The Effect of Public Science on Corporate R&D

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Universities as Engines of Growth
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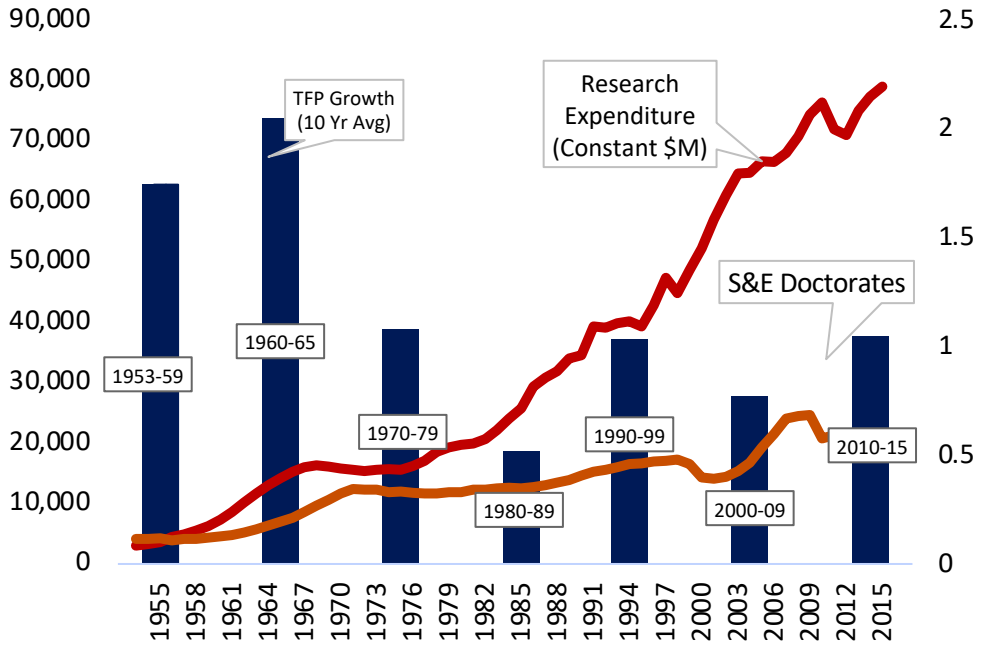
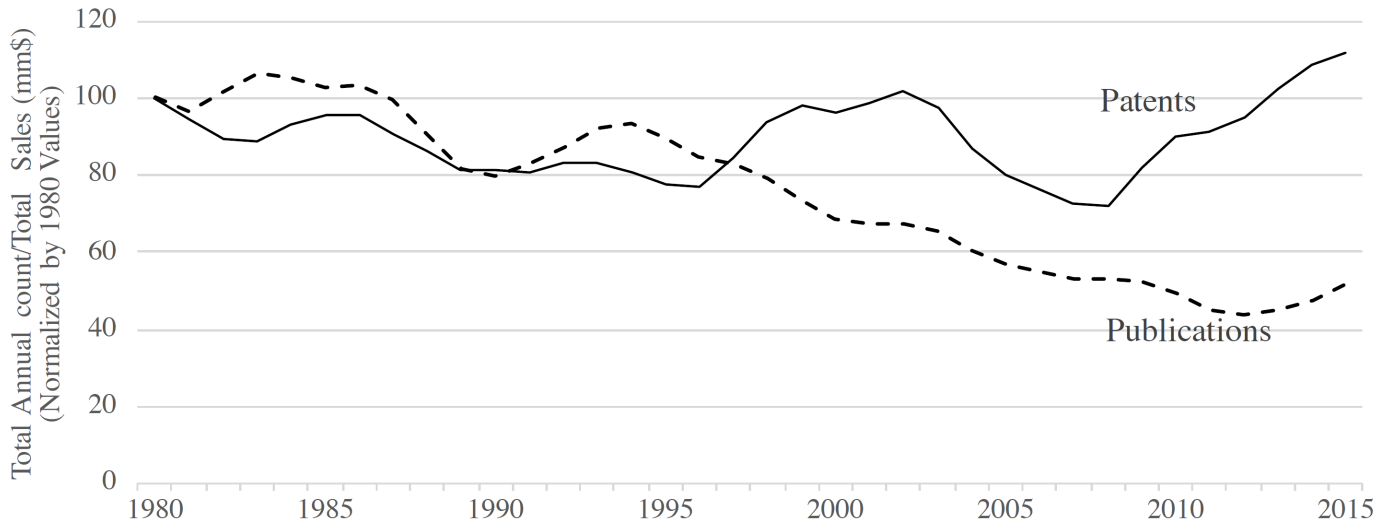
More Science for Less?

US TFP growth, R&D expenditures, and S&E doctorates



Publications/Sales and Patents/Sales, per firm, 1980-2015, US Public Firms (Arora, Belenzon, & Sheer, 2021)



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Research Question: What Is the Effect of Public Science on Corporate Innovation?

- **3 dimensions of public science:**
  - Public knowledge (scientific publications)
  - Human capital (PhD dissertations)
  - Public invention (university patents)

- **3 measures of corporate innovation:**
  - Scientific research (publications; employment of renowned scientists)
  - Invention (patents)
  - R&D (R&D expenditures)

- ~~**Explore heterogeneity by industry and proximity to the technology frontier**~~

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Data

- **Publication, patent, citation, and grant data from Dimensions**
  - 131.5 million publications, 149.7 million patents, 6.3 million grants
- **Scientists from American Men & Women of Science (AMWS)**
  - 20,097 AMWS scientists work for 1,727 sample firms during 1980-2015
- **PhD dissertations from ProQuest Dissertations & Theses Global**
  - 771,023 U.S. hard science PhD dissertations between 1986 and 2016
- **Firm financial data from Compustat North America**
  - 4,520 firms and 60,885 firm-year observations between 1980 and 2015 (Arora et al., 2021)

Instrumental Variables:

- **Federal R&D budgets from American Association for the Advancement of Science (AAAS)**
- **Political composition of appropriations subcommittees from the U.S. Congress**

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Main empirical challenges

Link university outputs (papers, patents, people) to firms

We use

- CPC classes where firm has patented in past for patents
- OECD scientific fields where firm has published in the past for publications
- Direct textual similarity between dissertation and firm's previous patents for people

Source of exogenous variation in university outputs

We use federal agency R&D (predicted by congressional subcommittee composition) by linking (using lags)

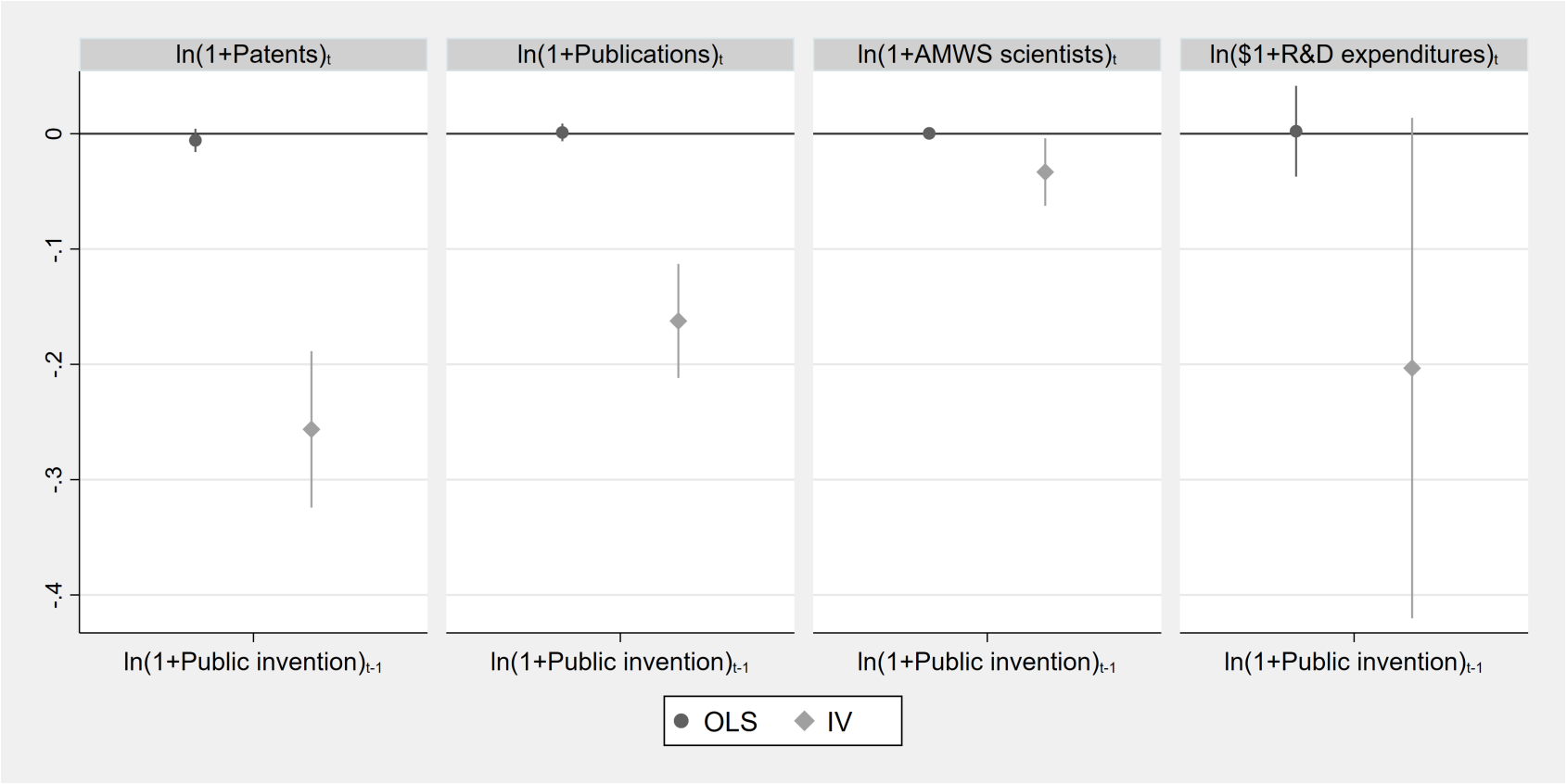
- OECD science subfield to federal agencies that funded papers in the subfield (share)
- dissertation to federal agency that funded advisor (share)
- CPC patent classes to federal agency that funded the papers that are cited by the patents in that class (share)

Alternative measures

- Invention: univ publications that are cited by patents in various CPC subclasses, weighted by the firm's lagged patenting shares across CPC subclasses.
- Human capital: Published PhD dissertations cited by patents in various CPC subclasses, weighted by the firm's lagged patenting shares across CPC subclasses.
- Human capital, OECD is a firm-year PhD dissertations in OECD science subfields, weighted by the reliance of CPC subclasses on science published in various OECD subfields and by the firm's lagged patenting shares across CPC subclasses.

Results

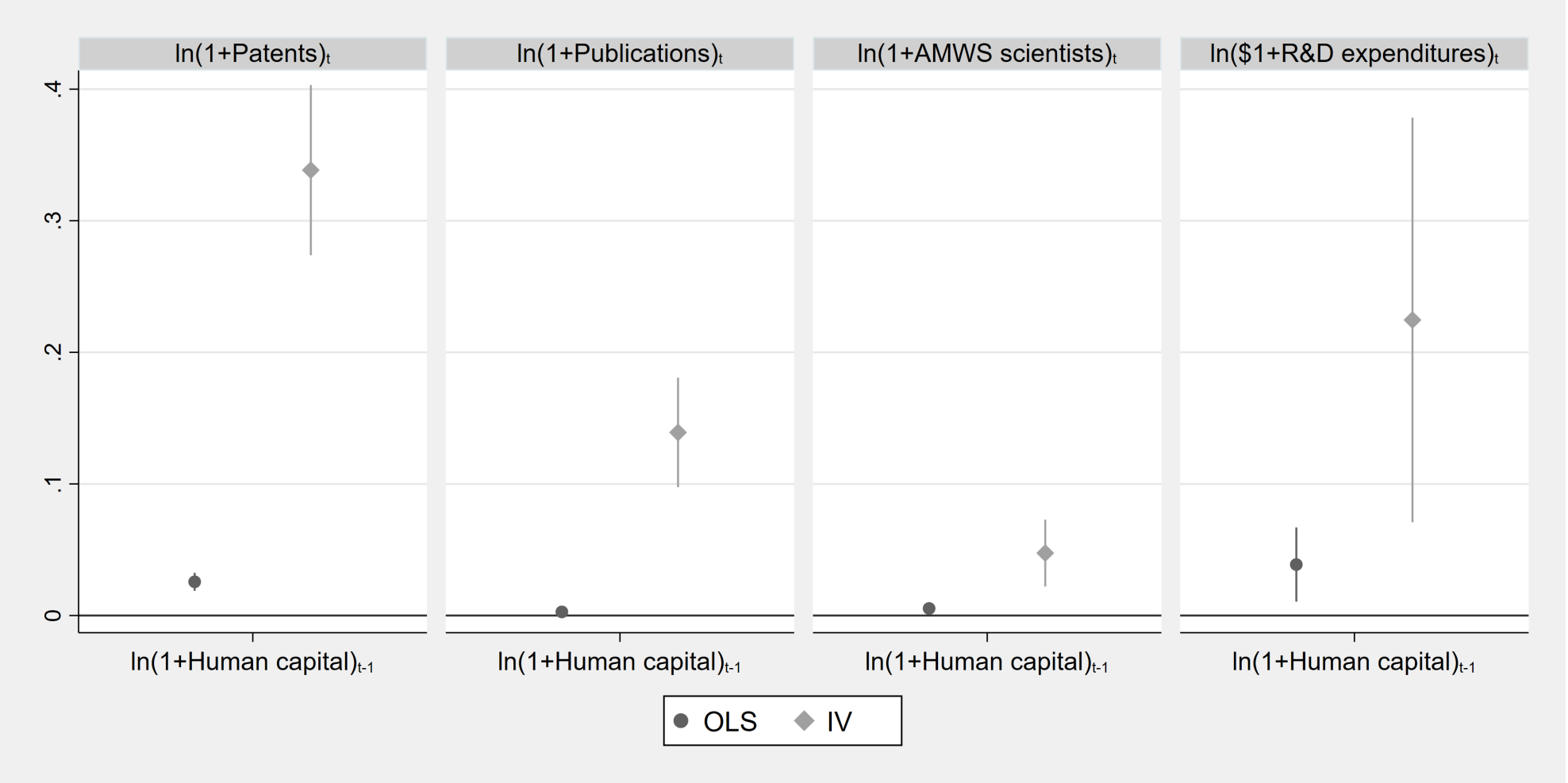
Firms Respond to an Increase in Public Invention by Producing Fewer Corporate Patents and Publications;



negative relationship with firm market value suggests startups are commercializing univ inventions that compete with corporate inventions

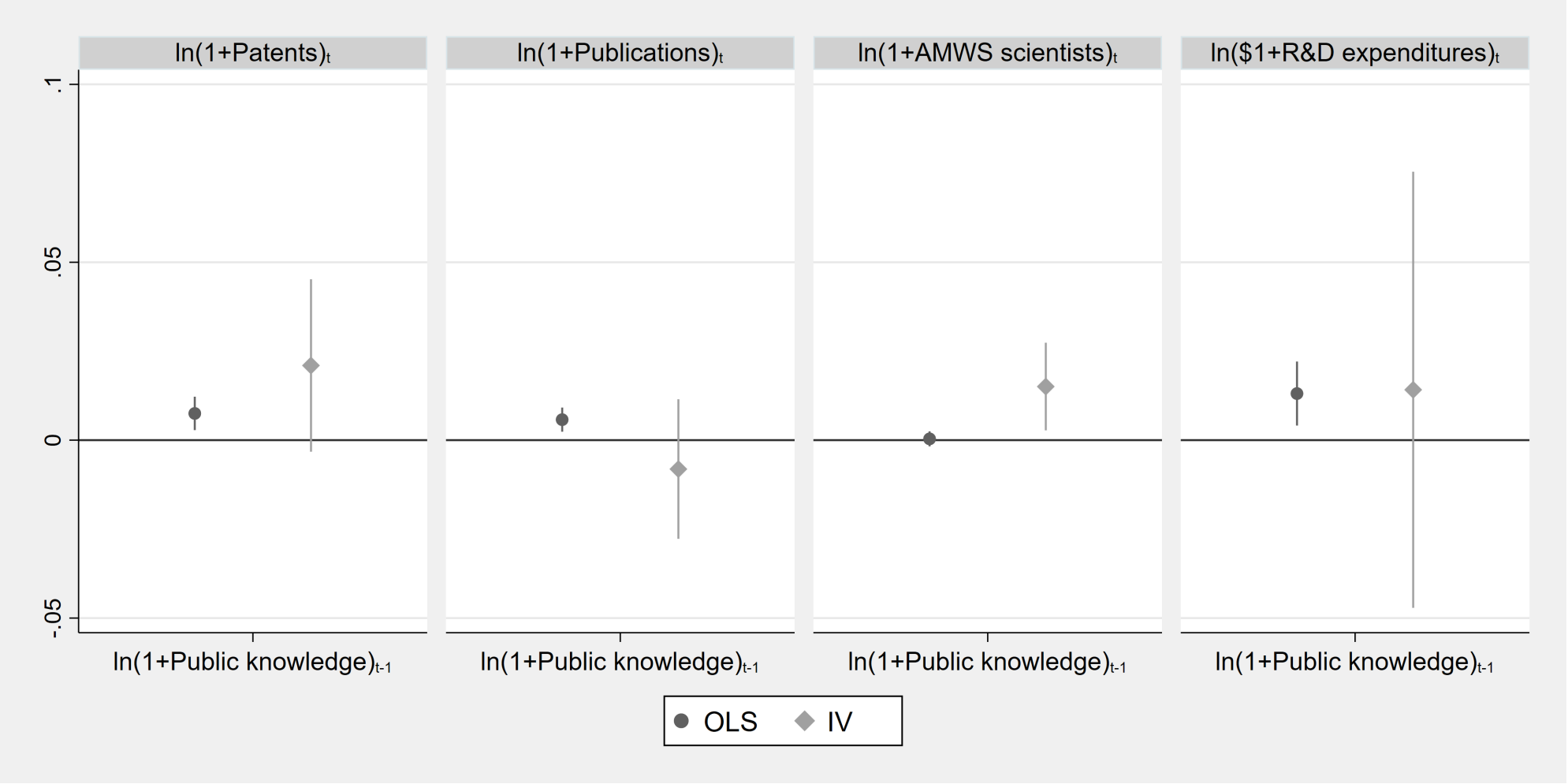
IV first stage Variation by industry

Firms Respond to an Increase in Human Capital by Producing More Corporate Publications and Patents



IV first stage Variation by industry

Firms Do Not Respond to an Increase in Public Knowledge



IV first stage Variation by industry

Exploring the null effect of public knowledge

Similar (null) results in OLS regressions with

- Relevant Nobel Prize winning papers (and papers that cite them) as an alternative measure of public knowledge
- Lags: 3, 5, 10 year
- Commercial potential (using Masclans-Armengol, Hasan, Cohen, 2024)

Why? (Speculation)

- Knowledge too abstract or under-developed ➔ needs to be further developed by univs or startups
- Lack of absorptive capacity due to withdrawal of firms from upstream research ➔ knowledge needs to be embodied in people

IV first stage Variation by industry

Summary & Conclusions

- **The impact of public science on corporate innovation depends on its embodied (and excludable) components**
  - Firms respond to increases in human capital embodied in PhD researchers and invention represented by university patents, but not to knowledge included in scientific publications

- **Potential explanation for the sluggish growth in productivity over the last three decades in the face of sustained growth in scientific output**
  - Abstract ideas are difficult to use
  - Firms, especially those not on the technological frontier, appear to lack the absorptive capacity to understand and use externally supplied ideas unless they are embodied in human capital or inventions
  - Expansion of public science may widen the gap between frontier firms and followers, with ramifications for product market competition, as well as for the rate and direction of technical progress