# A review of economic perspectives on collaboration in science

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*Workshop on Institutional & Organizational Supports for Team Science*

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# *Agenda*

- *Introduce economic perspectives on collaboration in science*
- *Explain 2 key facts about collaboration:*
  - *what draws scientific collaborators together?*
  - *why has collaboration increased recently?*
- *Issues*
  - *Views of teaming from labor economics*
  - *Calculus from a researcher's perspective*
    - *benefits/incentives*
    - *costs – coordination & credit*
  - *Open questions*

# Background notes on economic perspectives on scientific collaboration

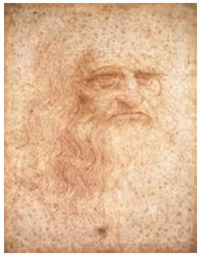
- *No single view or canonical model of scientific collaboration*
  - *much work in economics of science draws on sociology of science (e.g., Merton, Zuckerman, etc.)*

- *Four core features of economics of science*
  1. *knowledge accumulates*
     - *standing on the shoulders of giants" drives economic growth*
  2. *science is a competitive enterprise*
     - *both at level of individual and institution*
  3. *it anticipates that incentives, benefits, and costs that individuals & institutions face will shape their behavior*
     - *policies assumed to operate through those mechanisms to change behavior (though researcher preferences, especially for autonomy also matter)*
  4. *it cares about causality & wants to measure it precisely!*

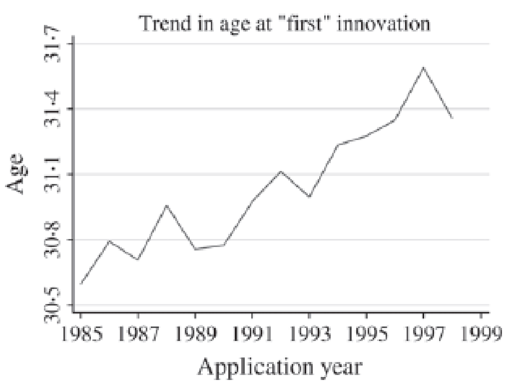
# *Teaming & Collaboration in labor economics*


- *Labor economics models of teaming & collaboration = basis for perspectives in economics of science*
  - *not designed for economics of science*
  - *but applicable*
  - *esp. Becker & Murphy (1992) & Lazear (1998 & 1999)*
- *Literature highlights tension between*
  - *benefits*
    - *task, skill, & knowledge complementarities (role for diversity)*
    - *specialization of labor*
  - *costs*
    - *direct costs of coordinating*
    - *incentive problems (e.g., free riding, increased monitoring, etc.)*

# The burden of knowledge & The death of the Renaissance Man



- *Ben Jones (Kellogg) unified explanation for increasing collaboration & specialization in knowledge production*
- *Knowledge frontier is ever-expanding*
  - *in world of limited knowledge…*
    - *getting to frontier requires genius and some time*
    - *it is possible to be expert in multiple fields*
  - *in world of substantial knowledge*
    - *getting to frontier requires genius & substantial time*
    - *it is difficult to be an expert in even a single field*



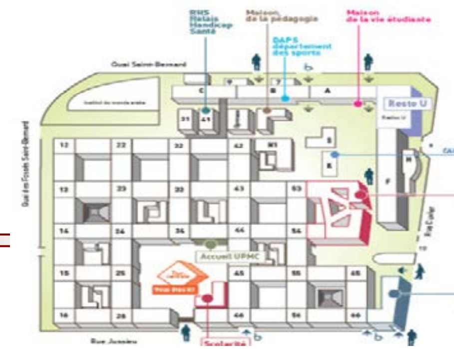

- *As "burden of knowledge" grows…*
  - *researchers require longer learning periods before making contributions (unless educational productivity expands more rapidly)*
  - *researchers become expert in increasingly narrow arenas*
  - *➔ must **specialize** & **collaborate** to contribute at frontier of knowledge*
- *Evidence*
  - *increasing ages of Nobel Prize winners & 1st contribution to innovation*
  - *mass influx of Soviet scientists → collaboration (Agrawral et al., 2013)*

# Researcher's calculus: Incentives for / benefits of scientific collaboration

- Complementarity
  - skills, tasks, resources, knowledge bases
  - gains to specialization
  - limited inquiry in economics of science (likely due to difficulty in measuring concepts in large scale data)
  - creativity (more work in OT & psych)
  - racing & collusion
- Economies of scale & scope
  - fixed costs
    - equipment, materials data
    - spread across multiple projects
  - Big Science
    - Manhattan Project, Apollo, CERN
  - labs
- Attention & networks of impact
  - can increase quality
  - more connections → more diffusion
  - legitimacy (Matthew Effect)
  - "ghost authorship"
- Credit arbitrage
  - Bikard, Gans, & Murray (2013) – if reputational boost of collaboration rises > cost of decreased credit
  - "guest authorship"
- Institutional incentives & subsidies
  - NIH – P01 grants, Glue Grants
  - EU Framework Programs
  - Catch-up incentives for publishing

# *Researcher's calculus: Costs of scientific collaboration*

Figure 1: Map of the Jussieu campus



- *Direct costs*
  - *Communication costs and costs of negotiation & disagreement*
    - *organizational costs*
  - *Distance & costs*
    - *falling over time*
      - *e.g., BITNET (Agarwal & Goldfarb + Azoulay et al.)*
    - *but face-to-face still important*
      - *Ganguli et al, 2013*
      - *micro-geography matters (Catalini, 2013)*
        - *UPMC-Sorbonne*
        - *lab co-location → 3-5x more collaboration*
        - *x-field :: cites & var ↑*

- *Other costs*
  - *Credit [Gans & Murray w Bikard (2013)]*
    - *individual credit for contribution to project ↓ as # of team members rises*
      - *1-author = 100%*
      - *3-author = 40%? 33%? 20%?*
    - *this function is not clear to*
      - *researchers ex ante*
      - *institutions ex post*
      - *policy-makers*
  - *Incentives*
    - *e.g., free-riding*
    - *not extensively studied, but anecdotal evidence strong*
  - *Potential for false science*
    - *pr(errors & fraud) may rise*

# Open Questions

- **Causality question**
  - *selection vs. treatment*
    - *does collaboration cause high research impact?* ***or***
    - *does high impact research require collaboration?*
  - *experimental approaches?*
  - *natural experiments?*
- **Policy questions**
  - *should public policies → collaboration?*
    - *what is market failure?*
    - *what does evidence suggest?*
    - *is diffusion a valuable goal of pro-team policies?*

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    - *is diffusion a valuable goal of pro-team policies?*
- ***Additional questions***
  - *who works with whom?*
    - *are there frictions that inhibit optimal matching? (e.g., Fleming, discovered penicillin, but lacked chemical engineers to scale up)*
    - *is there a role for policy (funding) in supporting matching*
  - *how can we usefully measure cross-field research & assess causal impact of doing such work?*
  - *how does the collaboration imperative shape (for better or worse) research agendas & output?*
    - *e.g., individual researchers may have different risk preferences than combination of researchers*
    - *long-term vs. short-term goals (Azoulay et al., 2011)*