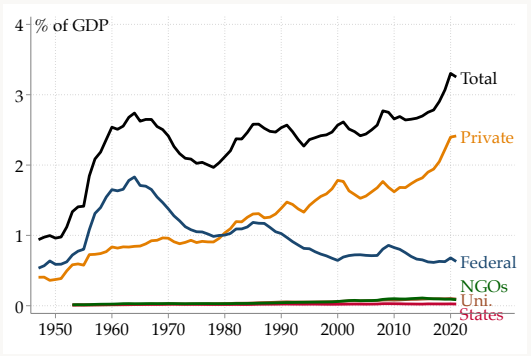
Public R&D Spillovers and Productivity Growth

Context

- Decline in public R&D since 1960 in the US



- **Research question**: What is the impact of the decline in public R&D on productivity growth?

1. Data

- **Patent data** + **Compustat**: 1950-2020
- Most comprehensive panel of its kind
  - Freely available on my website

2. How is public R&D different?

- $y_i = \alpha + \beta \mathbb{1}[\text{patent } i \text{ is publicly funded}] + \mathbf{X}_i\boldsymbol{\gamma} + \varepsilon_i$

1. More fundamental (y_i = % citations to papers)
   - +267%*** (baseline: 0.06)
2. More 'ahead of time' (y_i = years ahead of class creation)
   - +19%*** (baseline: 6.75)
3. More likely to generate spillovers (y_i = # of classes citing) Especially to small firms
   - +22%*** (baseline: 2.38)

3. From theory to data

- Productivity-enhancing function with spillovers

$$\text{productivity growth} = \text{R\&D} \times \text{spillovers} \quad \text{(Griliches, '79)}$$

$$\frac{A_{it}}{A_{it-1}} = e_{it}{}^{r} S_{it}$$

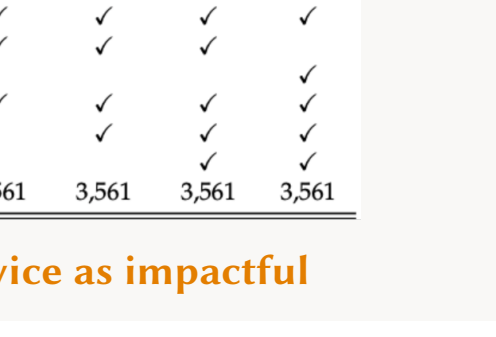
$$= e_{it}{}^{r} \left(\prod_a \left(\frac{P_{at}}{P_{at-1}} \right)^{s_{iat}} \right)^{\gamma} \left(\prod_f \left(\frac{P_{ft}}{P_{ft-1}} \right)^{s_{ift}} \right)^{\varepsilon}$$

- P_{at} and P_{ft} = patents s_{iat} and s_{ift} = shares of exposure (Jaffe '86)
- Take logs, estimate flow equation as

$$\Delta a_{it} = r \underbrace{\ln(e_{it})}_{\substack{\text{own ln} \\ \text{R\&D flow}}} + \gamma \underbrace{\sum_a s_{iat} \Delta p_{at}}_{\substack{\text{exposure to} \\ \text{public R\&D patents}}} + \varepsilon \underbrace{\sum_f s_{ift} \Delta p_{ft}}_{\substack{\text{exposure to} \\ \text{private R\&D patents}}} + \epsilon_{it}$$

4. Shift-Share IV for public R&D spillovers: funding shocks

- Due to wars, space race, geopolitics, pandemics, etc.



- **Positive impact** on firm-level productivity

5. Patent examiner IV for public and private spillovers

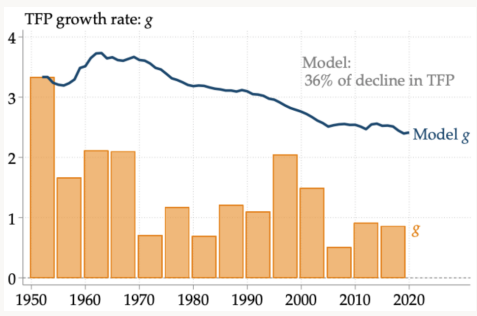
- Examiner **leniency** provides variation in the **visibility** of innovation

		(1)	(2)	(3)	(4)
Δ_5 ln(VA/worker)	*Public*	0.089***	0.090***	0.096***	0.065**
		(0.025)	(0.026)	(0.027)	(0.026)
	Private	0.035***	0.034**	0.031**	0.028**
		(0.013)	(0.013)	(0.012)	(0.013)
F-stats	*Public*	61.0	60.5	58.7	59.0
	Private	1,503	1,501	1,525	1,356
	Joint	43.3	42.9	39.9	39.8
Period FEs		✓	✓	✓	✓
State FEs		✓	✓	✓	✓
SIC2 sectors FEs		✓	✓	✓	
SIC3 sectors FEs					✓
Lagged sales		✓	✓	✓	✓
Lagged R&D			✓	✓	✓
Lagged firm controls				✓	✓
N		3,561	3,561	3,561	3,561

- Public R&D spillovers **twice as impactful**

6. Aggregation: Heterogeneous agent model of growth

- Heterogeneous firms + 2 types of spillovers
  - Private and public
- Decline in public R&D explains **a third** of the deceleration in TFP



Conclusion

- **Large, positive impact of public R&D** on firm productivity through technology spillovers
- Public R&D spillovers at least **twice** as impactful as private R&D spillovers
- **Smaller firms** are more negatively impacted by the decline in public R&D
- Decline in public R&D in the US can **account for a third of the deceleration in TFP**

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