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PUBLIC R&D SPILLOVERS AND PRODUCTIVITY GROWTH

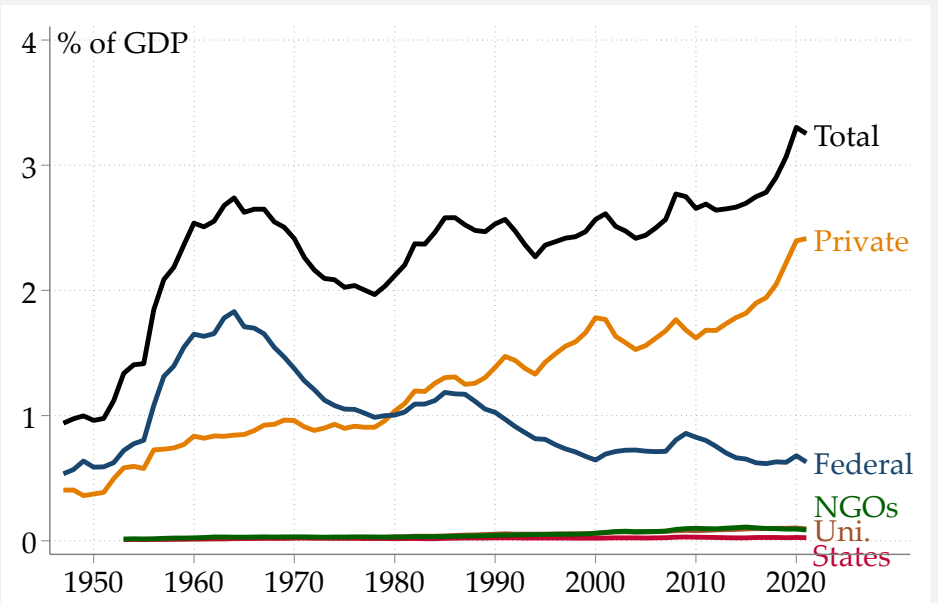
EUROPEAN CENTRAL BANK

EUROSYSTEM

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** (US firms): 1950-2020

Most comprehensive dynamic panel of listed firms matched to patents

2. How is public R&D different?

1. **More fundamental** (share of citations to scientific papers)
2. **More 'ahead of its time'** (years ahead of technology class creation)
3. **More likely to generate spillovers** (classes citing the patent), especially to **small firms**

3. From theory to data

Productivity-enhancing function with spillovers:

productivity growth = R&D × spillovers

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

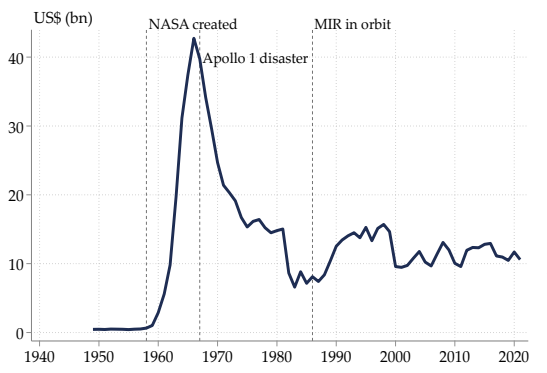
P_{at} and P_{ft}: patents. s_{iat} and s_{ift}: shares of exposure

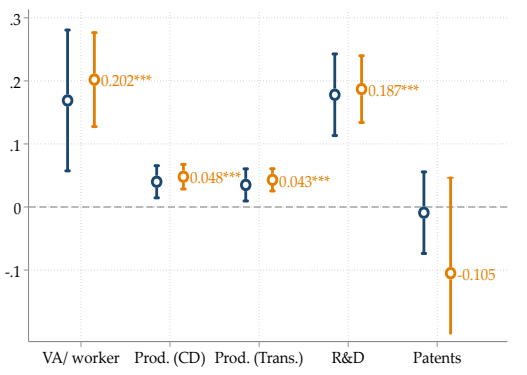
Take logs and estimate:

$$\Delta a_{it} = r \ \ln(e_{it}) + \gamma \sum_a s_{iat} \Delta p_{at} + \varepsilon \sum_a s_{ift} \Delta p_{ft} + \epsilon_{it}$$

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

Caused by wars, space race, geopolitics, pandemics, etc. (see NASA example, left)





Positive impact on firm-level productivity

5. Patent examiner IV for public & private spillovers

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

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

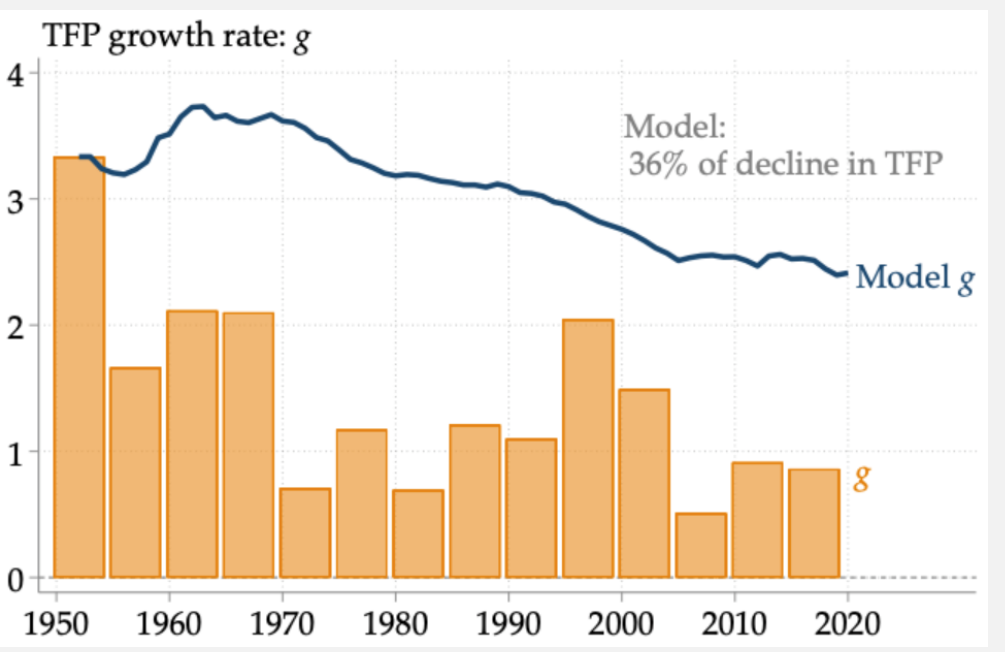
		(1)	(2)	(3)	(4)
$\Delta_5 \ln(VA/worker)$	*Public*	0.089***	0.090***	0.096***	0.065**
		(0.025)	(0.026)	(0.027)	(0.026)
	Private	0.035***	0.034**	0.031**	0.028**
		(0.013)	(0.013)	(0.012)	(0.013)

6. Aggregation: growth with spillovers and heterogeneous firms

Firms vary in productivity and there are 2 types of spillovers

- Private (applied) and public (fundamental)

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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Paper available at arnauddyevre.com