Open Science as an Economic Institution

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November 8, 2022

Economics of Ideas, Science and Innovation Online PhD Short Course

How do scientists decide what to do? What motivates or incentivizes them?

Discussion Prompt

Main Takeaways:

Science: a distinctive means of allocating resources towards the production of knowledge.

	Markets	Science
Purpose	Satisfy human wants	Produce knowledge
Better suited for	Rival + Excludable goods	Non-rival + Non-excludable knowledge
Property Rights	Traded?	Priority norm
Incentive	Profit	Social credit + Intrinsic interests

Agenda

1. Financial incentives and science: Myers (2020)
2. Understanding resource allocation in science: Dasgupta and David (1994), Azoulay, Fons-Rosen, and Graff Zivin (2019)
3. Science for Technology: Ahmadpoor and Jones (2018), Aghion, Dewatripont, and Stein (2008)
4. Charting the frontier

Financial Incentives and Science

Do scientists not care about money?

- Barham, Foltz, and Melo (2021)
- Survey of agricultural scientists at US Land Grant Universities

Table 5.8 Research choice criteria across UIR types, 2005 and 2015

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Enjoy doing this kind of research	4.50	4.53	4.69	4.69	4.27	4.33	4.50	4.50
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Do scientists not care about money?

- Freeman (2006): lifetime earnings of biology PhDs is ~$3mn less than doctors, ~$1.8mn less than lawyers
- Stern (2004): Do scientists pay to be scientists?
  - Compares salaries offered to post-doctoral biologists (who receive multiple job offers)
  - Non-academic job offers vary in freedom to do research
  - Tradeoff of wages and academic freedom: 20% lower salary for permission to publish
  - Understating tradeoff?

Myers (2020): The Elasticity of Science

- National Institutes of Health (NIH): biggest US biomedical science funder ($28bn average in grants annually)
- Two kinds of grants: investigator initiated and request for application (RFA). RFAs:
  - Requests for proposals on specific diseases, populations, methods
  - Typically $2-$3mn
- Data on:
  - 453 RFAs from 2006-2009
  - NIH grant applicants and publication history

Myers (2020): The Elasticity of Science

- What does Myers want to do?
- How does he assess similarity of a scientist's research with an RFA?
- What are some challenges to computing elasticity of science in the paper?

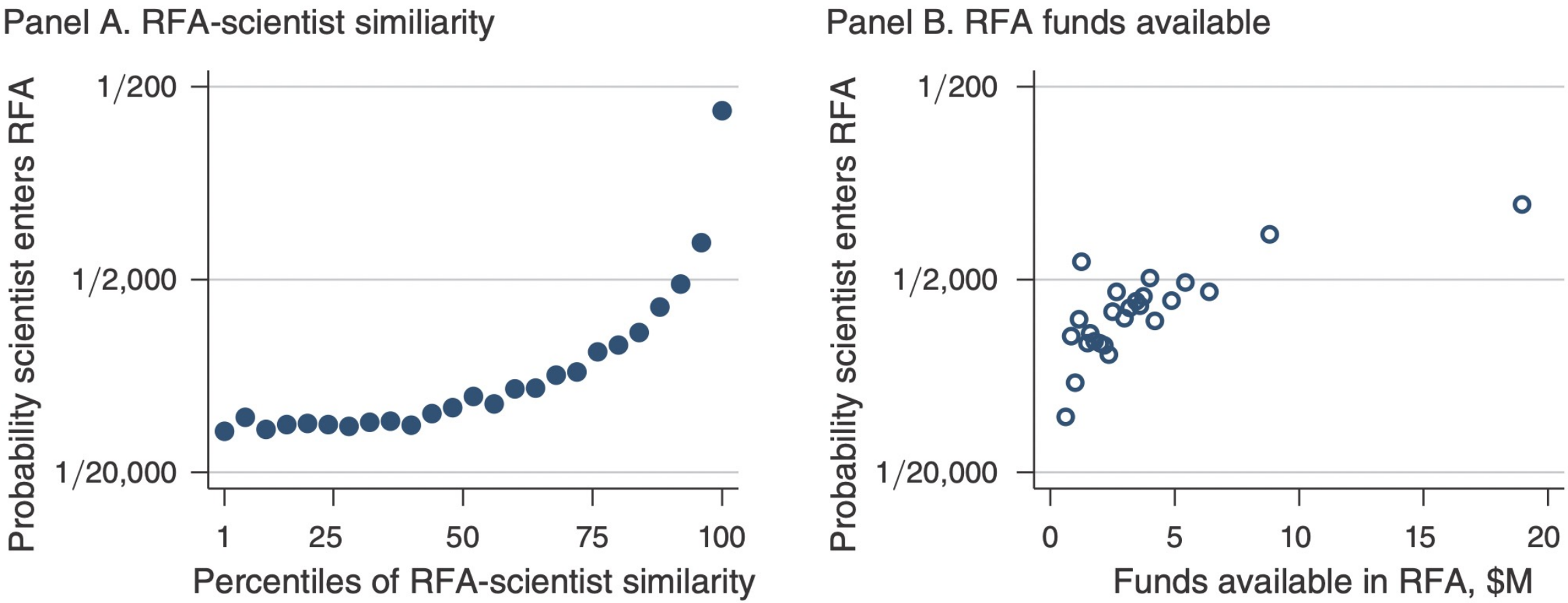
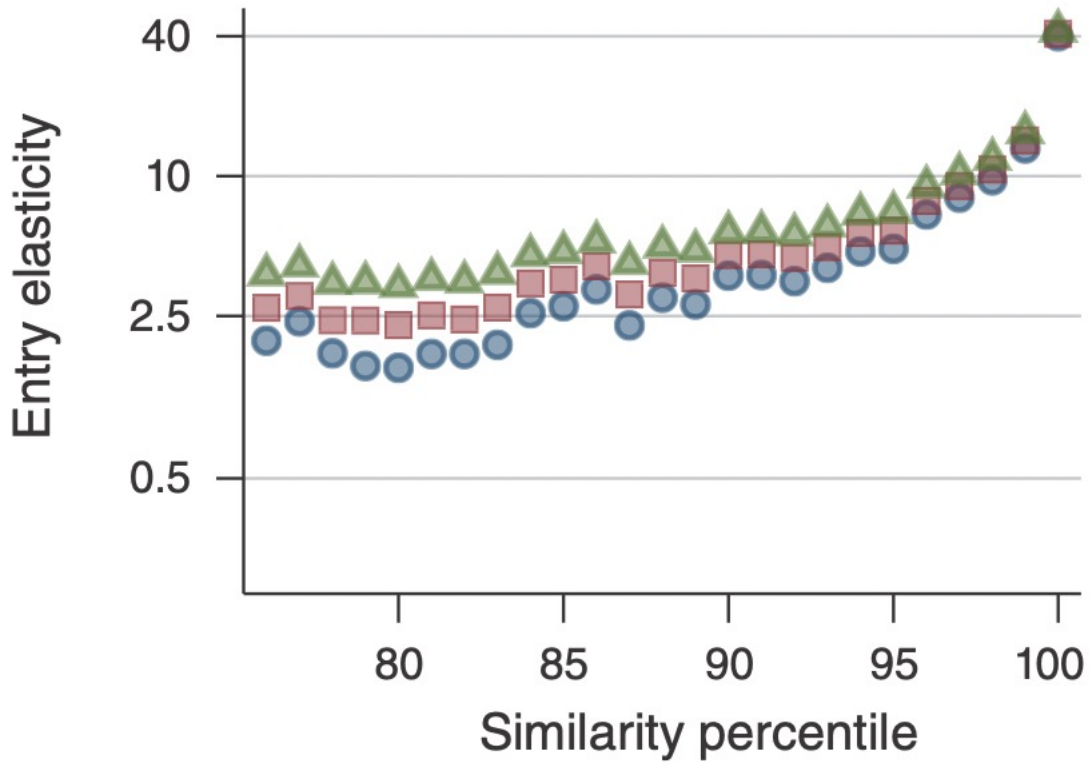
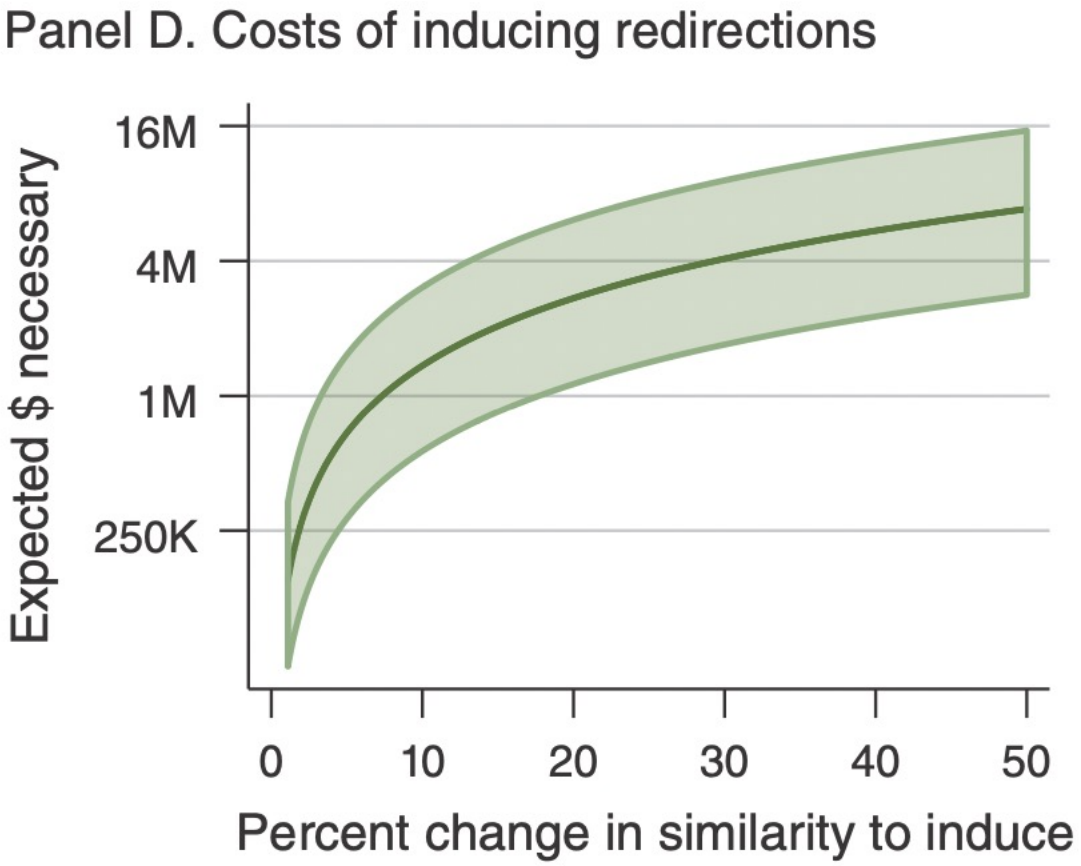


FIGURE 1. PROBABILITY OF RFA ENTRY PER SIMILARITY AND FUNDING


Panel A. RFA-Scientist similarity
Entry elasticity
40
10
2.5
0.5
80
85
90
95
100
Similarity percentile


Panel D. Costs of inducing redirections
Expected $ necessary
16M
4M
1M
250K
0
10
20
30
40
50
Percent change in similarity to induce

Myers (2020): The Elasticity of Science

- What does Myers want to do?
- How does he assess similarity of a scientist's research with an RFA?
- What are some challenges to computing elasticity of science in the paper?
- Why might research direction be so inelastic?

Resource Allocation in Science

Priority in Science

- Priority: scientific community recognizes a form of property rights for the first to discover and publish a finding
- Stein and Hill (2021): Scooped! Estimating the Rewards for Priority in Science
  - Structural Biology survey: If you were scooped, what do you think is …
    - … probability of publishing results? 67%
    - … the decline in citations you would receive? 41% of the citations to first to publish
  - Protein data bank confidentially receives data prior to publication.
    - Can detect teams that worked on same protein, have not yet published findings
    - Actual probability of being scooped? 8%
    - Actual decline in citations? 85% of the citation first to publish

Dasgupta and David (1994): Towards a New Economics of Science

- What are the advantages of a social reward system based on priority?
- What are some inefficiencies that could be induced by a priority system?

A “market” in social credit (from Hull 1988)

- Obtain “property rights” over an idea by being first to disclose it (priority)
- New ideas build on old ideas (science is cumulative)
- To “purchase” support for your new idea, pay the “owner” by citing the work with priority
  - (Actual currency is social credit; citations one proxy)
  - (Peer review can be very zealous in policing proper citation practices)
- Incentivizes:
  - New work (to claim priority)
  - Work that a community can validate
  - Work that will be valuable for further (new) research

Danger of priority system: Secrecy

- Why share results if you want priority?
- Why let someone stand on your shoulders?

A communication game in open science

- Inspired by Dasgupta and David, section 2.3
- Suppose: scientists in competition need to solve two subproblems to complete a research project.
- Assume each has solved a different subproblem, and can solve the other at cost c
- They can follow one of two strategies: share (cost s) or withhold
- $s < c < 0.5$

	Share	Withhold
Share	$0.5 - s$, $0.5 - s$	$-s$,1
Withhold	1, $-s$	$0.5 - c$, $0.5 - c$

A communication game in science

	Share	Withhold
Share	$0.5 - s$, $0.5 - s$	$-s$,1
Withhold	1, $-s$	$0.5 - c$, $0.5 - c$

- Standard prisoner's dilemma game
- Single-shot Nash equilibrium is (withhold, withhold)
- Repeated game Nash equilibrium: (Share, Share) (w/ grim trigger) is possible if discount rate is high enough:

$$\frac{0.5 - s}{1 - \beta} > 1 + \frac{\beta(0.5 - c)}{1 - \beta} \rightarrow \beta > \frac{1 + 2s}{1 + 2c}$$

- Sharing equilibrium more probable as cost of sharing falls and cost of independent research rises

A communication game in open science

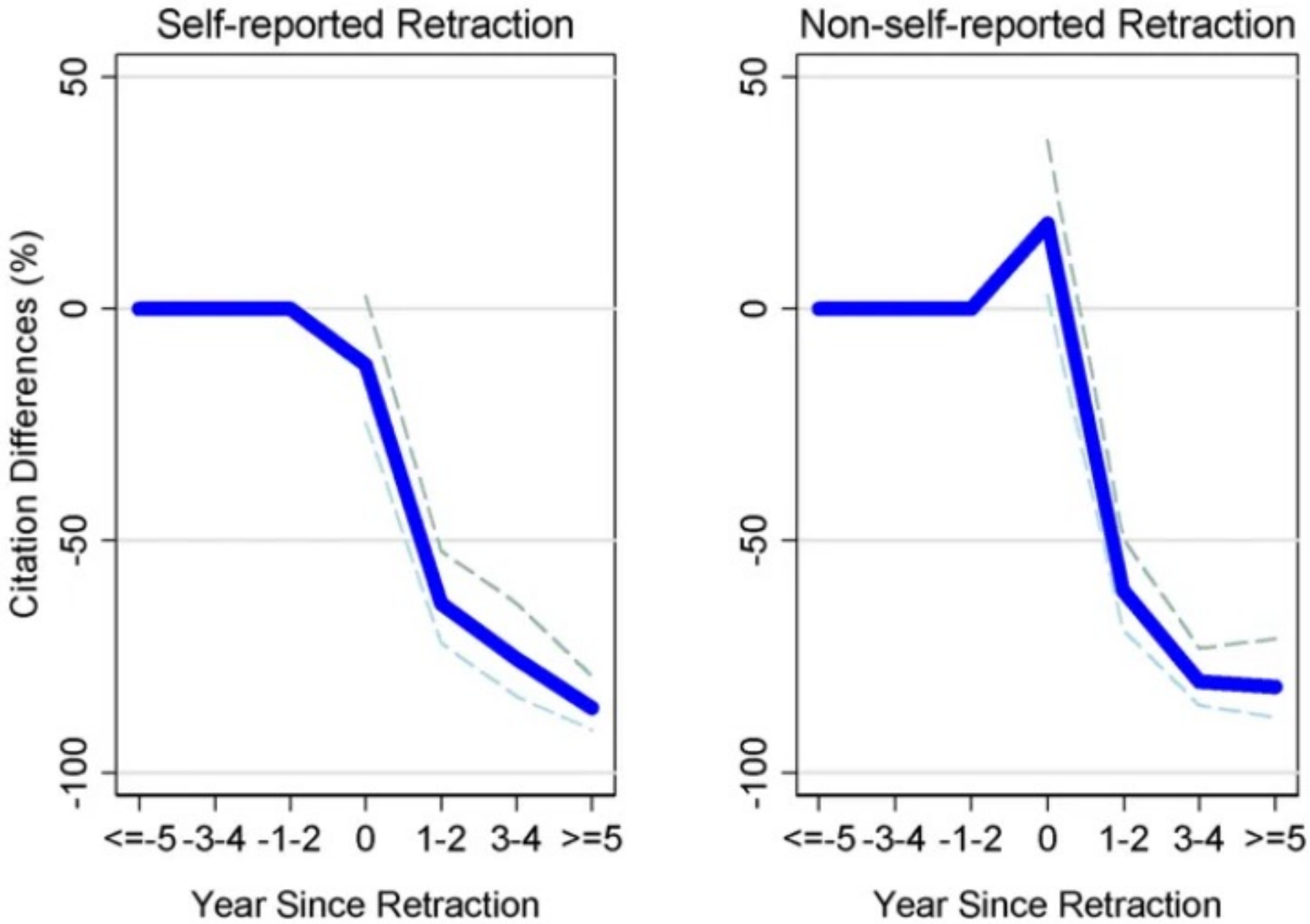
- You can extend this game to N players and obtain similar results
- Dasgupta and David do not propose grim trigger strategies for N players though; culture of science strategy
- Suppose **sanctioning** is possible at zero cost. Sanctioned players are kicked out of the community.
- All share equilibrium payoff: $\frac{1}{N}$
- Deviation pays 1 but is detected with probability $p(N)$
- Scientific norms of sharing sustainable if:

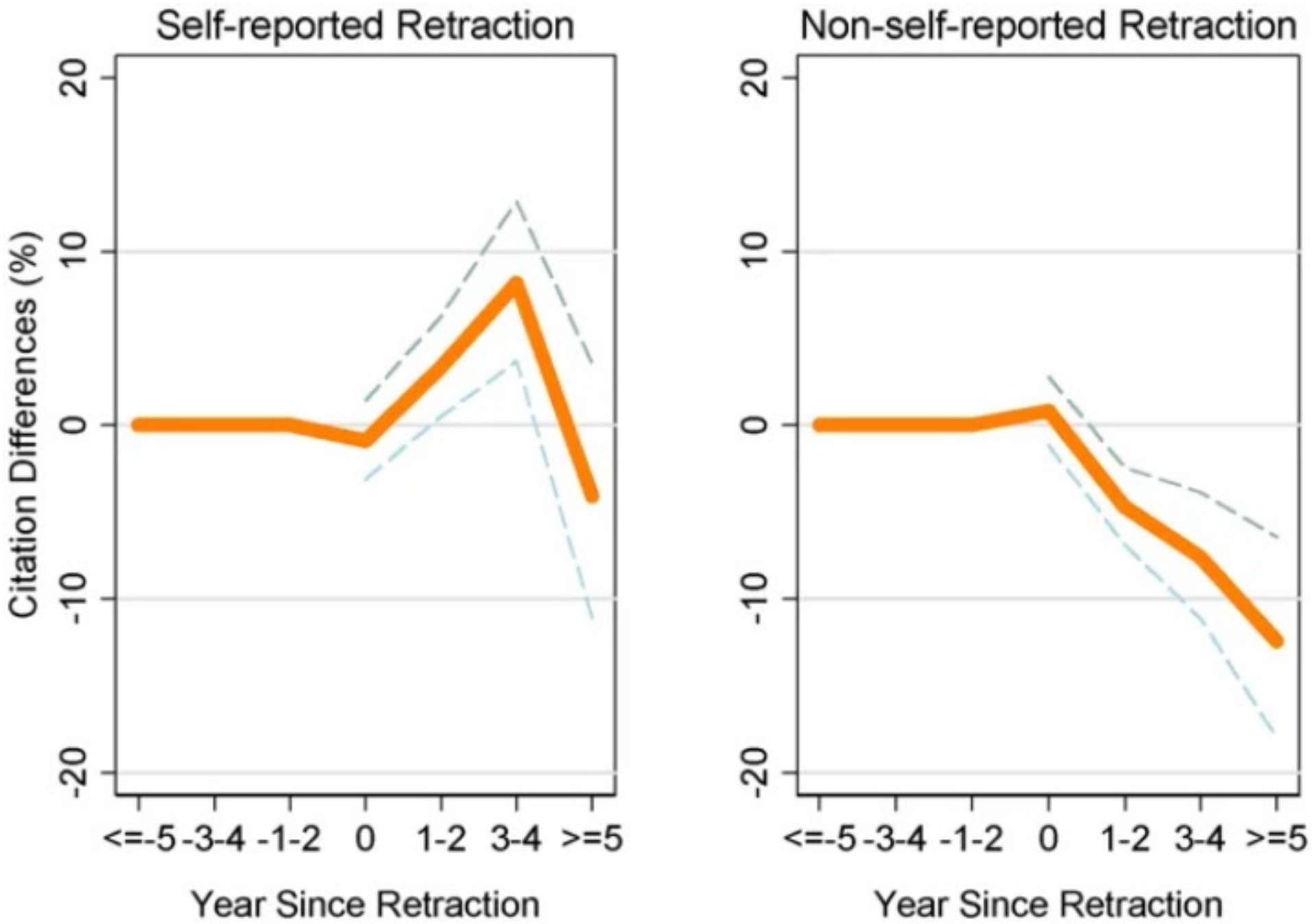
$$\frac{1}{N(1-\beta)} > \big(1-p(N)\big)\left(1+\frac{\beta}{N(1-\beta)}\right) \rightarrow p(N) > \frac{N-1}{N+\beta/(1-\beta)}$$

- If deviators can be detected with high enough probability (increasing in N), sharing dominates

Deviation and Punishment in Science

- Lu et al. (2013) - The retraction penalty: Evidence from the web of science
- What are the penalties for deviating from the norms of the scientific community, as measured by retraction?
- Compare citation trajectory of retracted papers to similar controls
- Compare citation trajectory of unretracted papers of scientists who retract to similar control papers


Self-reported Retraction
Non-self-reported Retraction
Citation Differences (%)
50
0
-50
-100
<=-5
-3-4
-1-2
0
1-2
3-4
>=5
Year Since Retraction


Self-reported Retraction
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Citation Differences (%)
20
10
0
-10
-20
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>=5
Year Since Retraction

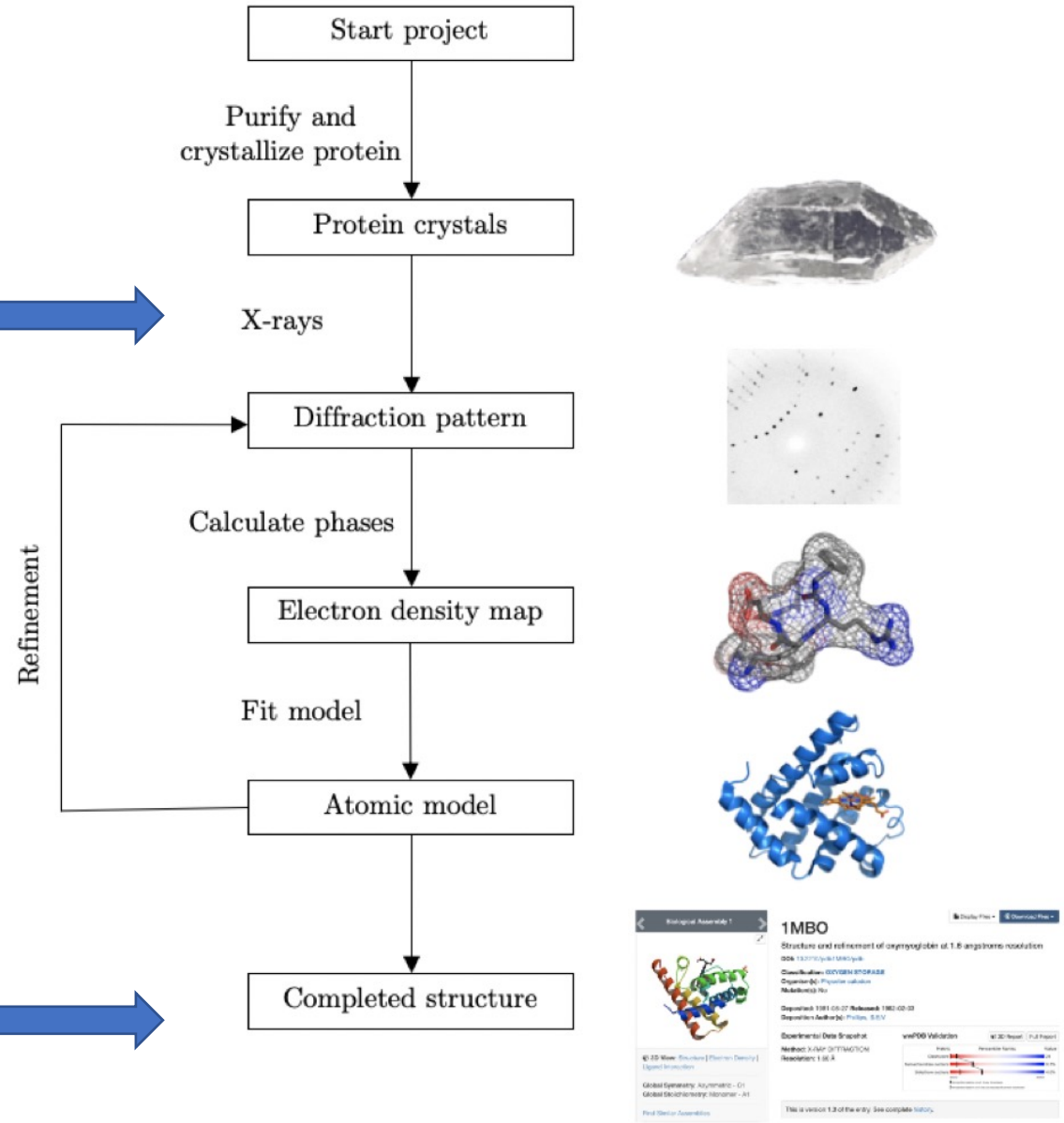
Danger of priority system: racing

- Hill and Stein (2021) - Race to the Bottom: Competition and Quality in Science
- Structural biology is a beautiful field to study. Data available on:
  - Which projects people are working on
  - How long they work on the projects
  - How good the resulting research is!
- Fields with more competition show less time spent on project, worse results

We observe when this happens

We observe when this happens
+ Quality of resulting models

Figure 3: Summary of the X-Ray Crystallography Process

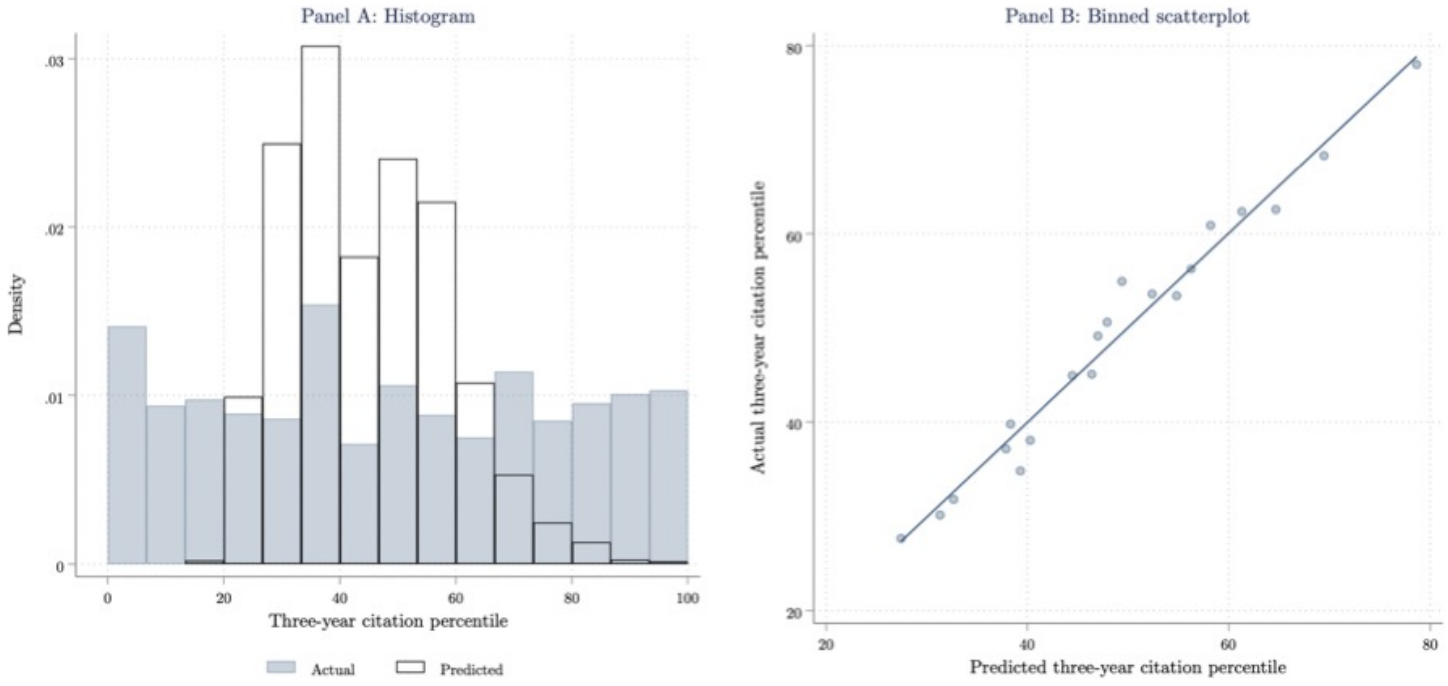


Notes: This figure summarizes the process of solving a protein structure via x-ray crystallography. The images in this figure were taken from Thomas Splettstoesser (www.scistyle.com) and rendered with PyMol based on PDB ID 1MBO.

Hill and Stein (2021): Race to the Bottom

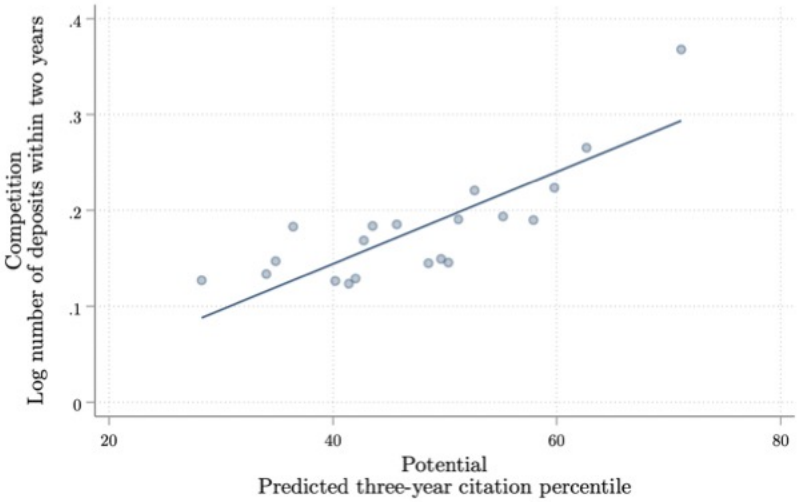
- Hill and Stein estimate "potential" of a protein
- LASSO regression: what kinds of proteins get more citations?

Figure 4: LASSO Validation



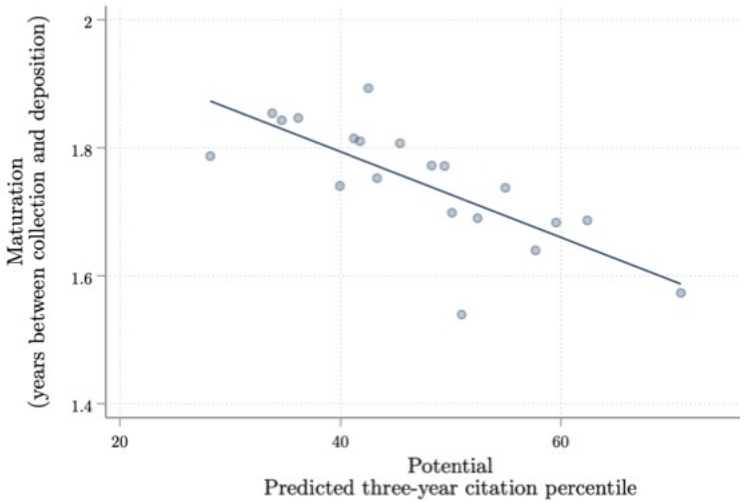
Competition

Figure 6: The Effect of Potential on Competition

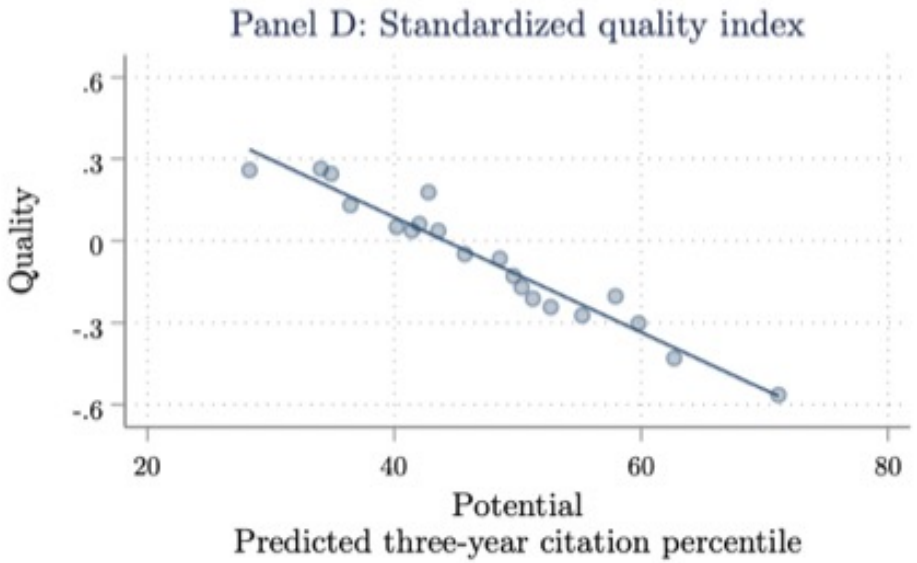


Duration of Study

Figure 7: The Effect of Potential on Maturation



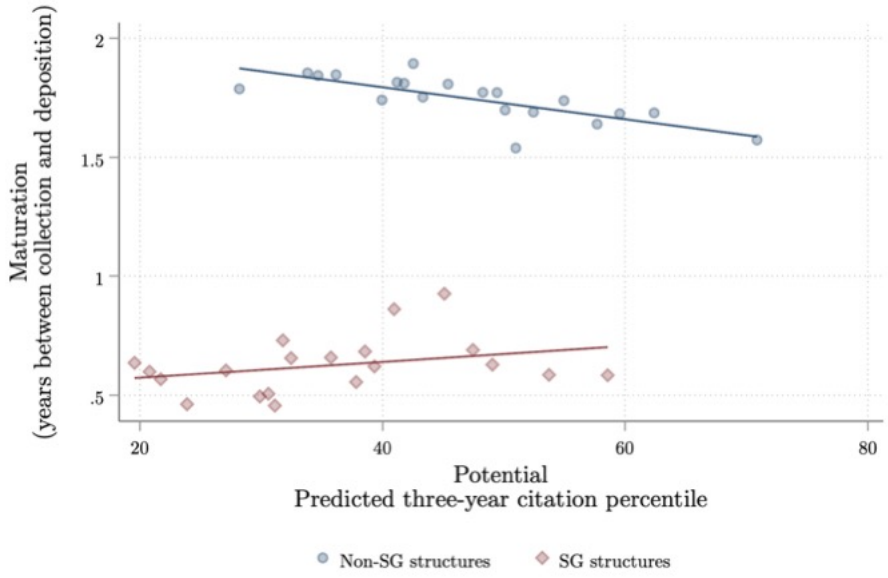
Quality

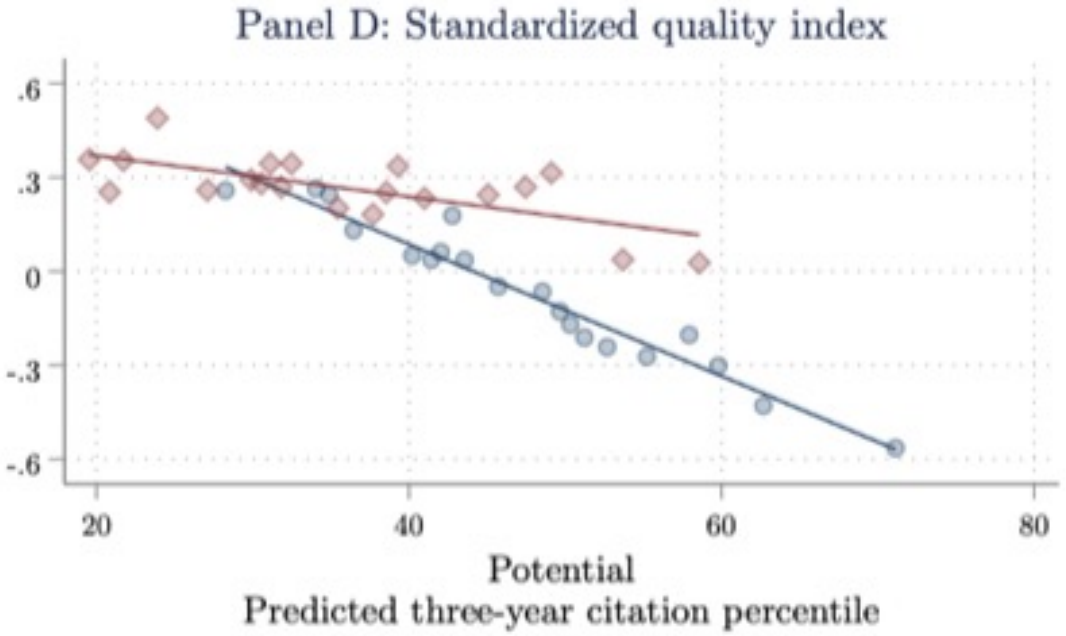


Hill and Stein (2021): Race to the Bottom

- If this is about priority in academia, what about structural biology workers outside of academia?
- Structural genomics groups provide alternative

Figure 10: The Effect of Potential on Maturation by Structural Genomics S





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- Subjective assessment of personal interest and importance

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- Individual assessment of personal interest and importance
- Individual assessment of communal interest and importance
  - Science as a Keynesian beauty contest?

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Most funds are allocated by peer review

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Illustration

- Consider these five papers:
  - Paper 1: "Academic Freedom, Private Sector Focus, and the Process of Innovation" by Aghion, Dewatripont, and Stein
  - Paper 2: "The Dual Frontier: Patented Inventions and Prior Scientific Advances" by Ahmadpoor and Jones
  - Paper 3: "Does Science Advance One Funeral at a Time?" by Azoulay, Fons-Rosen, and Graff-Zivin
  - Paper 4: "Towards a New Economics of Science" by Dasgupta and David
  - Paper 5: "The Elasticity of Science" by Myers
- Which looks most interesting to you?
- Which do you think will be voted most interesting by the class?

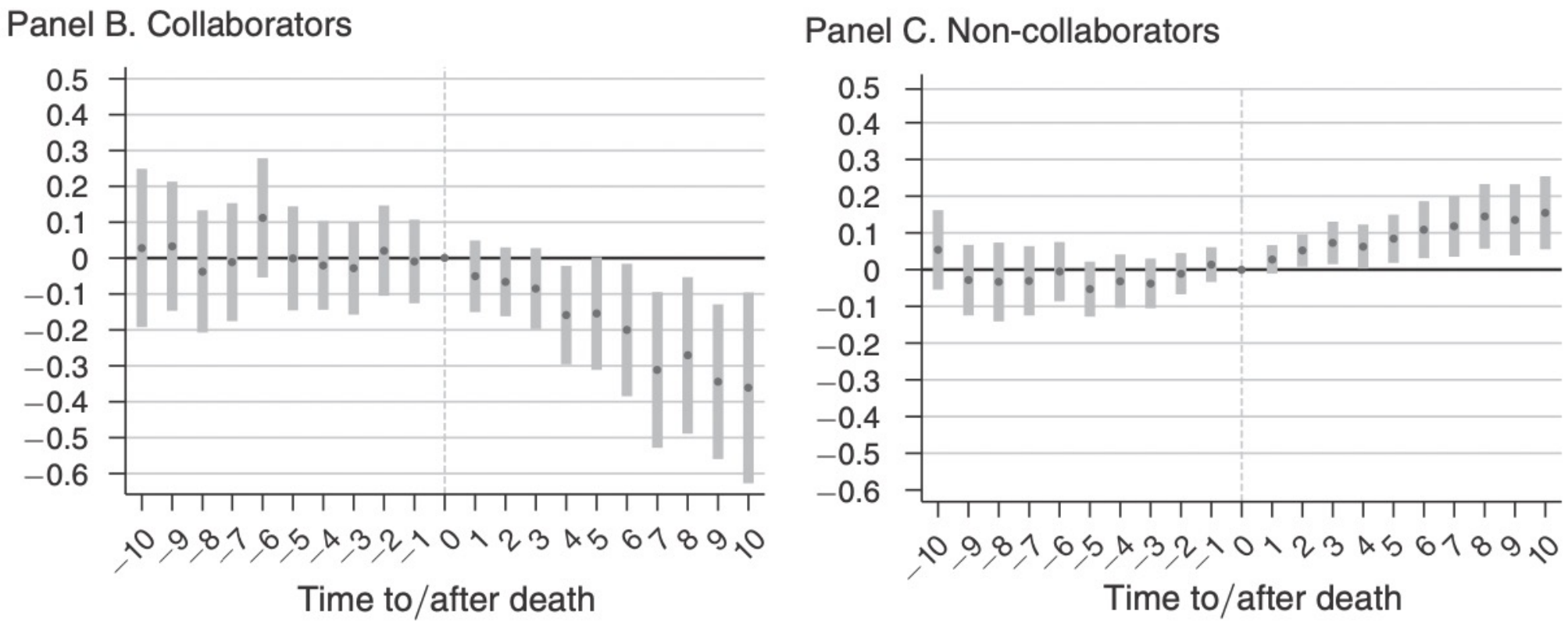
Azoulay, Fons-Rosen, Graff Zivin (2019): Does science advance one funeral at a time?

"*A new scientific truth does not triumph by convincing its opponents and making them see the light, but rather because its opponents eventually die, and a new generation grows up that is familiar with it.*"

Max Planck

- What do Azoulay, Fons-Rosen, and Graff Zivin want to do?
- How is this related to decisions about the allocation of attention (and other resources) to research questions in science?
- What is their empirical approach? Sample? Matching?

Does science advance one funeral at a time?



Does science advance one funeral at a time?

- In terms of the research questions asked and approaches taken, do entrants differ from the deceased or not? How do we know?
- How do elite scientists "block" entrants, if they do?

Two quotes

"It is not from the benevolence of the butcher, the brewer, or the baker that we expect our dinner, but from their regard to their own self-interest. We address ourselves not to their humanity but to their self-love, and never talk to them of our own necessities, but of their advantages"

- Adam Smith, Wealth of Nations Volume 1

Two quotes

"…communities of scientific peers define what contributions to knowledge it is worth bothering to have arrived at before others. What effect does this have? It creates a cumulative, chain-linked impetus to the advance of knowledge, because **what turns out generally to be appreciated is the disclosure of knowledge that aids (or is expected to aid) colleagues in the field in generating findings** on the basis of which they can establish priority claims of their own."

- Dasgupta and David (1994)

Science for Technology

Science for Social Welfare

- Markets and social welfare: 1st & 2nd welfare theorems
- What about science?
  - Individual assessments of social impact
  - Collective assessments of social impact (focal points?)
  - This can be desirable, if taste for research freedom lowers costs of research

Aghion, Dewatripont, and Stein (2008)

- What are Aghion, Dewatripont, and Stein trying to model? And what are the key assumptions?
- Intuitively, why is a non-market system for allocating scientific resources potentially desirable in their paper?

Aghion, Dewatripont, and Stein (2008)

Knowledge production assumptions

- Research projects proceeds in stages
- A project completing k stages is worth V
- Working directly on the "most practical" approach, advance to next stage with probability p
- **Scientists are easily distracted**; with probability α they are interested in the practical approach
- Scientists have reservation wage rate R
- Scientists have additional disutility z if forced to work on a project they are not interested in

Aghion, Dewatripont, and Stein (2008)

- What do we need to pay scientists?
  - If we don't care what they work on (academia): $w_a = R$
  - If we want them to work on the practical problem (private sector):

$$w_p = R + (1 - \alpha)z$$

- What is the probability we advance to the next stage in each institution?
  - Academia (do what you want): αp
  - Private sector (you must work on the project): p
- What is the value of a research project?

Aghion, Dewatripont, and Stein (2008)

- Suppose you are on stage *k* (final stage)

  Academic value: $\Pi_k^a = \alpha p V - R$

  Private sector value: $\Pi_k^p = pV - (R + (1-\alpha)z)$

- The value of the project is higher in the private sector if:

$$\Pi_k^p - \Pi_k^a > 0 \rightarrow (1-\alpha)pV - (1-\alpha)z > 0$$
$$pV > z$$

- If expected value of focused research exceeds disutility of working on projects that are not interesting, private sector has higher value
- Define: $\Pi_k = \max \ \{\Pi_k^a, \Pi_k^p\}$

Aghion, Dewatripont, and Stein (2008)

- Go back one stage to *k* – 1. Next period, use value maximizing institution.

  Academic value: $\Pi_{k-1}^{a} = \alpha p \Pi_k - R$

  Private sector value: $\Pi_{k-1}^{p} = p\Pi_k - (R + (1-\alpha)z)$

- The value of the project is higher in the private sector if:

$$\Pi_{k-1}^{p} - \Pi_{k-1}^{a} > 0 \rightarrow (1-\alpha)p\Pi_k - (1-\alpha)z > 0$$

$$p\Pi_k > z$$

Aghion, Dewatripont, and Stein (2008)

- Recursively, for any stage *i* project value is higher in private sector if:

$$p\Pi_i > z$$

- Proposition 1: It cannot be value maximizing to have academia operate at later stages than the private sector
  - An explanation for why universities focus on "basic" or "upstream" research
- Intuition:
  - You can increase the probability an idea succeeds at some cost (supervising/monitoring researchers, compensation for disutility)
  - Cost of increasing probability is always the same: $(1-\alpha)z$
  - Every stage, the increased probability gets bigger: $\alpha P_i \rightarrow P_i$

Aghion, Dewatripont, and Stein (2008)

- If k is large enough, some ideas are not viable if entirely privately led
- Ideas may have higher value in academia than in private sector, at early enough stage
- Therefore, academia can enable some ideas to be completed that would not otherwise exist
  - Extension: when researchers get distracted, they may sometimes "birth" new research projects
  - Private sector researchers never get distracted; never birth new fields
- **Bottom line: Academia can enable more ideas to be completed**

Aghion, Dewatripont, and Stein (2008)

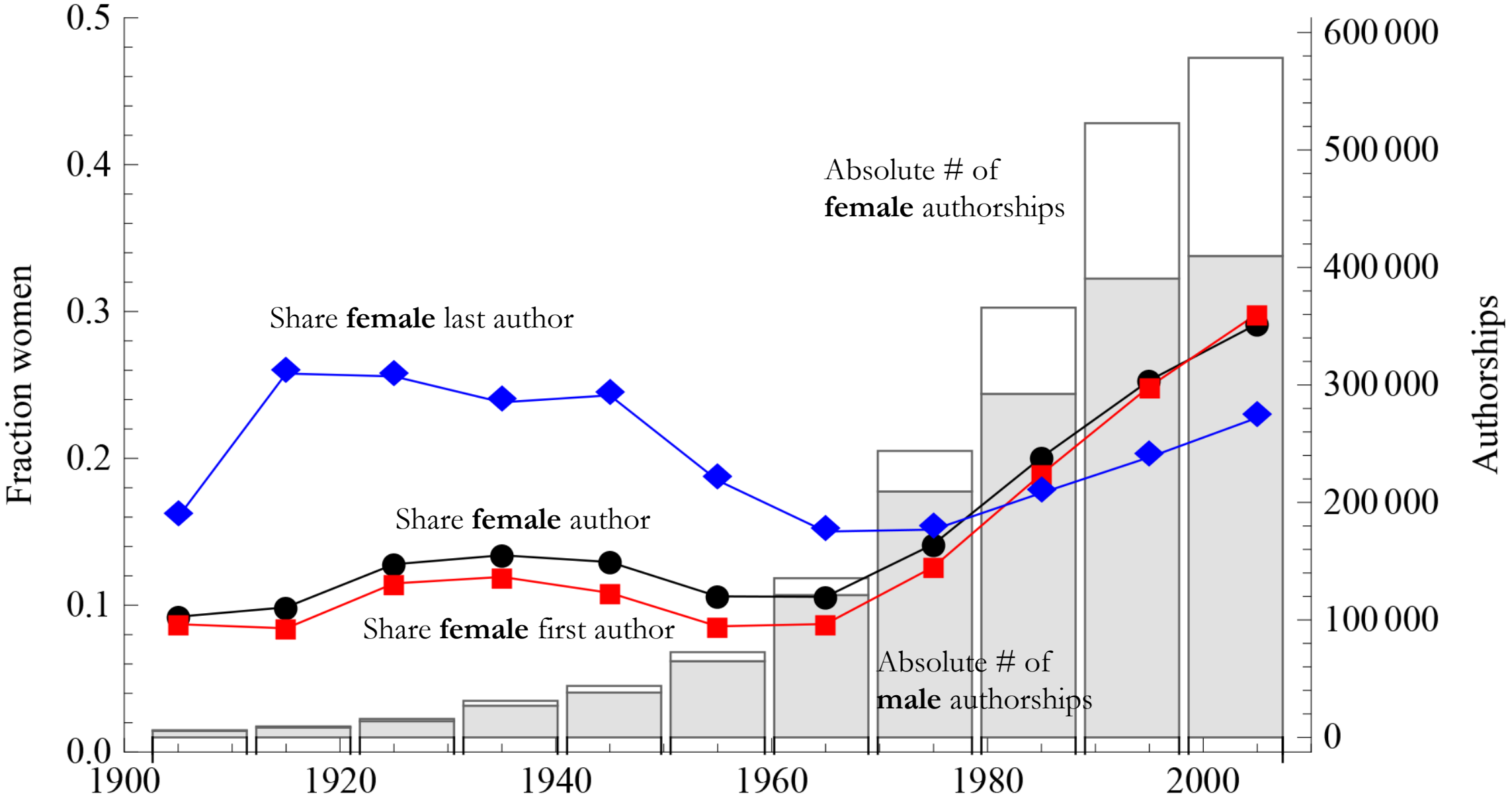
- What are Aghion, Dewatripont, and Stein trying to model? And what are the key assumptions?
- Intuitively, why is a non-market system for allocating scientific resources potentially desirable in their paper?
- Potential issues with this paper?

Science for Social Welfare

- Markets and social welfare: 1st & 2nd welfare theorems
- What about science?
  - Individual assessments of social impact
  - Collective assessments of social impact (focal points?)
  - This can be desirable, if taste for research freedom lowers costs of research

Representation matters

- What scientific topics attract resources may be largely due to individual and collective assessments of value to society
- Change the background of scientists, change research?
- One case study: gender and science



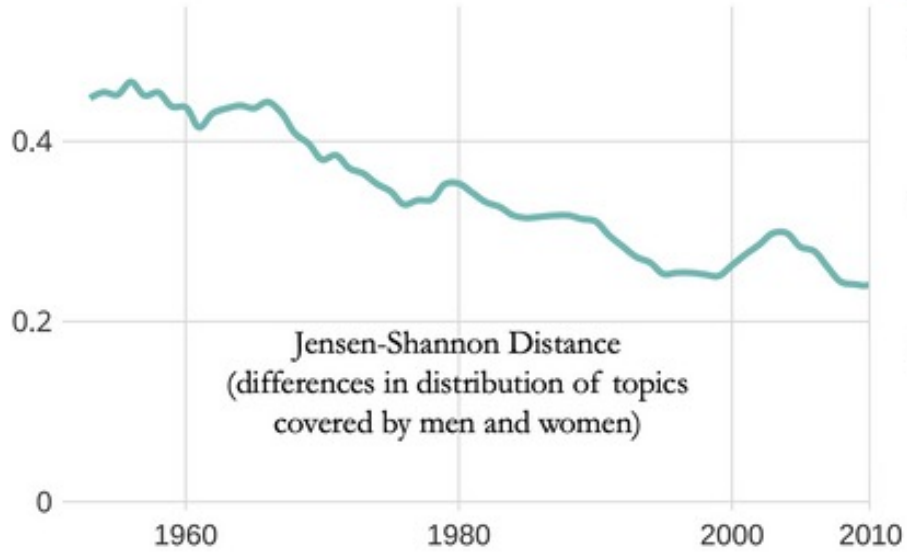
West et al. (2013)

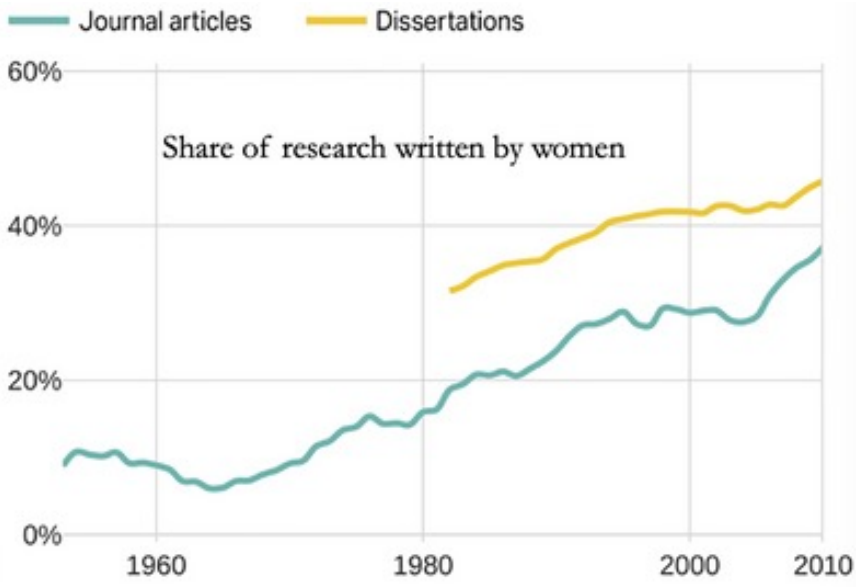
Individual Assessment of What Matters

- Nielsen et al. (2017): biomedical papers with more scientists who identify as women are more likely to include a gender and sex analysis
- Koning, Samila, and Ferguson (2021): among biomedical scientists, the greater the share of women on a team, the more likely the paper is to study a disease affecting women
- Risi et al. (2022): among historians, there is significant variation in gender share by subtopics
- Truffa and Wong (2022): Incumbent male faculty more likely to do gender related work after their schools go coed

Collective Assessment of What Matters

- Nielsen et al. (2017): All-male teams in fields with a greater share of women are more likely to include a gender and sex analysis
- Risi et al. (2022): knowing gender has become increasing less predictive of topical choice; male and female authored articles increasingly likely to include gender-salient words in titles





Representation matters

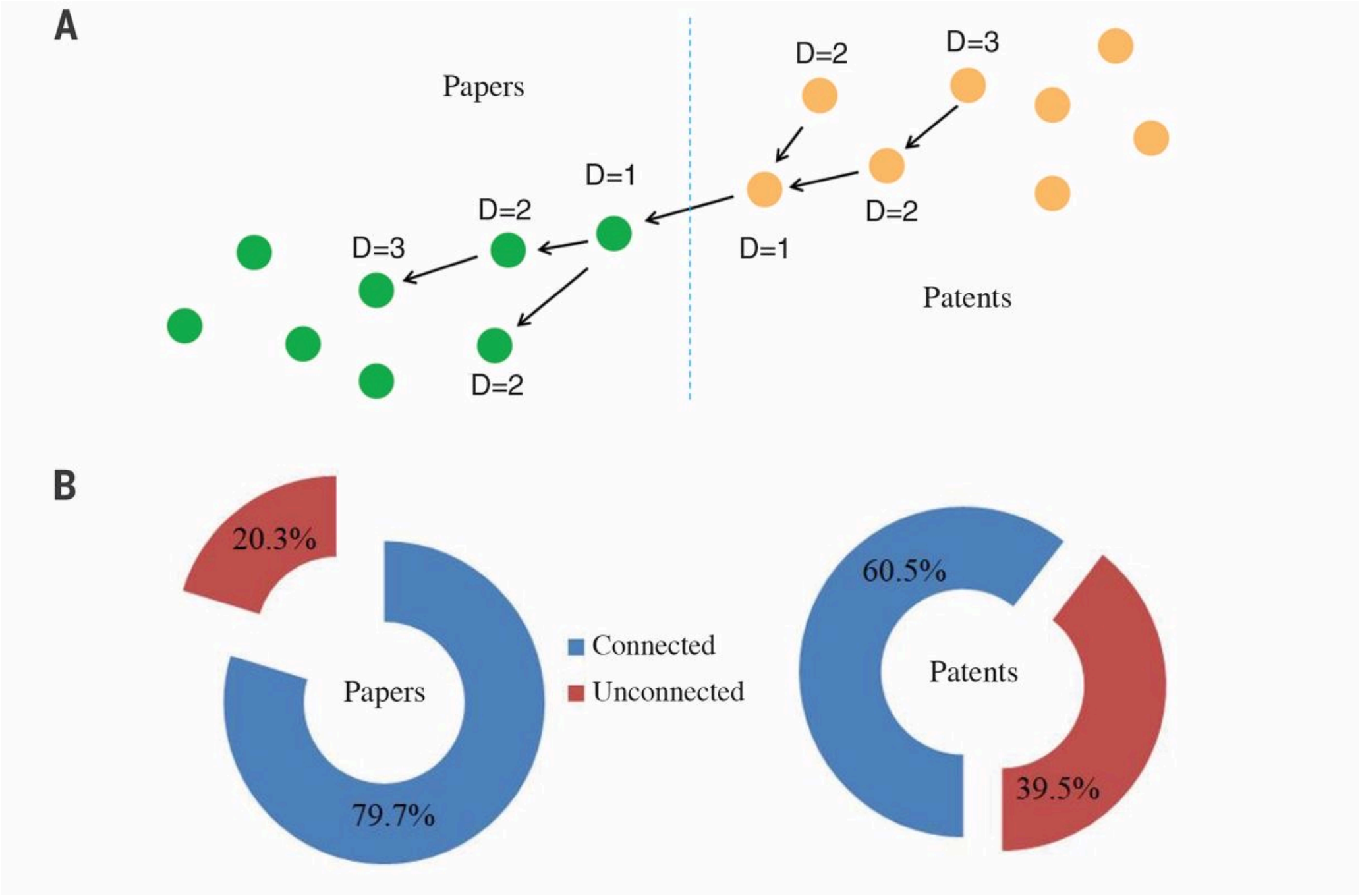
- What scientific topics attract resources may be largely due to individual and collective assessments of value to society
- Change the background of scientists, change research?
- One case study: gender and science
- Other dimensions of representation?
    - Geography
    - Income
    - Race/ethnicity
    - Disability
    - Age
    - Others?

Science for Social Welfare

- Markets and social welfare: 1st & 2nd welfare theorems
- What about science?
  - Individual assessments of social impact
  - Collective assessments of social impact (focal points?)
  - This can be desirable, if taste for research freedom lowers costs of research
- Science also trains researchers for private sector
  - Private sector gains access to high human capital, frontier ideas
  - Science has access to cheaper trainee labor
  - Training duties is a riskless component of otherwise risky science jobs

Does technology depend on science?

- Ahmadpoor and Jones (2017) - The Dual Frontier: Patented Inventions and Prior Scientific Advance
- What is this paper trying to do?
- What is the approach taken?
- What are some things to worry about?


A
Papers
Patents
D=1
D=2
D=3
D=2
D=3
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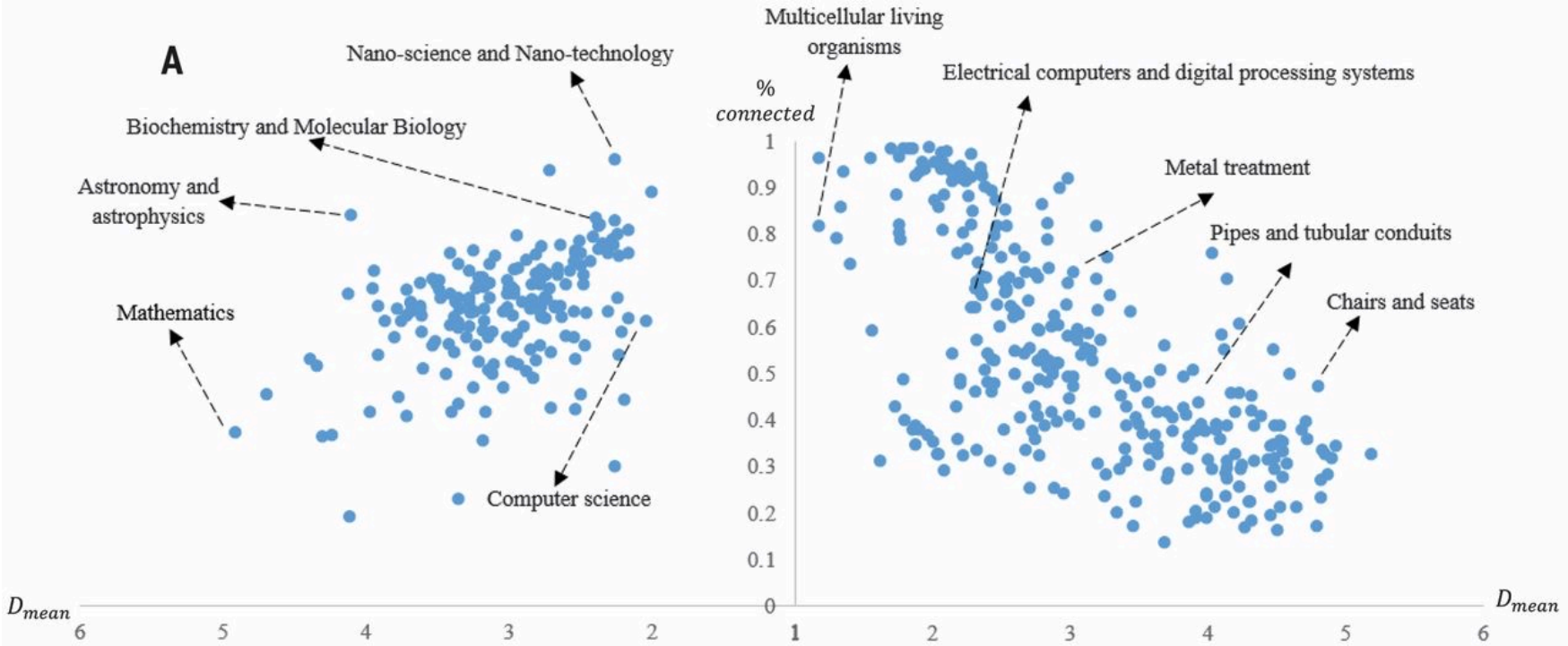
D=1
D=2
B
20.3%
79.7%
Papers
Connected
Unconnected
60.5%
39.5%
Patents


A
Nano-science and Nano-technology
Biochemistry and Molecular Biology
Astronomy and astrophysics
Mathematics
Computer science
Multicellular living organisms
Electrical computers and digital processing systems
Metal treatment
Pipes and tubular conduits
Chairs and seats
% connected
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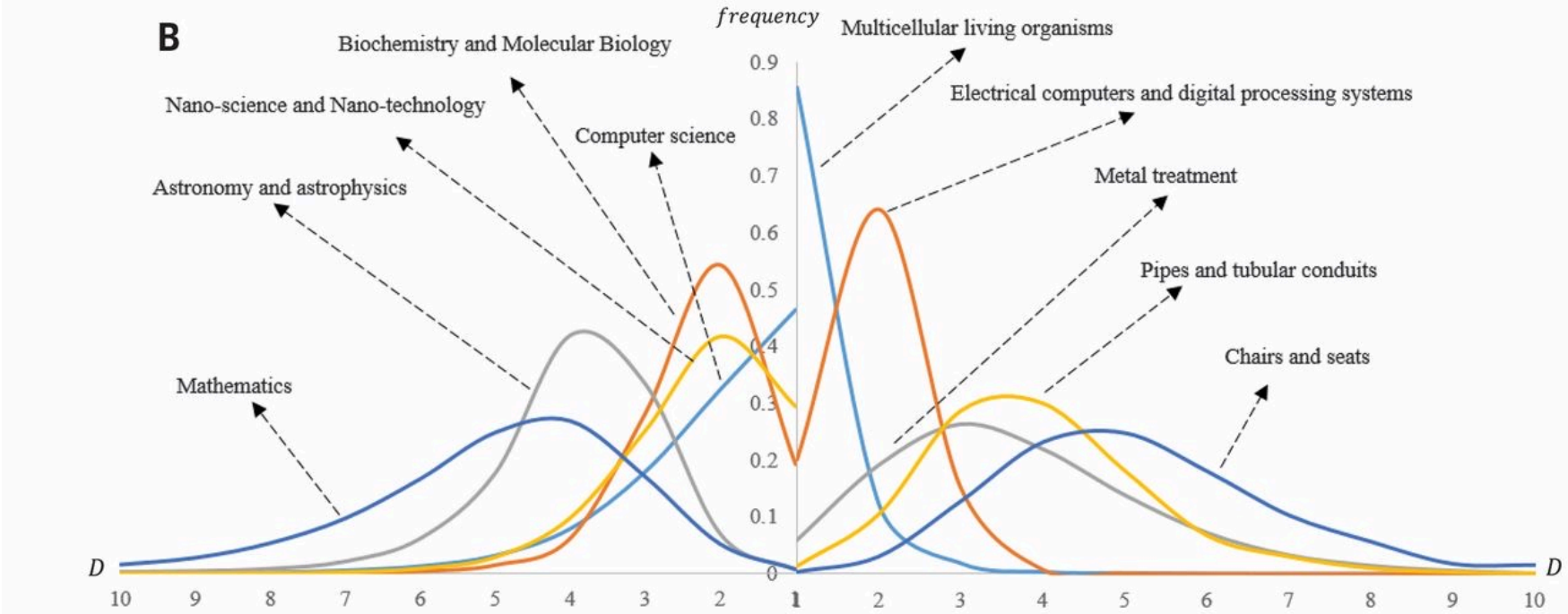
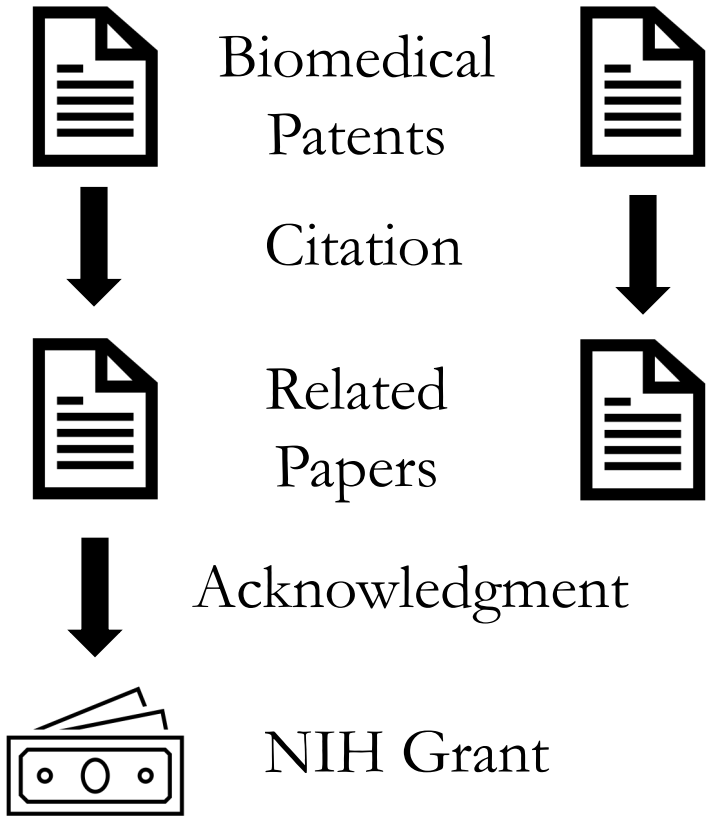

B
frequency
Biochemistry and Molecular Biology
Nano-science and Nano-technology
Computer science
Astronomy and astrophysics
Mathematics
Multicellular living organisms
Electrical computers and digital processing systems
Metal treatment
Pipes and tubular conduits
Chairs and seats
D
D

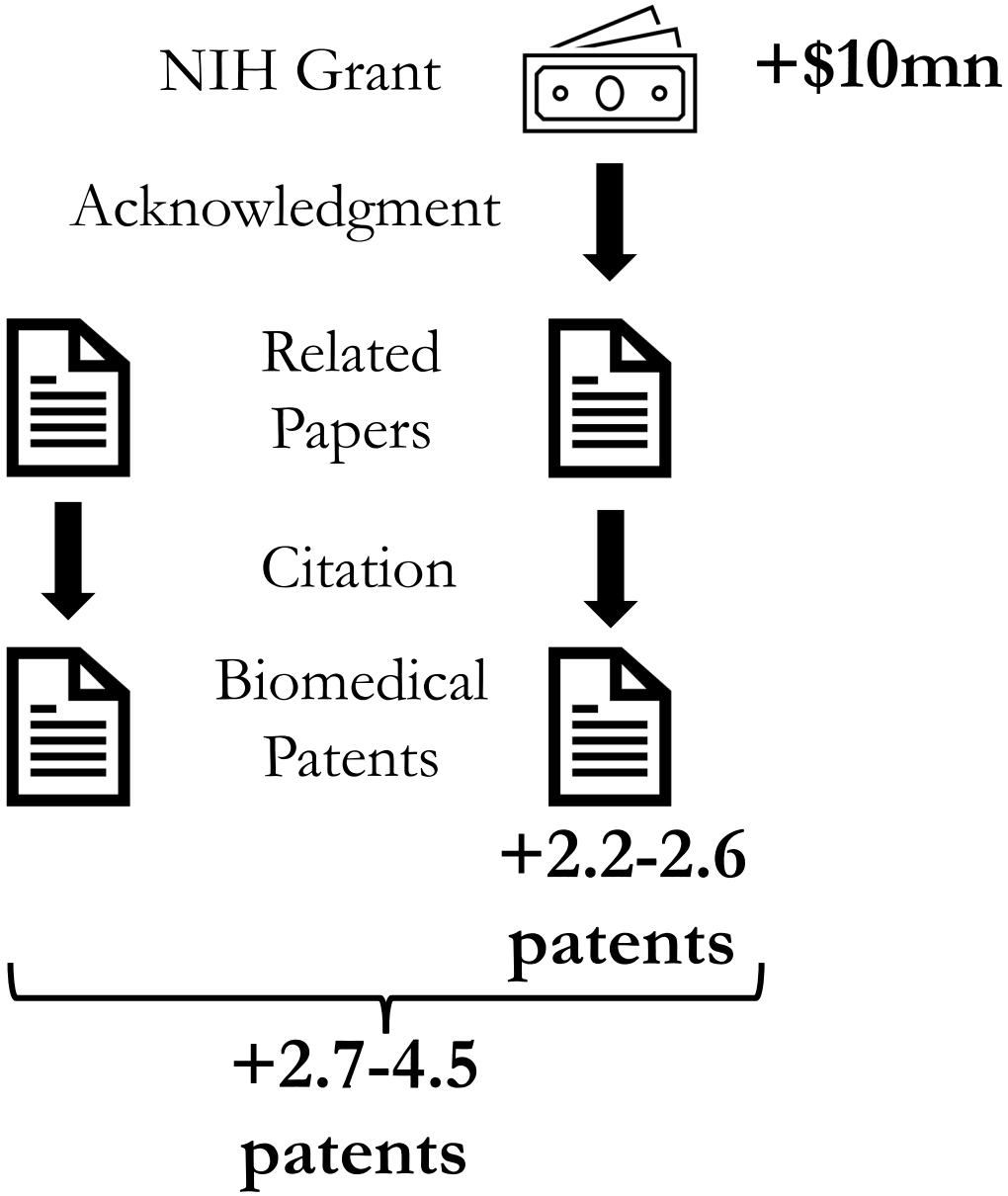
Does technology depend on science?

- TFP and science
  - Adams (1990): Number of articles published in related fields is correlated with TFP changes in industry 20 years later
  - Baldos et al. (2018): Using a Bayesian approach, public R&D funding for agricultural science is correlated with agricultural TFP growth 20 years later
- Patents and science
  - Watzinger and Schnitzer (2019): Patents citing science are more valuable, more likely to include novel combinations of words
  - Arora, Belenzon, and Suh (2021): (among other things), collapse of USSR as source of exogenous shocks to science funding – fields with more funding publish more papers, more patents in related fields cite the science

Azoulay et al. (2019)
Public R&D Investments and Private Sector Patenting: Evidence from NIH Funding Rules

- Can track citation chain from patents to papers to NIH grants
- Also track patents to papers in same scientific field, but not receiving NIH grants
- Compare:
  - # of patents in year-science-disease area to
  - $ in year-science-disease area
- Idiosyncracies in NIH funding rules exploited to identify quasirandom windfall funds




NIH Grant
+$10mn
Acknowledgment
Related
Papers
Citation
Biomedical
Patents
+2.2-2.6
patents
+2.7-4.5
patents

Charting the Frontier

What's going on in the economics of science?

- How do management practices matter for science?
- What drives publication bias? Can it be fixed? How should we design the publication process?
- How should select which project to fund? Who should decide? Can we design better incentive systems to do a good job?
- How should grants be structured?
- Can we do a better job measuring the impact of science?
- What is the role of replication in science? How do incentives for replication work?

What's going on in the economics of science?

- When does technology transfer work well and when does it not?
- What factors hinder representation in science, and how can they be fixed?
- What is the impact of aging on science?
- How is the internet changing science? Use of knowledge? Team formation? Seminars? Representation?
- How is AI and machine learning changing science?
- Does the rising scale of science lead to new kinds of dysfunction?

Additional Topics

Incentives in Grant-Making

Focal Points in Research

Appendices

A Model of Grant-Making

- Inspired by Scotchmer (2006)
- Scientists:
  - Research projects can be performed at cost c to scientist
  - Research succeeds with probability p_i where p_i is unobservable to funder, known to scientist, and varies across scientists
  - Funds for science are needed **up front**; incentives must be dynamic
- Funder:
  - Provide funds v to scientists to perform research where $v > c$
- **Funder's rule:**
  - **First grant for all applicants**
  - **Subsequent grants given to everyone who completed research last period**

Expected Value of Doing Research

$$E[V_r] = v - c + \sum_{t=1}^{\infty} (\delta p_i)^t (v - c)$$

Value this period is $(v - c)$;

Conditional on succeeding (p_i) and discount (δ) obtain same thing next period

Simplifies:

$$E[V_r] = \frac{v - c}{1 - \delta p_i}$$

Expected Value of Shirking

$$v$$

Obtain v this period (no cost of research). Never receive future grants.

Who performs research?

- Performing research is optimal if

$$\frac{v - c}{1 - \delta p_i} > v$$

- Solve for p_i:

$$p_i > \frac{c}{\delta v}$$

- Result: In long run only scientists with high p_i are funded
  - Incentive effect: only scientists with sufficiently high p_i stay in research game
  - Selection effect: among scientists with $p_i > c/\delta v$, higher p_i more likely to be retained
- Observation: grant-makers do rely heavily on past research success

Risky Research?

- What if can choose from a menu of projects that vary by risk?
- Perhaps some projects are high-risk but highly socially valuable?
- In this grant-model, scientists would maximize p_i
- In fact, grant-makers are routinely criticized for being [excessively risk averse]
- How to incentivize riskier work?

Manso (2011): Motivating Innovation

- Simplified setup:
- One scientist, doing research in two periods
- Three research projects feasible:
  - Shirk: Succeeds with probability p_0 but costs 0
  - Exploitation: Succeeds with probability p_1 every period
  - Exploration:
    - Succeeds with probability p_2 in first period
    - Succeeds with probability p_{2F} in second period, if first period research fails
    - Succeeds with probability p_{2S} in second period, if first period research succeeds
  - $p_0 < p_{2F} < p_2 < p_1 < p_{2S}$
- Funder cannot observer research type. Only observes failure or success in each period
- How to design a contract to incentive exploration?

Manso (2011): Motivating Innovation

Optimal contract should…

… Reward success in period 2

… NOT reward success in period 1

… in some cases, reward failure in period 1!

Rewards in period 1 encourage exploitation (bad)

Rewards in period 2 discourage shirking in either period (good)

Risky research should be long-term and highly tolerant of early failure

An empirical application: NIH vs. HHMI

National Institutes of Health (NIH)

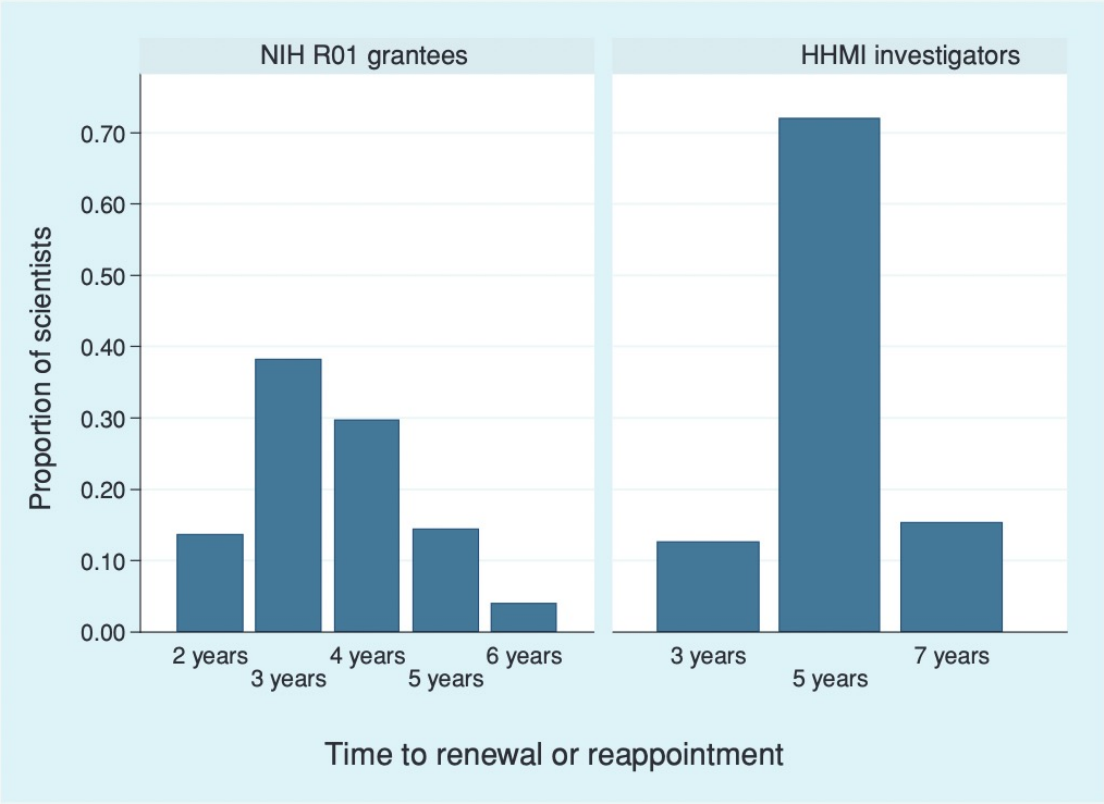
- biggest US biomedical science funder ($45bn in 2022)
- Specific project proposals evaluated by peer review sections
- NIH reputation for risk aversion
- Grant renewal after 3-5 years; review similar to first application
- Some feedback provided
- Funds end if not renewed

Howard Hughes Medical Institute (HHMI)

- $831mn budget in 2021
- Individual investigators selected (nominated by others)
- Encourages risk and experimentation
- Grant renewal after 5 years; first review is relaxed (are you experimenting?)
- Feedback from renowned scientists
- Funds end after two years if not renewed

Time to renewal

LENGTH OF NIH R01 GRANTS VERSUS HHMI APPOINTMENTS



Azoulay, Graff Zivin, and Manso (2011)

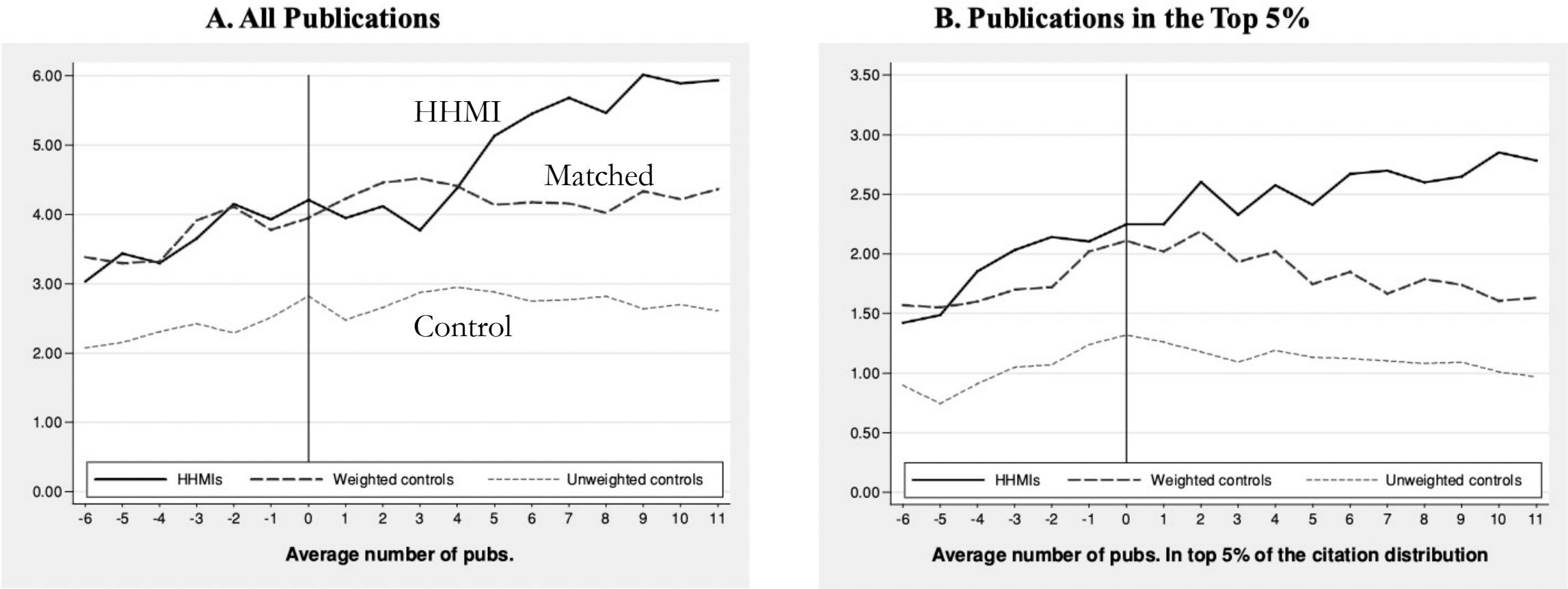
- Does funding mechanism affect risk taking and research productivity?
- Ideal: compare identical researchers, operating under NIH and HHMI regimes
- How to measure outcomes?
  - Research productivity: Total publications, top cited publications
  - Appetite for risk: variance of citation outcomes (number of "flops")
  - Exploration: "younger" MeSH words, change in MeSH keywords, diversity of citations
- Challenge: HHMI cherrypicks the best researchers
- Comparing HHMI to NIH will probably show HHMI outperformance even if funding mechanism does not actually matter

Azoulay, Graff Zivin, and Manso (2011)

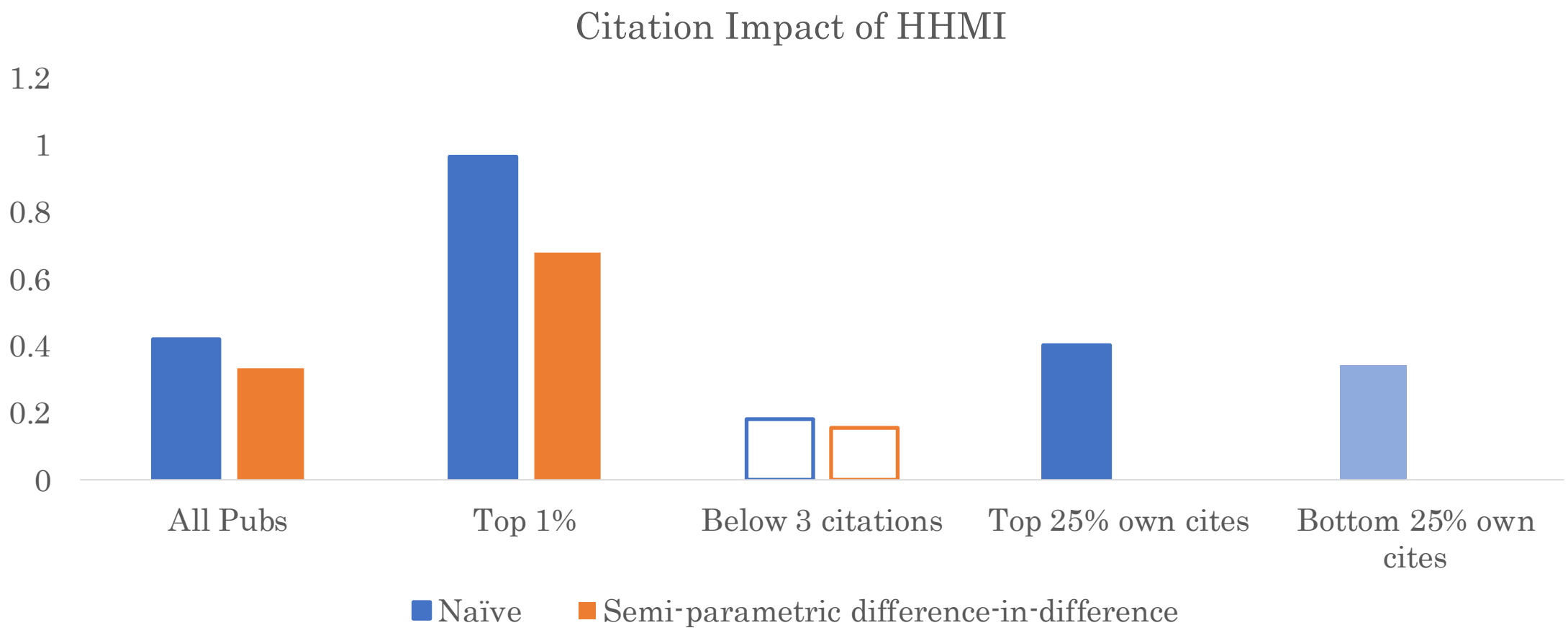
Approach: control panel of accomplished non-HHMI scientists + propensity score matching

- Early career prize winners (Pew, Searle, Beckman, Packard, and Rita Allen scholarships)
- About 60 per year – major honor, but not enough funds to escape R01 system
- Match to HHMI winners on career age, field, laboratory type, gender, cumulative NIH funding, publications, top publications

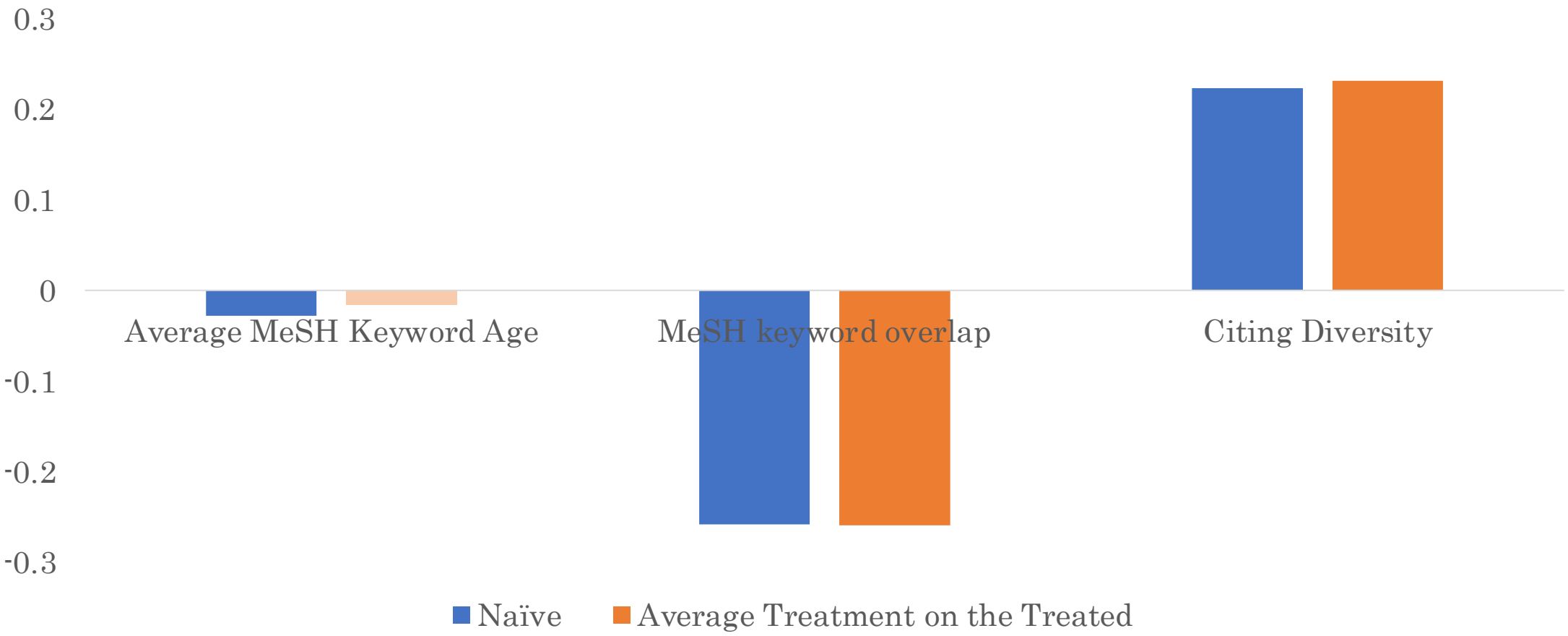
Research Productivity



Risk: HHMI vs. NIH



Exploration: HHMI vs. NIH



Tenure to encourage risk-taking?

Why do we have tenure?

- Carmichael (1988):
  - Suppose the quality of scientific promise can only be evaluated by peers
  - University needs input from faculty to evaluate hires
  - Challenge: if universities only retain best faculty, then incentive to recommend hiring low promise candidates
  - One resolution: give faculty recommending new hires job security – tenure
- Non-monetary incentive to perform research
  - Job security
  - Academic freedom

Does Tenure Lead to Risk-Taking?

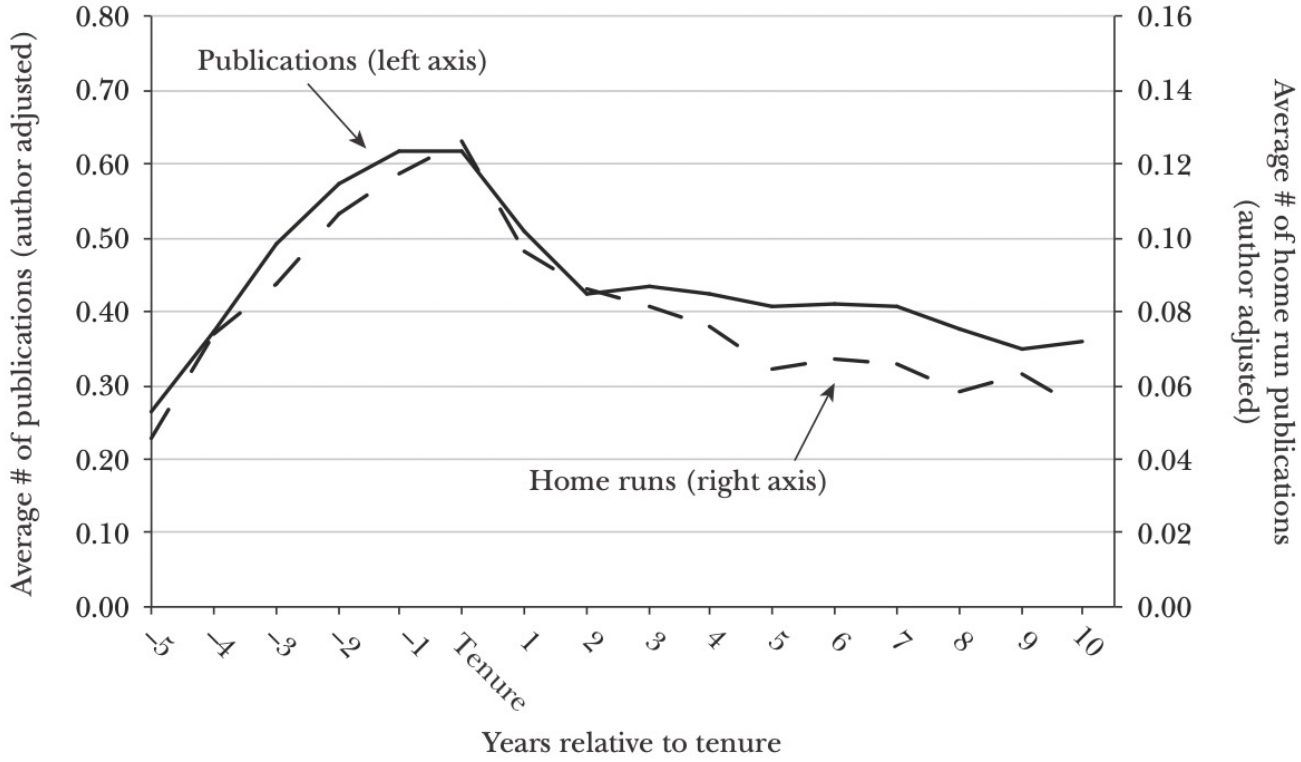
Tenure…

- is <u>very</u> tolerant of failure = + Risk taking?
- selects for project completion= + exploitation?
- provides weak incentives = + Shirking?
- Engelerberg, Brogaard, and Van Wesep (2018): Do economists swing for the fences after tenure?
  - Look at 980 economists employed at top 50 economics/finance departments over 1996-2004
  - What happens after tenure?

After Tenure: Research Productivity Down

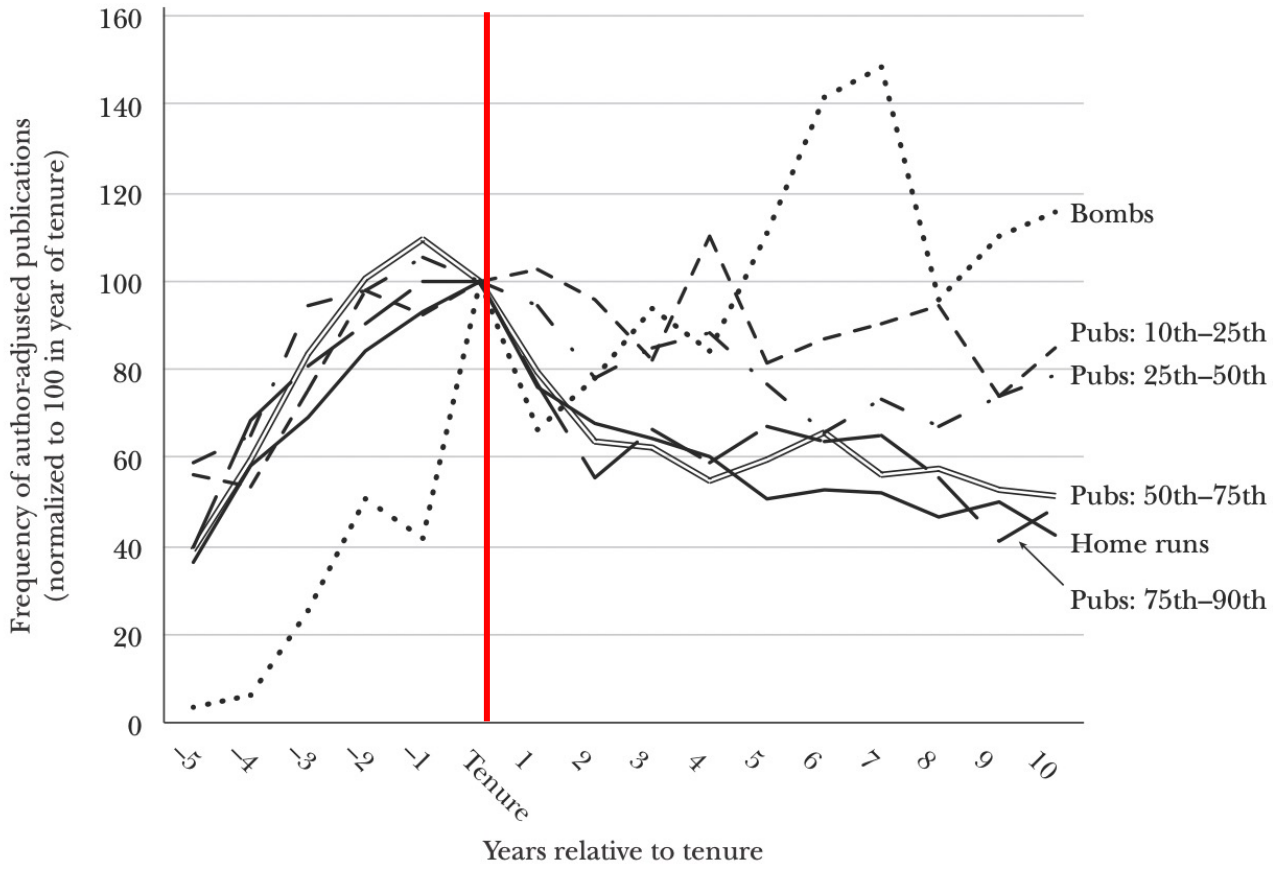
Figure 1

Publications and Home Runs around Tenure



After tenure: bombs up, hits down?

Figure 2
Publications around Tenure by Citation Percentile



Other facts about tenured economists

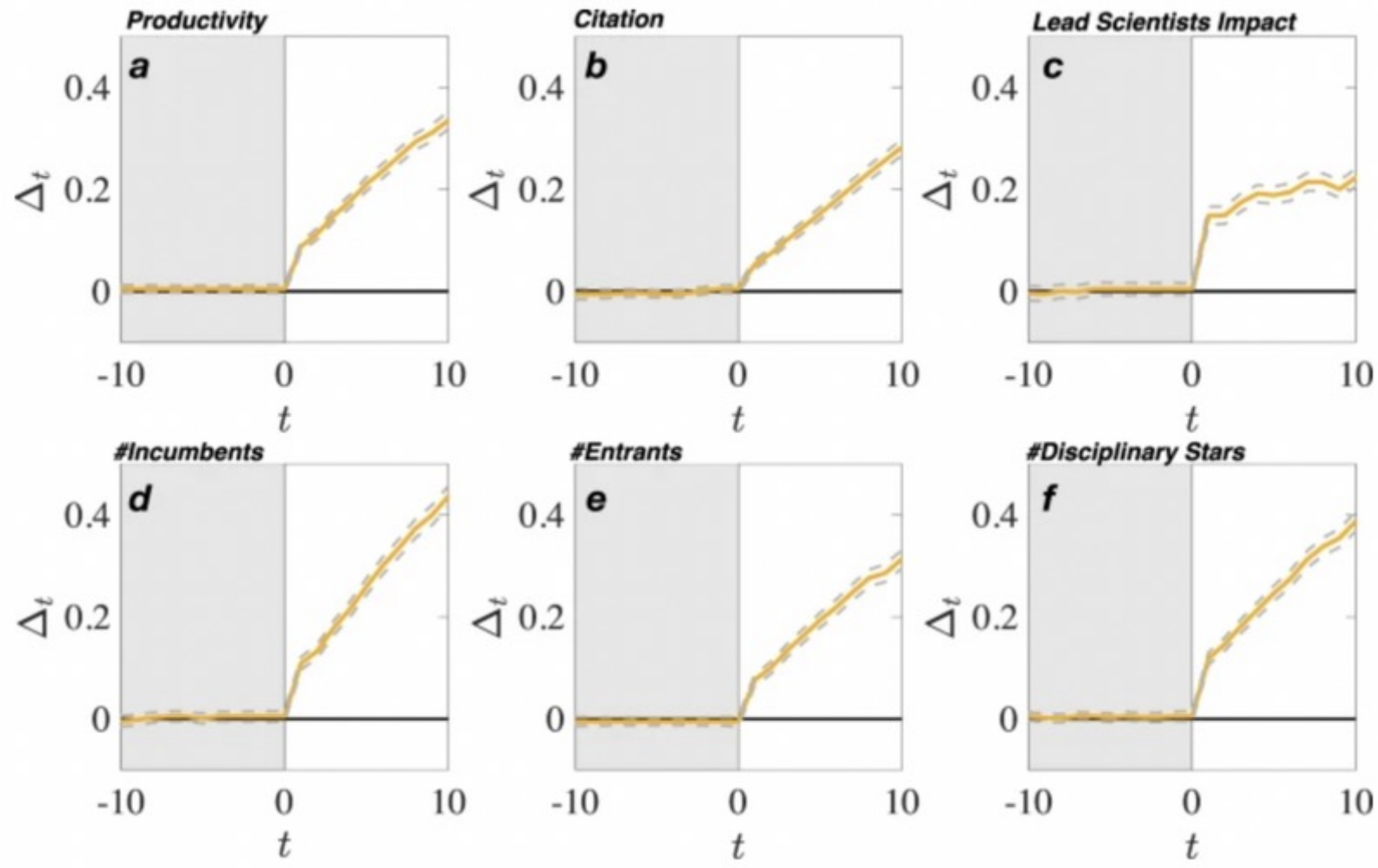
- No more likely / less likely to publish in new journals, new topic areas, or with new coauthors
- Effects robust to restriction to only elite universities
- Effects robust to restriction to only tenured before 1994

Focal Points in Research

- Science as a coordination problem: how to work on projects that others work on?
- Prizes as one solution
  - Scarce
  - Credible
  - Public
- (Not only, or even primary, point of prizes)

Jin, Ma, and Uzzi (2021)

- Compare prize-winning topics to similar topics that do not win prizes
- Topics winning prizes exhibit more papers, citations, entrants, elite scientists compared to controls
- **Challenge**: unobserved differences between prize-winning topics and controls



Reschke, Azoulay, and Stuart (2018)

- Does interest in a topic rise after someone working on the topic is awarded an HHMI Investigatorship?

Different topic, same journal issue

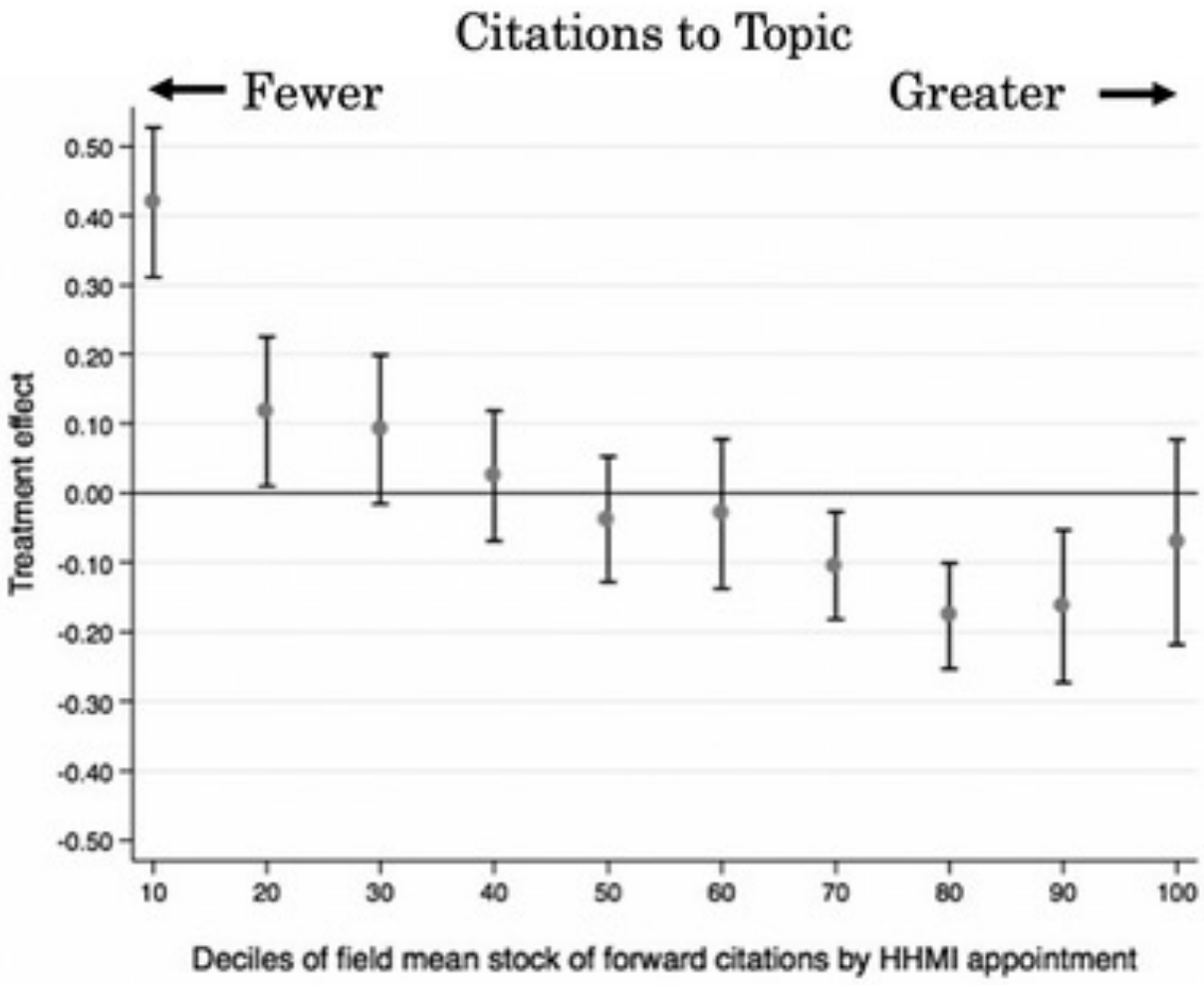
Same narrow topic

Later, author(s) **not** awarded an HHMI investigatorship

Later, author awarded an HHMI investigatorship

Compare citations

- Matching on papers easier than matching on topics?


Citations to Topic
Fewer
Greater
Treatment effect
0.50
0.40
0.30
0.20
0.10
0.00
-0.10
-0.20
-0.30
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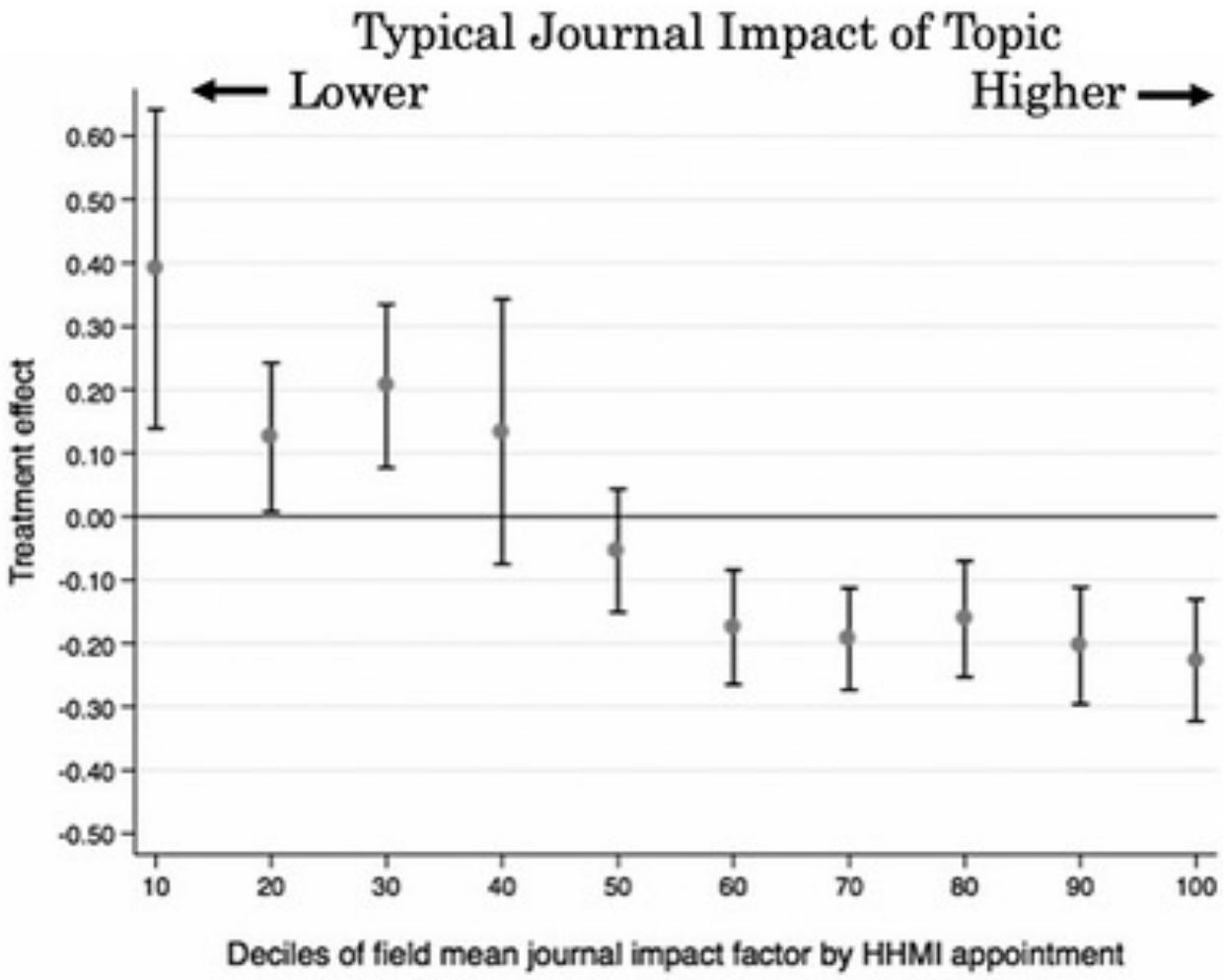
70
80
90
100
Deciles of field mean stock of forward citations by HHMI appointment

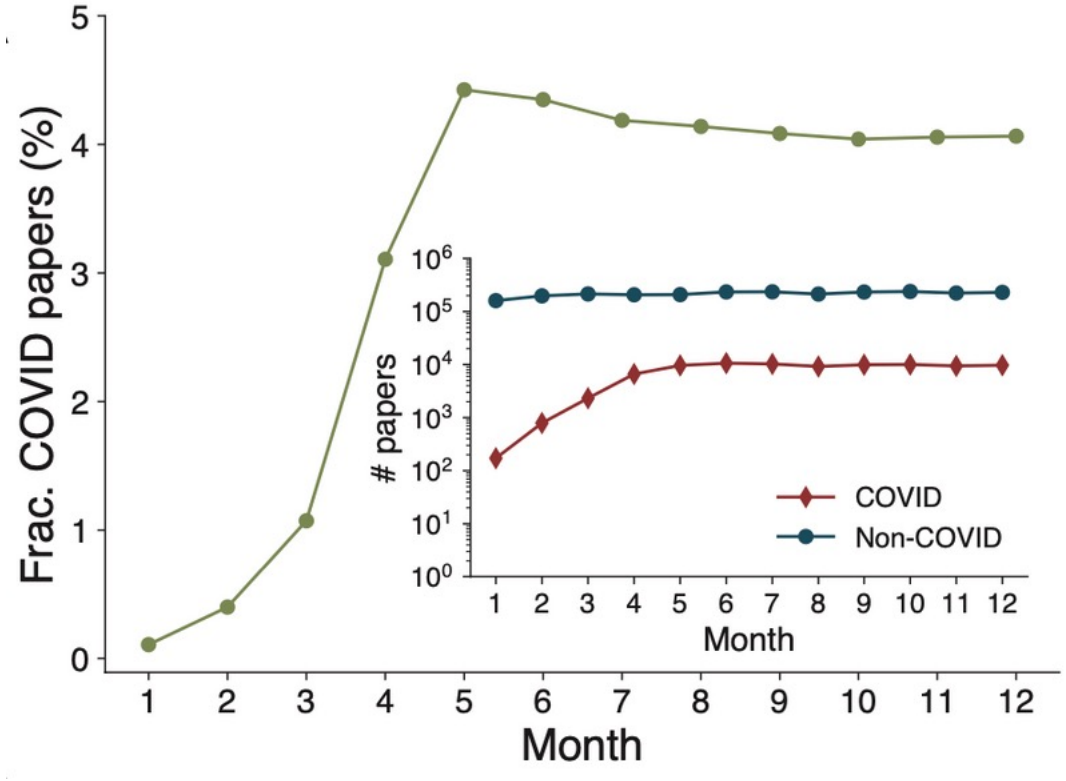

Typical Journal Impact of Topic
Lower
Higher
Treatment effect
0.60
0.50
0.40
0.30
0.20
0.10
0.00
-0.10
-0.20
-0.30
-0.40
-0.50
10
20
30
40
50
60
70
80
90
100
Deciles of field mean journal impact factor by HHMI appointment

Azoulay, Wahlen, Zuckerman Sivan (2019)

- Challenge: awards are not exogenous. Could be proxy for topic potential.
- Death provides plausibly exogenous shocks to public honors 😬
- Compare citation profiles of elite life scientists who die, relative to elite life scientists who live
- Death leads to:
  - Increase in public memorials
  - +7% citations to the work of the deceased
  - Permanent shift? Robust to starting citation count 5 years after death
  - Effect largest for recent and least well known works

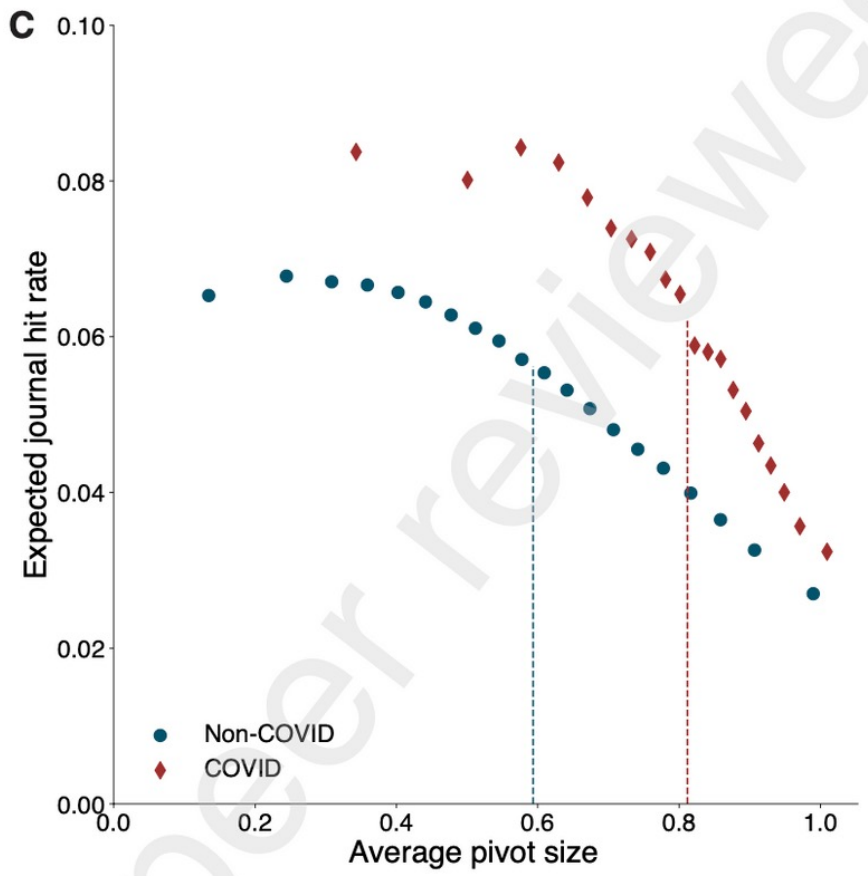
Focal points in Research

- Public honors are a credible signal of research merit
- Public honors → increased research attention for under-recognized research topics
- Other focal points?
- Hill et al. (2021): Covid-19
- Pretty obvious to everyone that others would think covid is important



Hill et al. (2021)

- Normally, research pivots are penalized.
- Pivot: measure of similarity of distribution of cited journals in most recent paper and preceding few years
- Pivoting is penalized; but covid has a journal impact premium



Extra Slides

A communication game in science

- N-player extension with $0 < k \leq N$ players withholding information
  - Withholders publish first
  - Sharing payoff is zero
  - Withholding expected payoff is $\frac{1}{k} - c_N(k) > 0$, where cost of completion $c_N(k)$ is increasing in number of withholders, k.
- Withholding payoff > sharing payoff
  - $k = N$
  - Payoff is $\frac{1}{N} - c_N(N)$
- Payoff in sharing equilibrium ($k = 0$) is $\frac{1}{N}$ (assume $s = 0$)
- Similar answer: sharing viable as a repeated game equilibrium
- (This is not a very realistic model; Dasgupta and David suggest social sanctions for scientists who violate sharing norms, not a grim trigger strategy)