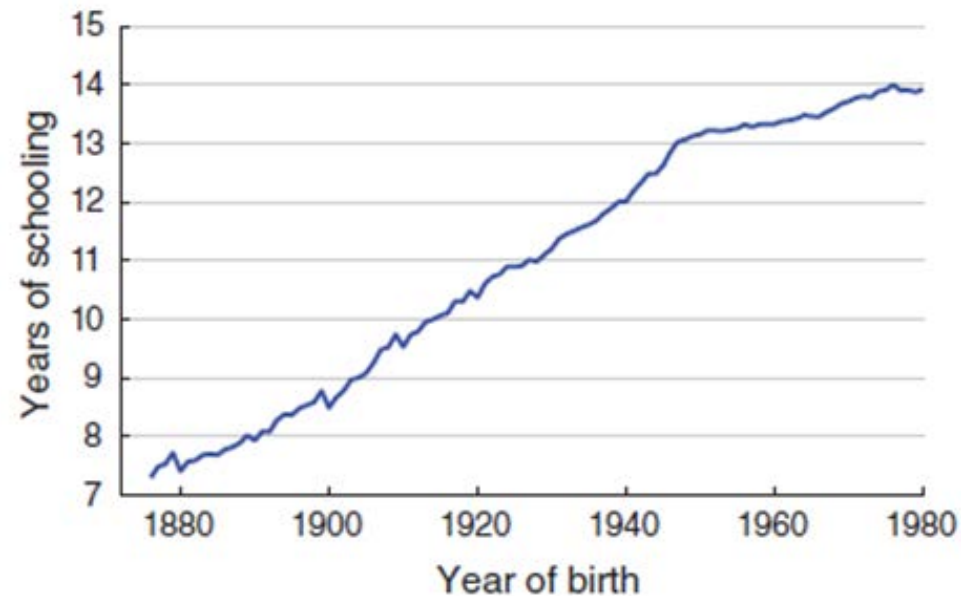
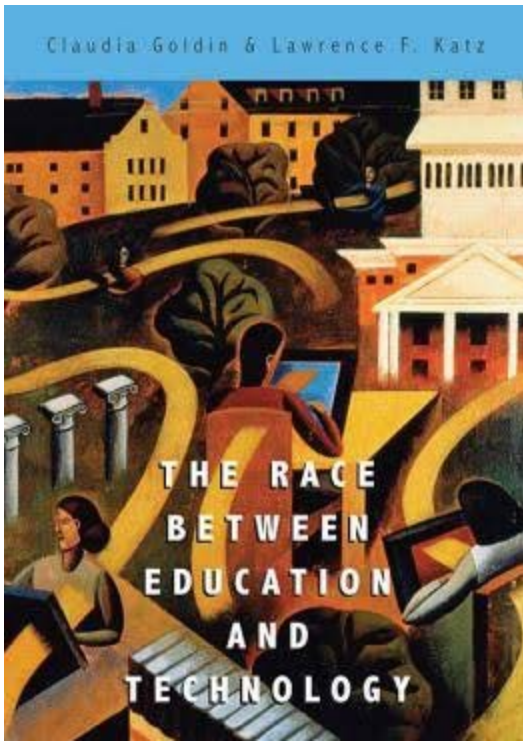


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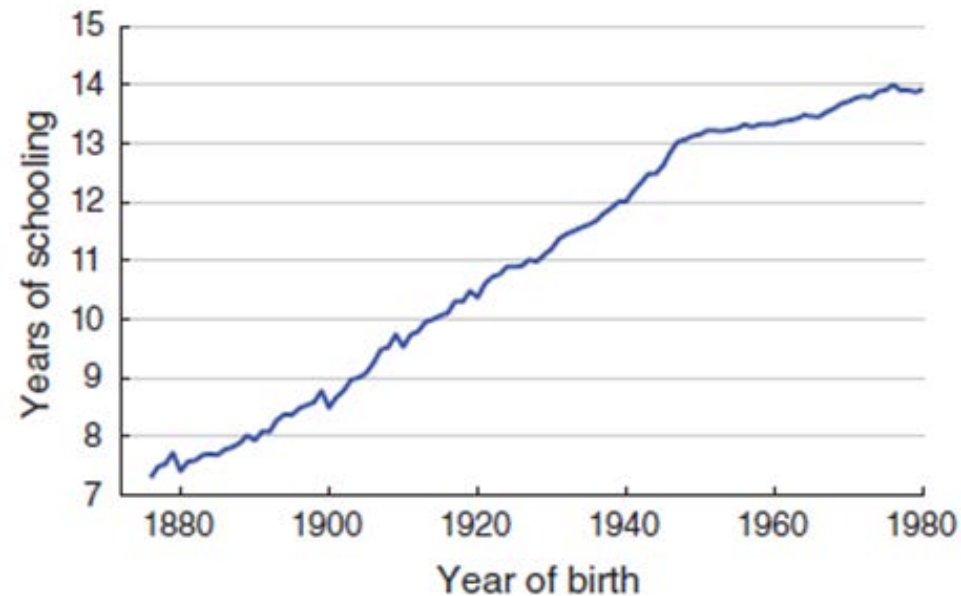
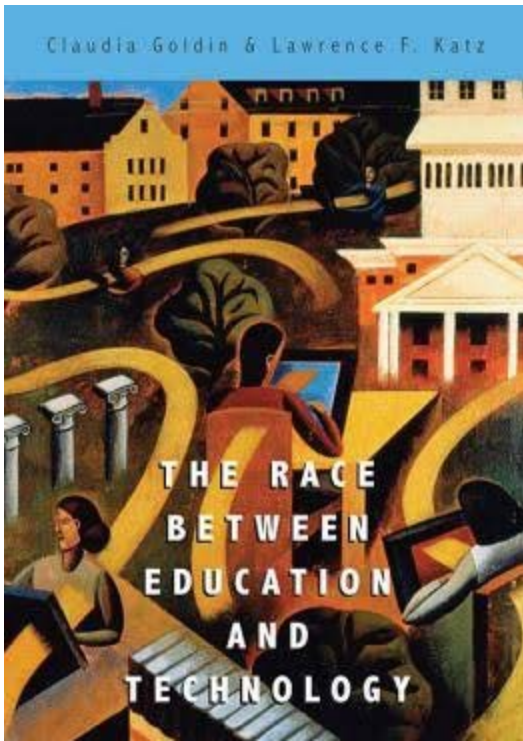


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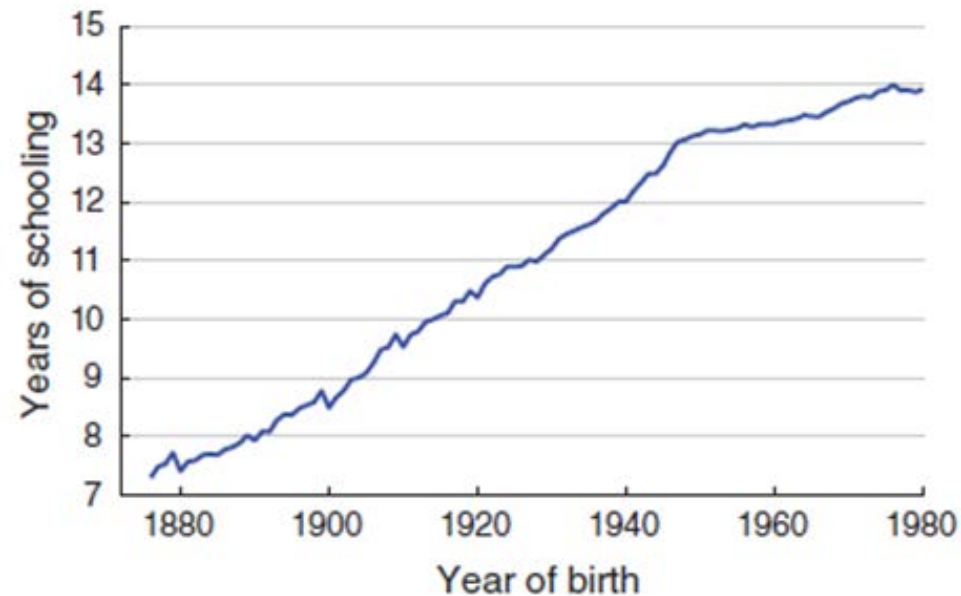
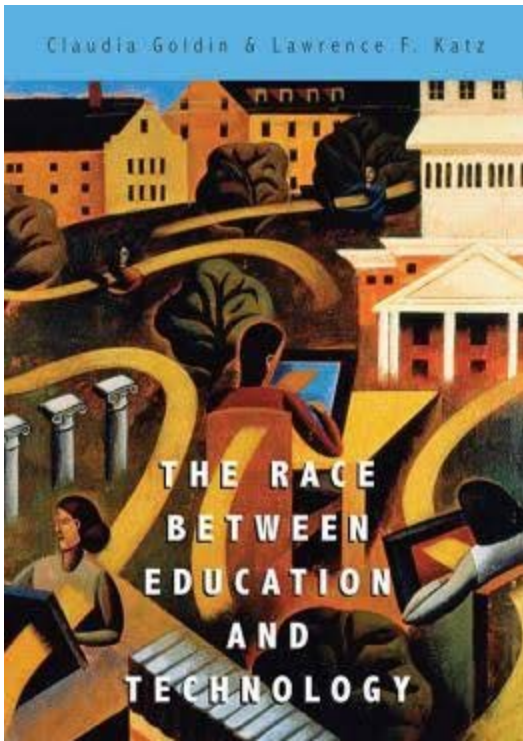


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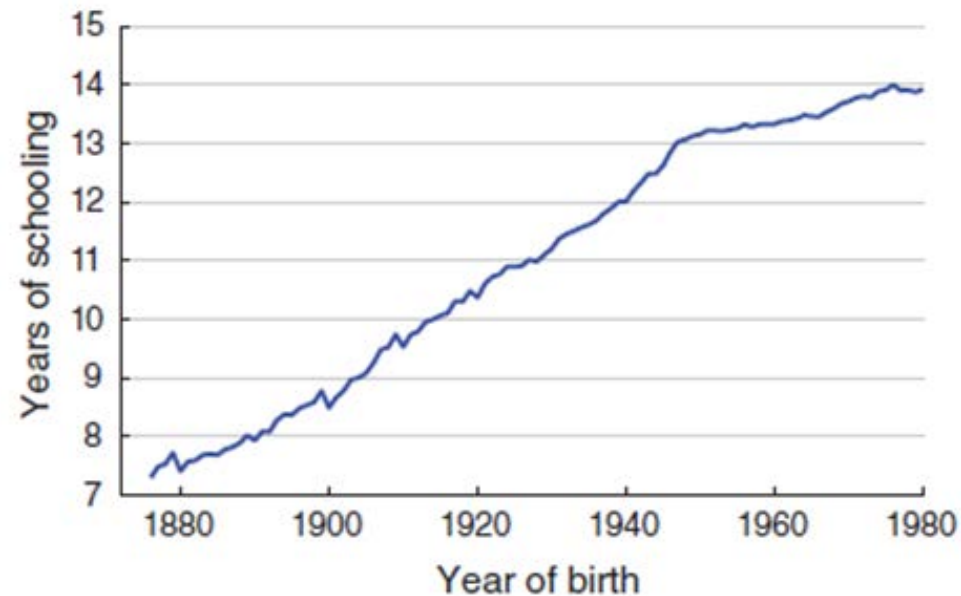
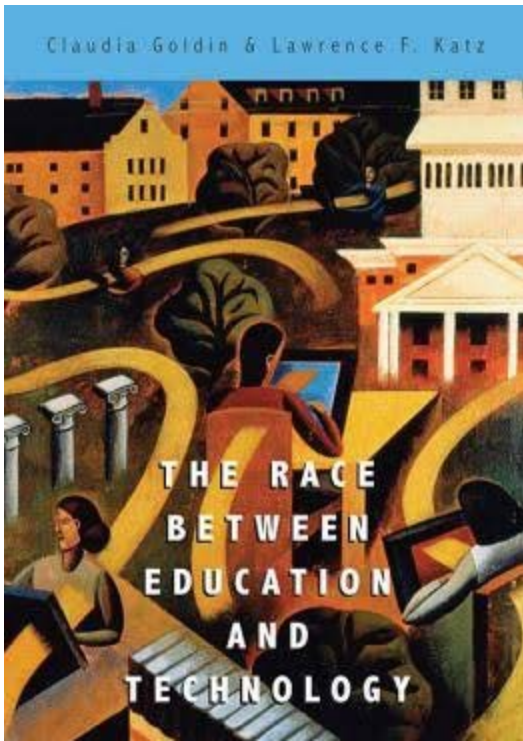


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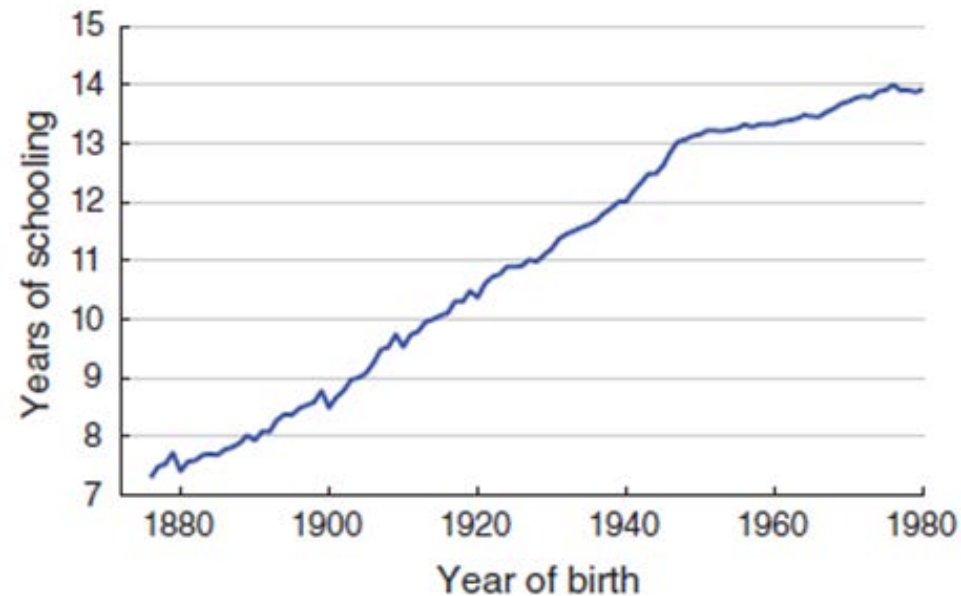
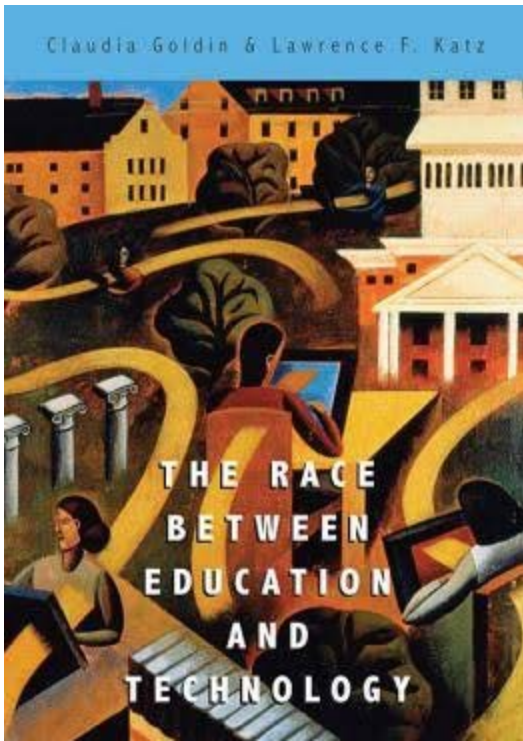
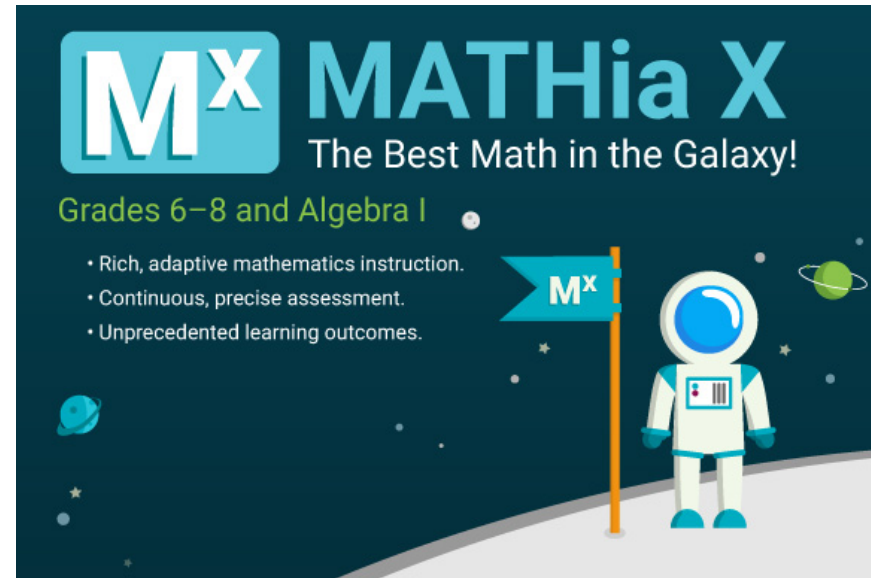


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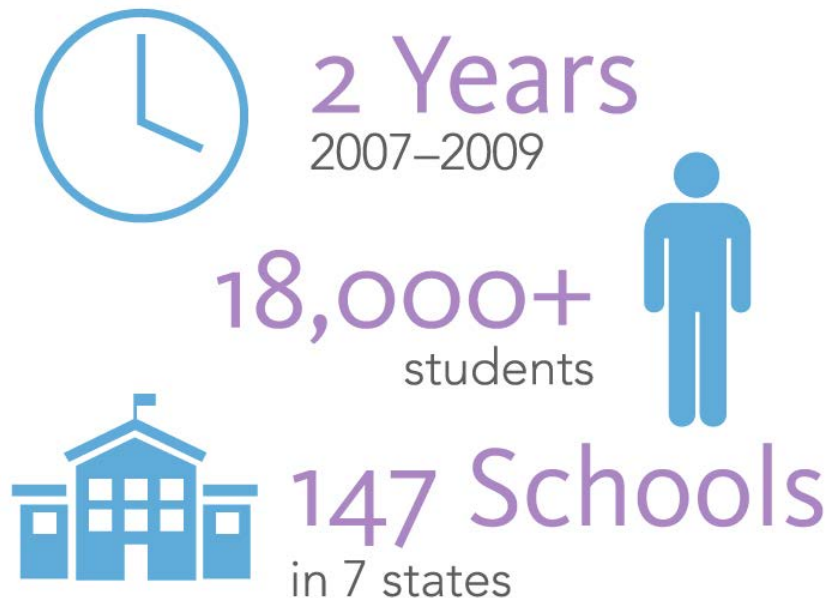
The federal role in human capital accumulation – limited but important

- K-12 education is (mostly) a state and local gov't responsibility.
- Federal investment is focused on graduate training in STEM fields.
- Professors Stephan and Freeman will devote their remarks to the challenges that arise in measuring the returns to these investments.
- But federally funded *research* could lead to breakthroughs in the *technology* of K-12 education.

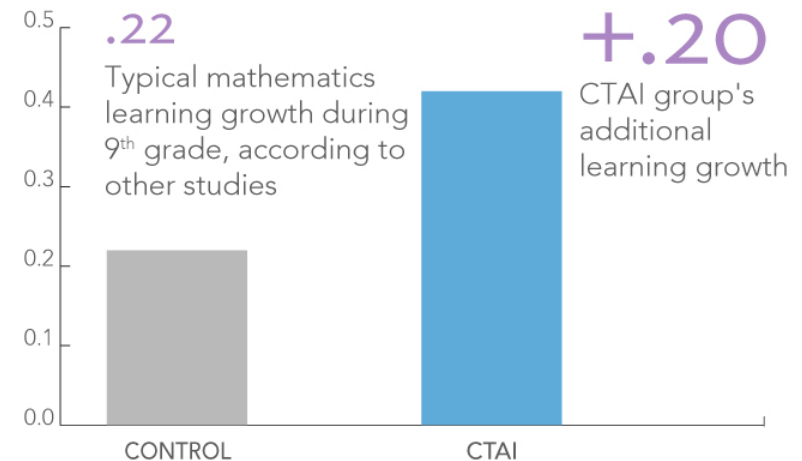


Recent innovations hold out the possibility of an e-learning revolution

Scope of Study



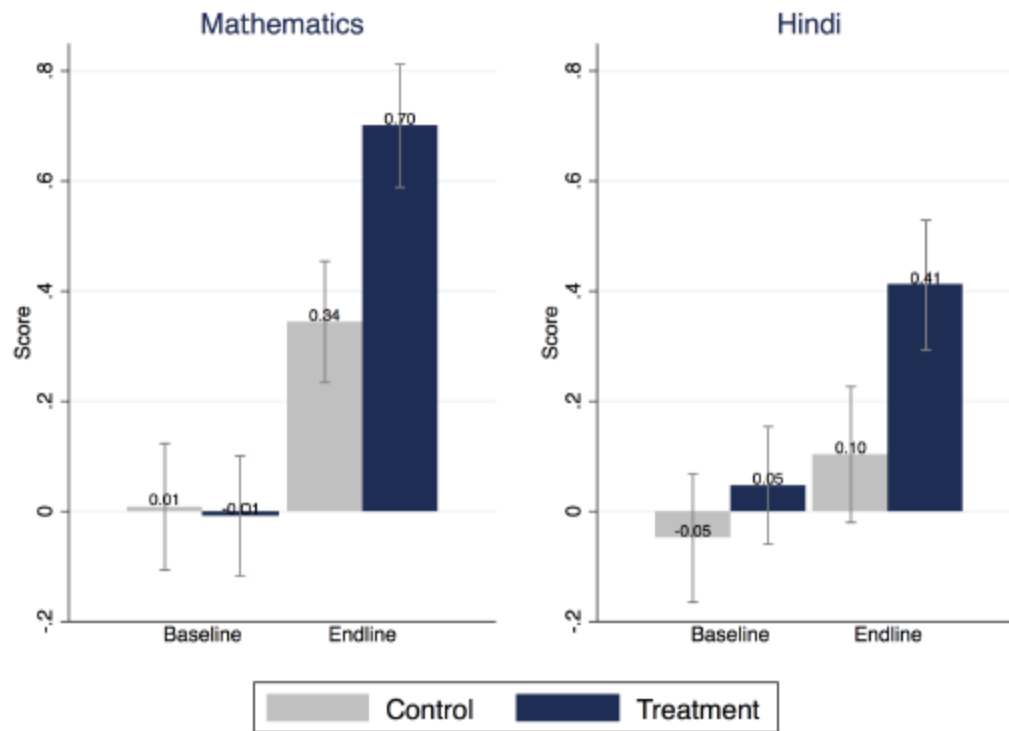
The Effect Is Large Enough to be Educationally Meaningful



Source: RAND Corporation

Other evidence points to the transformative potential of cognitive tutors

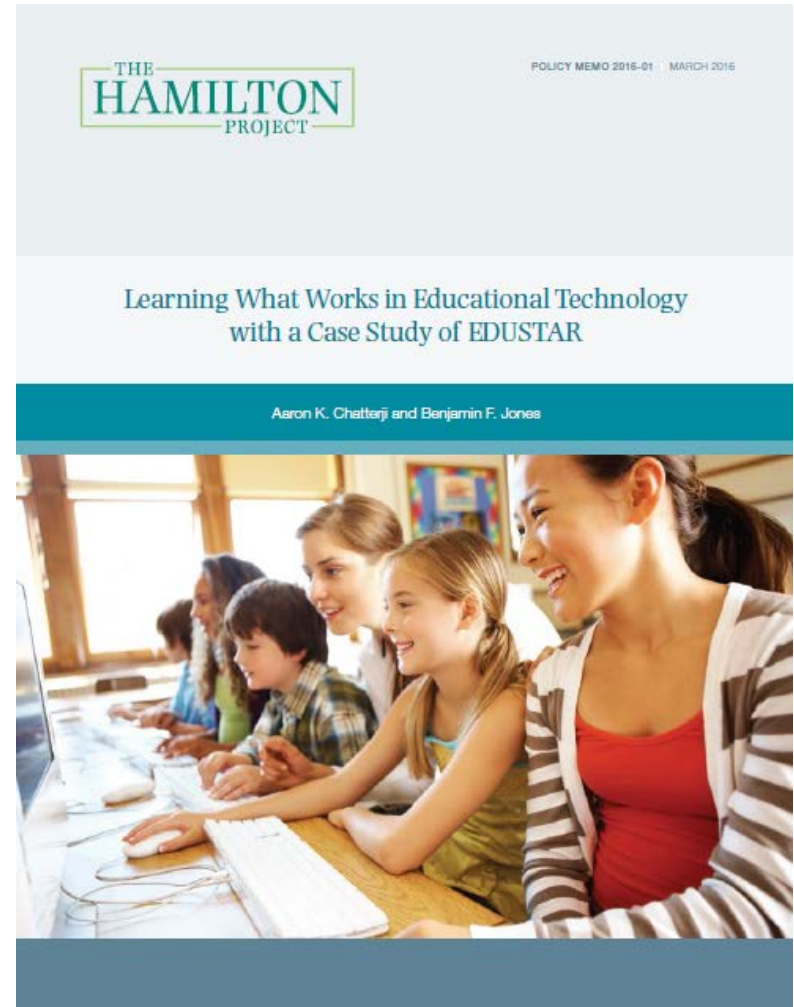
- Muralidharan et al. (2016) find strong experimental evidence that these technologies raise student learning in India.
- This study suggests that 90 days of participation in technology-aided after school programs raises test scores by 0.59σ in math and 0.36σ in Hindi.
- These programs cost roughly U.S. \$3 per student per month.



Muralidharan et al. (2016)

The federal government (or private foundations) could help certify useful products

- How is the local Superintendent supposed to evaluate the efficacy of digital learning activities (DLAs)?
- The FDA evaluates the results of rigorous RCTs and certifies safe and effective drugs and medical devices.
- The DOE could perform this function in the realm of education.
- So could a private organization like EDUSTAR



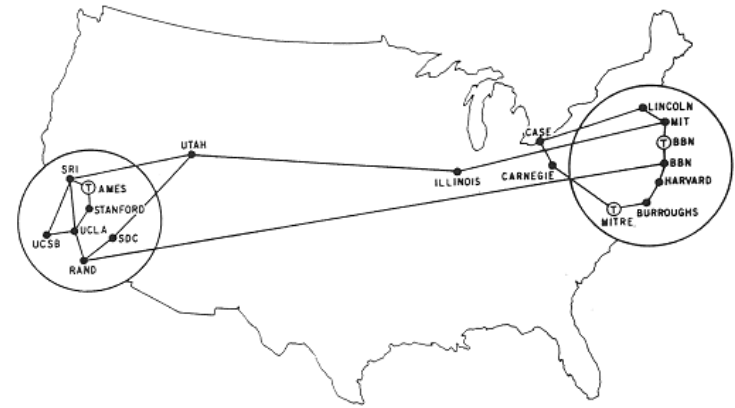
Could a federal infrastructure investment surge lift growth and productivity?

- Experts affiliated with both parties have called for a large infrastructure investment program in the United States.
- On the campaign trail, Donald Trump suggested a trillion dollar infrastructure investment program.
- Could an infrastructure investment program lift growth and productivity?

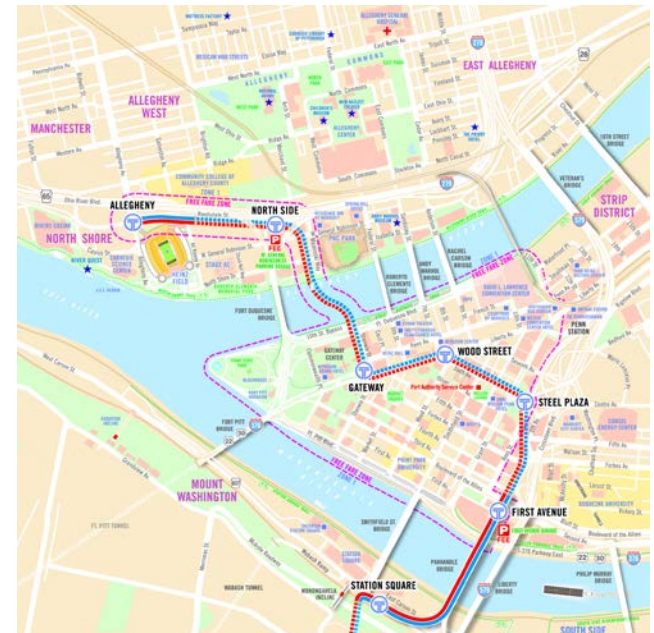


It really depends on what federal investments are made...

- It turns out that the social returns to infrastructure projects vary enormously.
- Investment in ARPANET led to a rewiring of the entire global economy.
- On the other hand, many ill-conceived public works programs have cost more than the benefits they have delivered.



MAP 4 September 1971



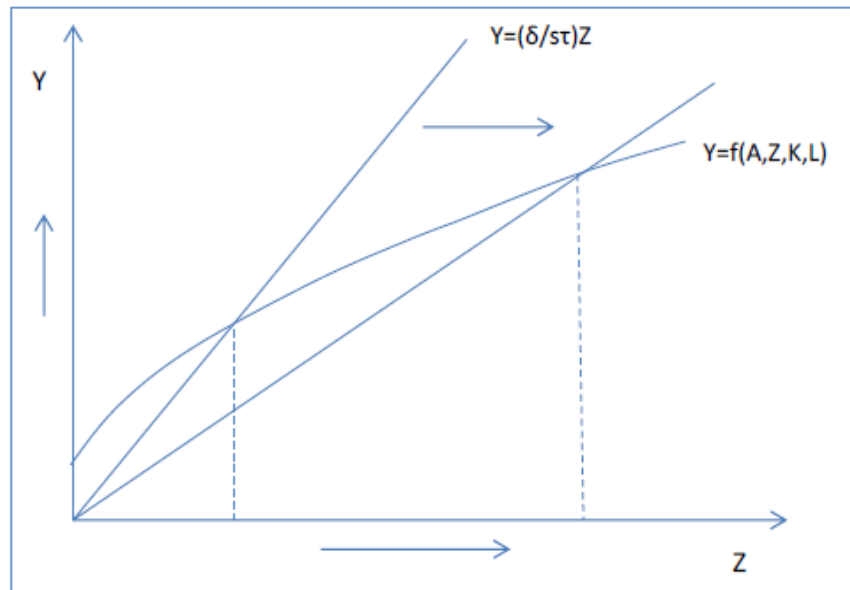
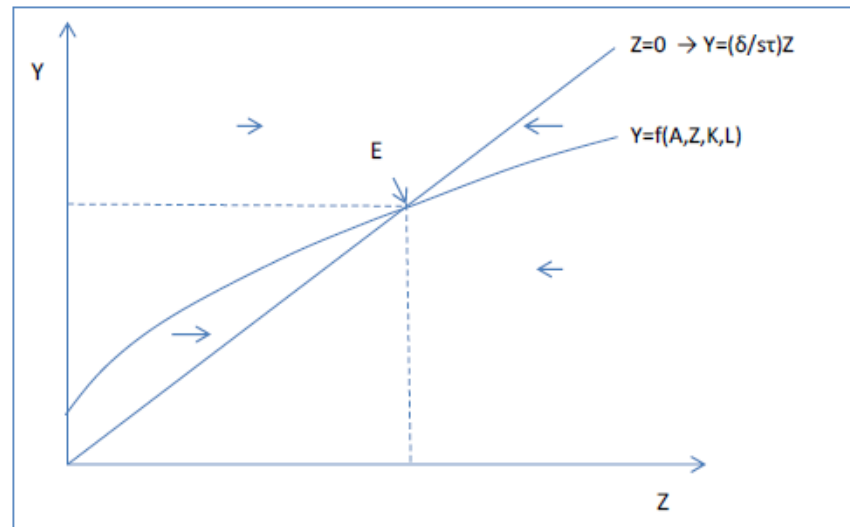
The basic framework economists use to evaluate the impact of infrastructure investment

$$Y = AZ^{\varepsilon\psi} K^{\beta} L^{\alpha}$$

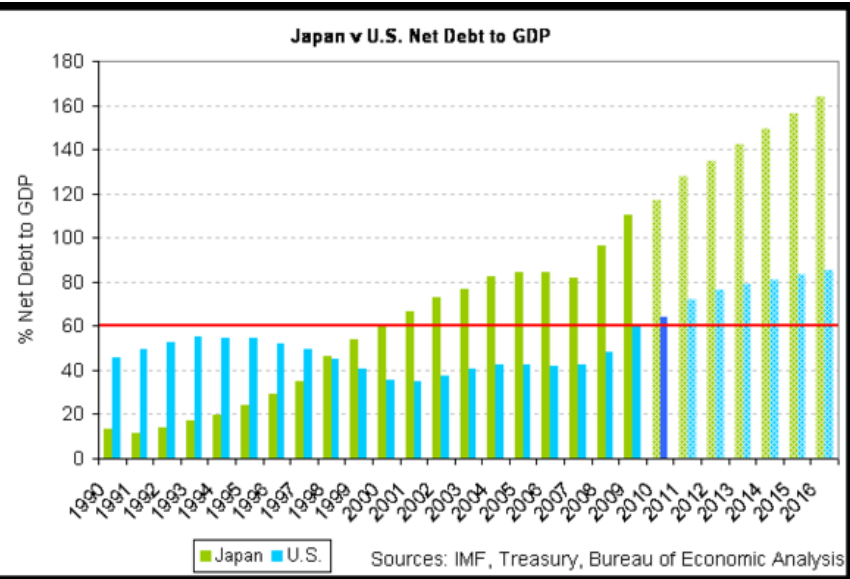
$$Z = sI_z - \delta Z$$

$$C = Y - I_z$$

$$\tau Y = I_z$$



Some cautionary evidence from Japan



A smart infrastructure investment program could yield ***HUGE*** benefits, but...

- America's infrastructure needs are significant
- An evidence-based, scientifically rigorous infrastructure investment program could generate enormous benefits.
- Is that the kind of infrastructure program we are likely to get in the next administration?



Leading growth theorists suggest that there are diminishing returns to R&D...

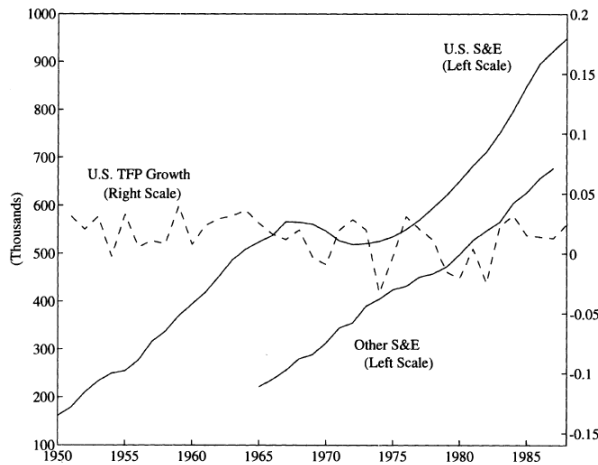
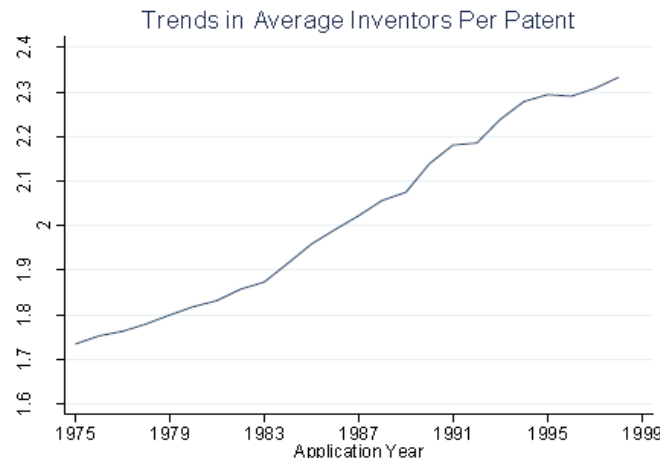
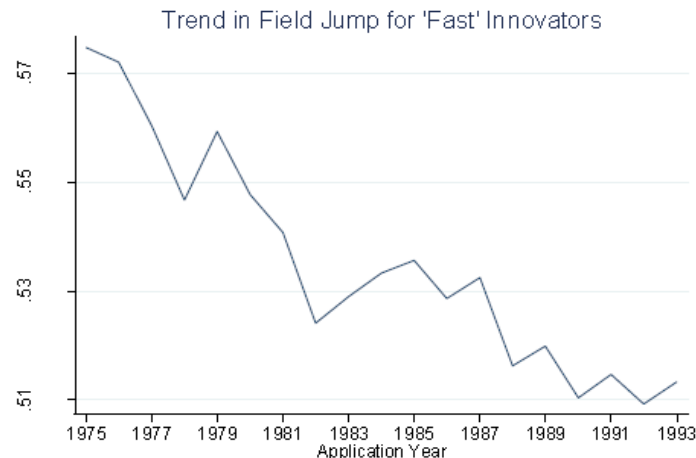


FIG. 1.—Scientists and engineers engaged in R & D and U.S. TFP growth. Source: The number of scientists and engineers engaged in R & D is taken from National Science Foundation (1989) and various issues of the *Statistical Abstract of the U.S. Economy*. TFP growth rates are calculated using the private business sector data in Bureau of Labor Statistics (1991). "Other S&E" is the sum of scientists and engineers engaged in R & D for France, West Germany, and Japan.



Chad Jones



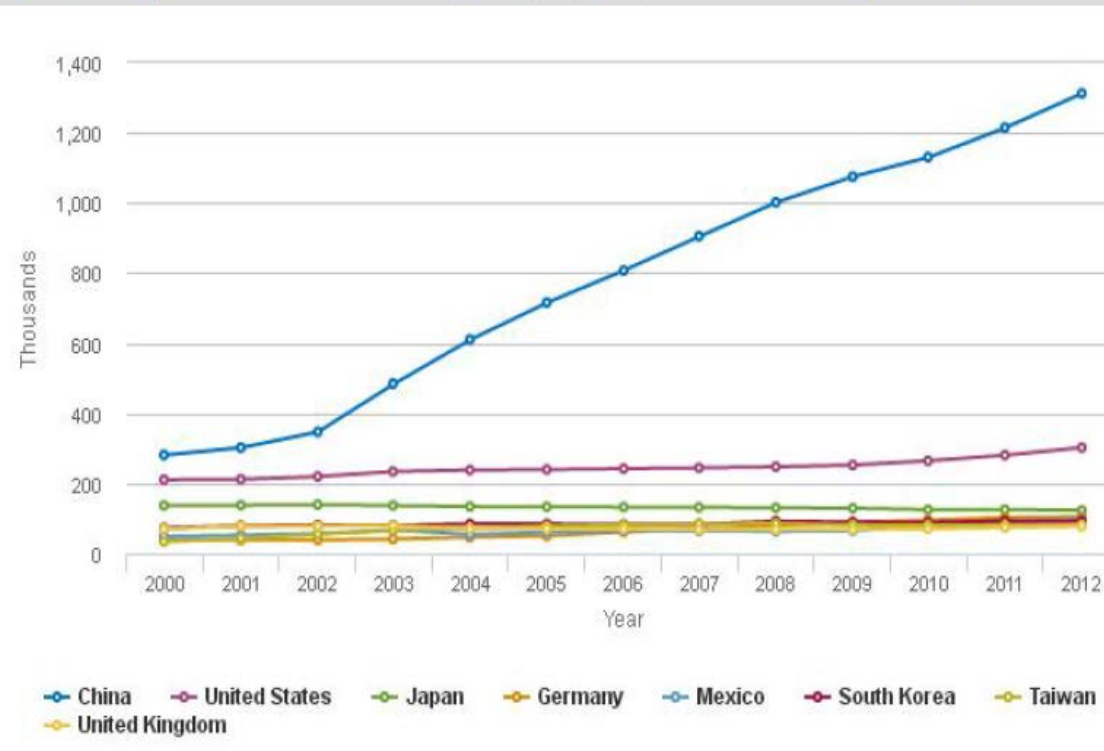
Ben Jones

But a massive human capital mobilization is underway in Asia

- Asia (and the rest of the developing world) have been largely out of the innovation game...
- Freeman (2006) describes the mobilization of engineering and scientific human resources underway in emerging markets
- Can Asian talent revive the global innovation machine?

Figure 2-29

First university natural sciences and engineering degrees, by selected country: 2000–12



NOTE: Natural sciences include agricultural sciences; biological sciences; computer sciences; earth, atmospheric, and ocean sciences; and mathematics.

Theory and history suggest that the scale of innovative effort matters

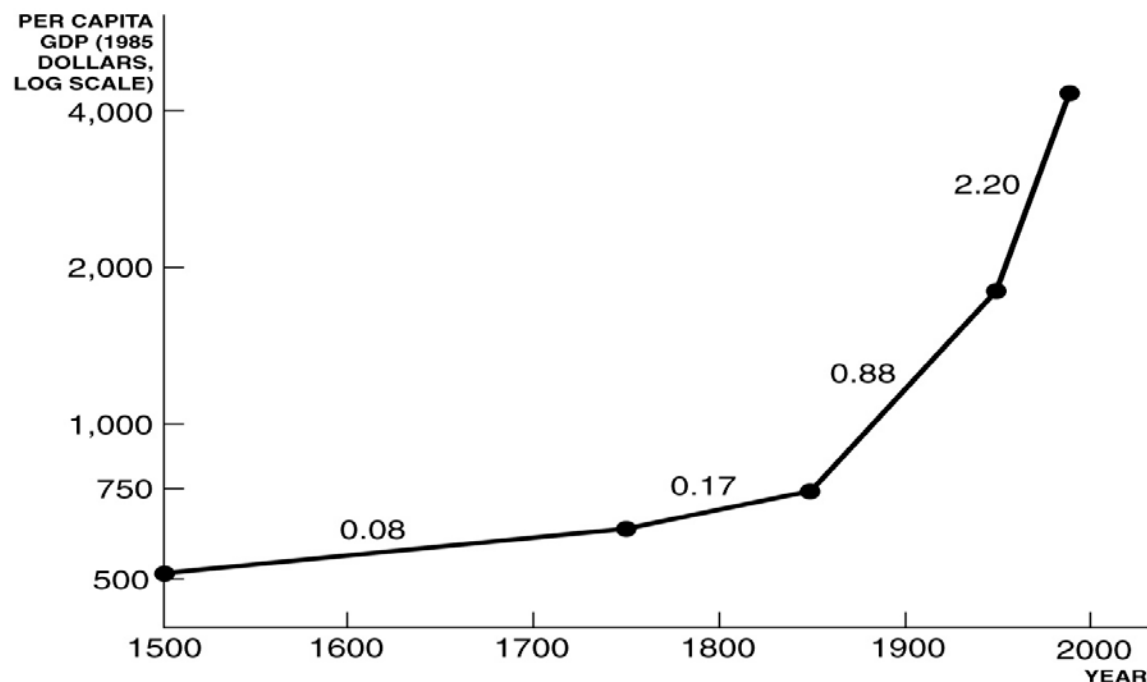


FIGURE 1.3 WORLD PER CAPITA GDP AND GROWTH RATES, 1500–1990

Economic Growth, 2nd Edition
Copyright © 2004 W. W. Norton & Company

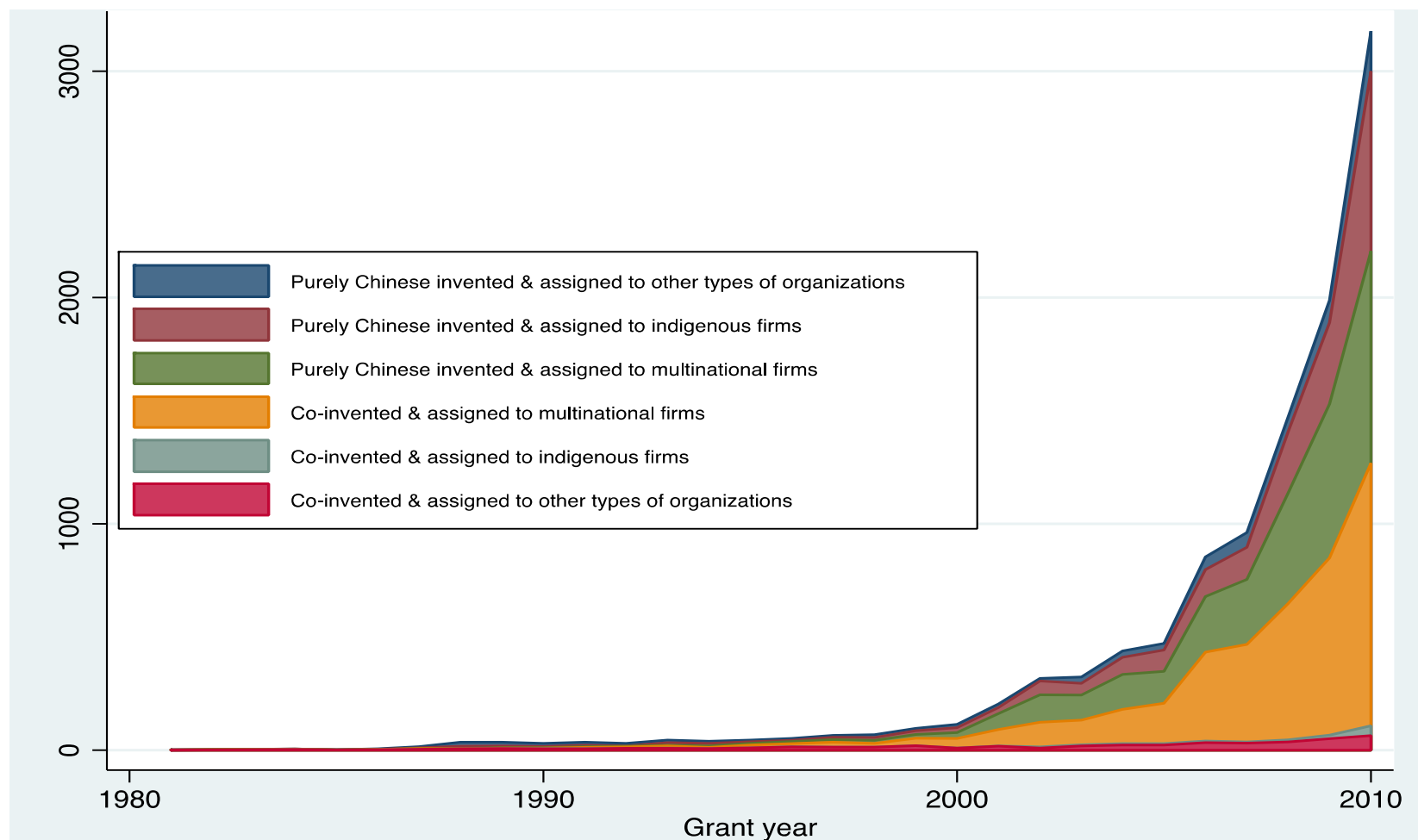
Chinese inventors' own behavior suggests the quality of indigenous invention is still relatively low...

PERCENT FOREIGN PATENTS PER REGION 2008 VERSUS 2013

Region	% filed abroad 2008	% filed abroad 2013	Difference 2008 - 2013
China	5.4%	5.3%	-0.1%
US	54.9%	51.1%	-3.8%
Japan	29.2%	36.0%	6.7%
EPO	26.5%	24.8%	-1.7%

Source: Derwent World Patents Index and Thomson Innovation

But multinational patents generated in China (and India) are growing rapidly in quantity and quality



The linkage of Asian human resources to Western research networks could be a game-changer

- **95% of indigenous Chinese patents are judged by their inventors to be not worth patenting abroad.**
- **Patents produced by Chinese inventors working for MNC R&D labs in China appear to be at least as good as the patents generated by MNCs in their own country.**
- **Global partnerships – mediated by multinationals -- could revive innovation, at the global level, for at least a generation.**
- **China (and India) won't eat our lunch – they'll take us out to dinner!**