Returns to Federal Funding of Basic Research

Conceptual Issues, Facts, and Conjectures

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NAS: 15 December 2016

Basic Research

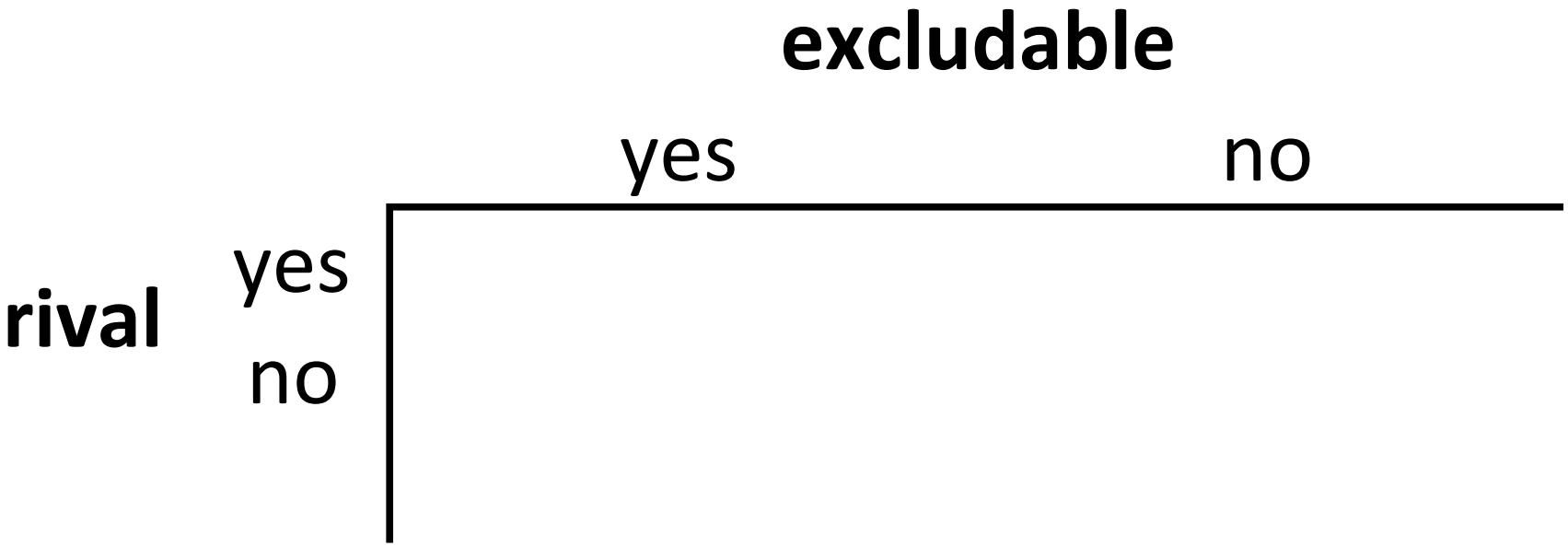
- To gain ...

  knowledge or understanding of the fundamental aspects of phenomena and of observable facts, without specific applications toward processes or products in mind (National Science Foundation)

- Think, scientific findings

Romer's Box

Clarifies what's special about knowledge goods


excludable
yes
no
rival
yes
no

		excludable	
		yes	no
rival	yes	Private Goods	
	no		Public Goods

	excludable	
	yes	no
rival	Automobile	Amtrak seat
nonrival	Patentable	Scientific
	Research	Findings

Challenge

- Market failure: weak incentives to produce nonrival goods

  ... particularly those on the basic end of the spectrum (lower-right corner)

- Can create excludability such as patents, copyright, trade secrecy

- Yet problematic to push excludability margin too far right

- Government funding is one way around this conundrum

Actual Funding Patterns

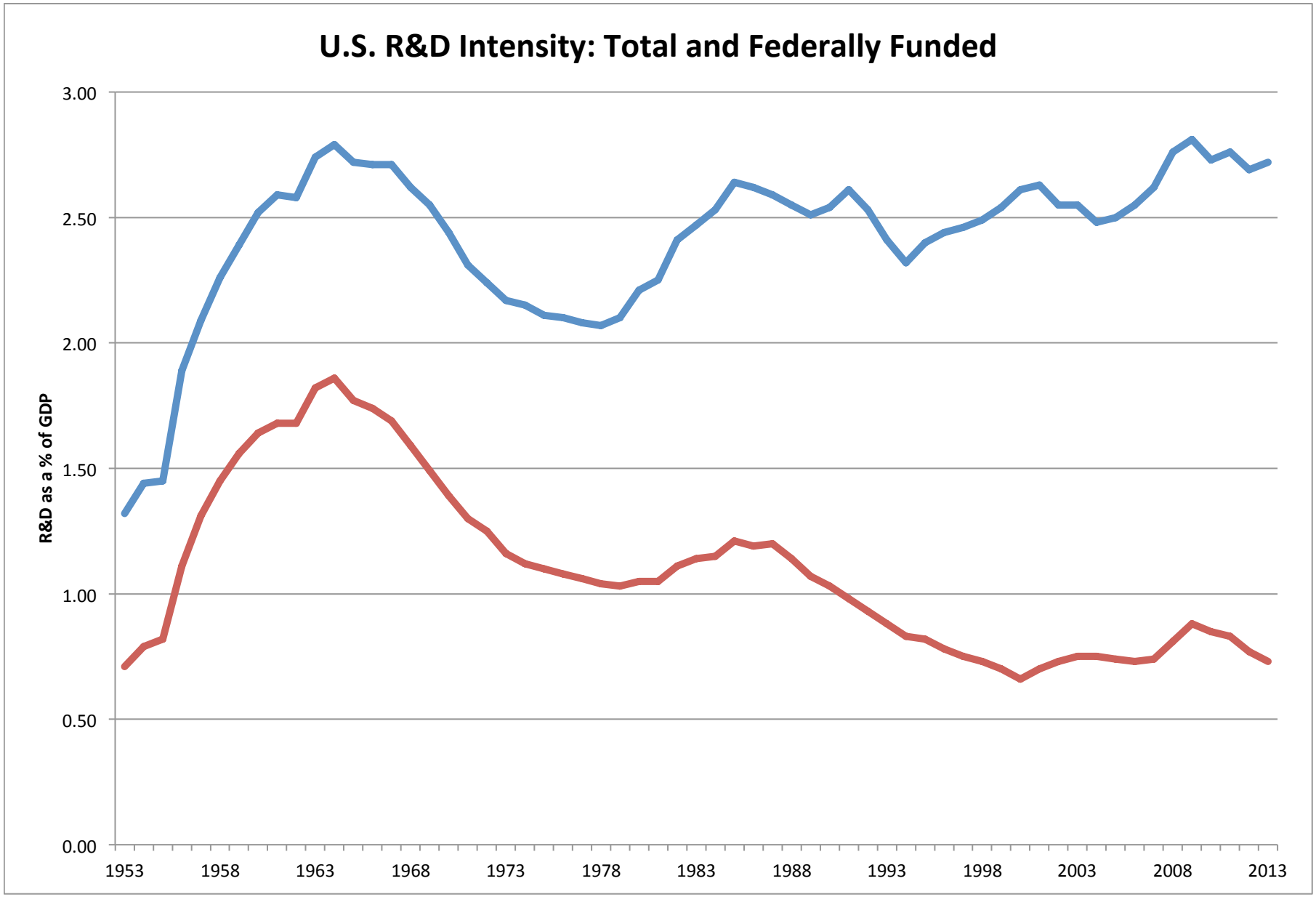
- Federal government is the major source of funds for Basic Research
- Although less than 1/3 of all Federally Funded R&D goes to Basic Research
- Federally Funded R&D has declined as a share of total R&D

  ... but has recently stabilized as a share of GDP

U.S. R&D in 2013 ($ billions)

	Source of Funds			
	Business	Fed. Govt.	Other	Total
Basic	21.2	37.8	21.4	80.4
Applied	46.3	33.4	11.0	90.7
Development	229.8	50.6	4.6	285.0
Total R&D	297.3	121.8	37.0	456.1

source: NSF


U.S. R&D Intensity: Total and Federally Funded
R&D as a % of GDP
3.00
2.50
2.00
1.50
1.00
0.50
0.00
1953
1958
1963
1968
1973
1978
1983
1988
1993
1998
2003
2008
2013

Nelson's and Evenson & Kislev's Paradigm

- Basic research improves search distribution for applications
- Generates nonrival goods for applied research
- Advantageous to keep basic research open, not excludable
- Want basic and applied research to interact

Perspective of New Growth Theory

- Aghion and Howitt, Grossman and Helpman, Romer:

  ... developed models of imperfect competition and excludability

  ... showing how a market economy could generate long-run growth

- Klette and I tightened the connection between these growth models

  ... and firm-level observations

- Akcigit, Hanley, and Serrano-Velarde enhance to address questions here

  ... quantitative theory, disciplined by data

Akcigit, Hanley, and Serrano-Velarde Model

- Government-funded basic (academic) R&D; basic & applied (firm) R&D

- Formalizes Nelson and Evenson & Kislev ideas:

  ... basic R&D creates opportunities for firms' applied R&D

  ... basic R&D creates spillovers; opportunities in other industries

  ... basic R&D by private firms has immediate application

  ..... but, academic research must await application by firms

- Use calibrated model to perform counterfactual policy exercises

Conjectures from Good Quantitative Theory

- Targeted subsidy of firm R&D produces a 3% welfare gain

  ... basic research increases but applied R&D falls

- Uniform subsidy of firm R&D generates only a modest welfare gain

- Optimally funding academic research doesn't help much

- If academic research has immediate applications, optimally funding it

  ... is as beneficial as the targeted subsidy of firm R&D

	Labor Allocation (% of workers)				Outcome Measures (%)	
	Production Sector	Research Sector			Economy Growth Rate	Welfare Rel. to Baseline
		Academic	Private Firms			
		Basic	Basic	Applied		
Baseline	85.6	0.52	0.53	8.9	1.34	0
Targeted Subsidy of Firm R&D	83.1	0.5	5.3	7.5	1.75	3.0
Uniform Subsidy of Firm R&D	81.8	0.49	1.54	10.8	1.7	0.8
+ Optimal Academic Funding	81.6	0.7	1.5	10.8	1.72	0.8
+ Immediate Applications	81.2	3.3	0.9	9.7	1.92	3.1

source: Akcigit, Hanley, and Serrano-Velarde (2016)

Conclusions

- Solid case to promote basic research, as nonrival not-easily-excludable goods are underprovided in a market economy
- Subsidy targeting basic R&D by firms is promising but hard to implement
- An alternative is government funding of basic research outside of firms
- Which is effective if it's not too detached from its applications