The Impact of U.S.-China Tensions on U.S. Science

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July 19, 2022

NBER SI, Science of Science Funding

Motivation: Scientific collaboration in our era

Scientific collaboration has become increasingly international.

- From 2008 to 2018, the percentage of science and engineering papers with authors from different countries has increased from 17% to 23% (NSF report, 2019).
- International collaborations in science have resulted in great achievements such as the International Space Station and the completion of the Human Genome Project.

The free flow of ideas facilitates the progress of science.

Motivation: Political tensions over science

However, science is never isolated from politics.

- Science and technology are key components of economic growth and military capability.
- Governments care about advances in science and fund scientific research.

International collaborations can cause concern,

- such as the leakage of military technology or intellectual property, especially to competitors.

This paper: U.S.-China tensions over science

- The U.S. has long been concerned about loss of intellectual property to China.
  - Cyber-theft; Company agreements to transfer IP; Economic espionage; Use of U.S. science by China's military
- $\rightarrow$ 'China Initiative': DOJ countering national security threats from China
- On August 20, 2018, NIH sent letter to American institutes about foreign interference in research.
- As of June 2020, 54 researchers lost their jobs as a result; 93% of those investigated source of foreign support was from China.

A lot of discussion, little empirical investigation

- Our question: what is the impact on U.S. science?
  - **Data**: scientists with international collaborations more productive.
  - Scientists with international collaborations with institutions in China among most productive.
- Has there been a chilling effect on U.S.-China scientific collaboration?
- How have researchers with collaborations with China been affected?
- Which scientific fields, institutions, and researchers have been most affected?
- What impact does this have on the competitiveness of U.S. and China in science?

This paper: U.S.-China tensions over science

We study the impact of the NIH investigations on U.S. scientists in the field of life sciences.

- Quantifying the effect of the NIH investigations
- Interviews of scientists: underlying channels

Quantifying the effect of the NIH investigations

We exploit: timing of the NIH investigations.

Main findings

1. Investigations coincided with a **small but significant decline the productivity** and **significant decline in citations** for U.S. life scientists with history of collaborating with research institutes in China.
    - These scientists published fewer papers in life sciences (1.9%) and had fewer citations (7.1%).
2. The effects concentrate in particular fields with high U.S.-China collaboration and NIH funding.
3. The more affected fields have progressed more slowly in both U.S. and China. If anything, the pattern is more apparent in the U.S.

Data

1. **PubMed**: the primary database of papers on biomedical topics
   - 2010 - 2020
   - 12 million published articles
   - Each paper has a unique *PubMed* id
2. **Dimensions** is a database that covers publications in various disciplines
   - We use *PubMed* id to match papers and authors
   - We extract all the publications of PIs in our sample

U.S.-China collaboration in the Life Sciences

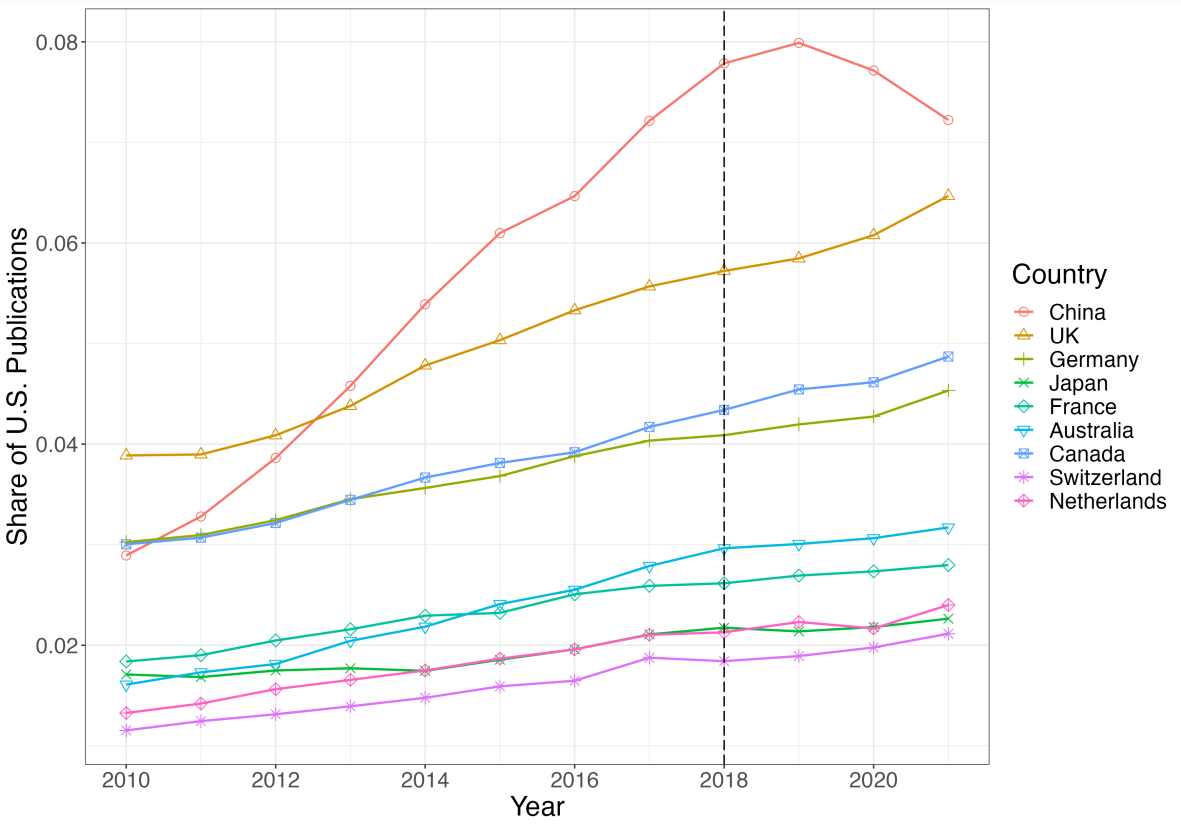


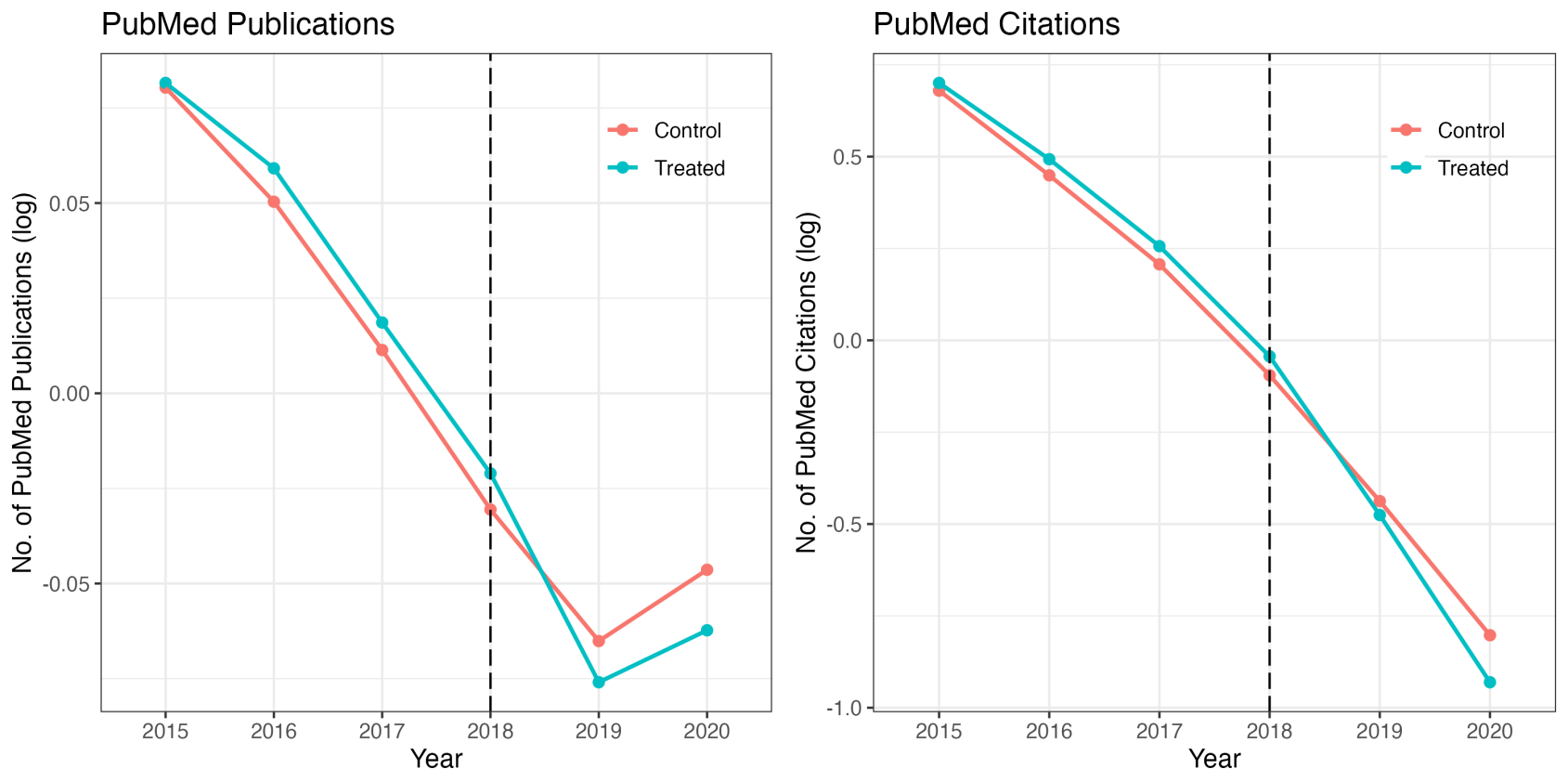
Figure 1: PubMed publications indexed by Dimensions by U.S. scientists, 2010-2020

Research Design

- We employ a difference-in-differences (DID) design to analyze the impact of the NIH investigations
  - **Sample**: PIs with at least two papers in PubMed from 2010-2014
  - **Treatment group**: PIs with at least one paper collaborated with scholars in China between 2010 and 2014
  - **Control group**: PIs with at least one paper collaborated with scholars from any other foreign country between 2010 and 2014
- 32,056 treated PIs and 70,746 untreated PIs
- 4,124,064 total papers
- Treatment date: January 1, 2019 and the pre-treatment period is from 2015 to 2018

Time trends, de-meaned

Average de-meaned outcome for both treated and untreated PIs



Research Design

- We estimate the following equation:

$$Y_{i,t} = \mu + \beta 1\{TiesToChina_i\} * 1\{Post_t\} + \alpha_i + \xi_t + X_i * \xi_t + \varepsilon_{i,t},$$

  Ties to China$_i = 1$ for treated PIs;
  Post$_t = 1$ when $t \geq 2019$;
  α_i and ξ_t: scientist and year fixed effect;
  X_i: 1) #publications, 2) #citations, and 3) #NIH-funded publications in 2010-2014.

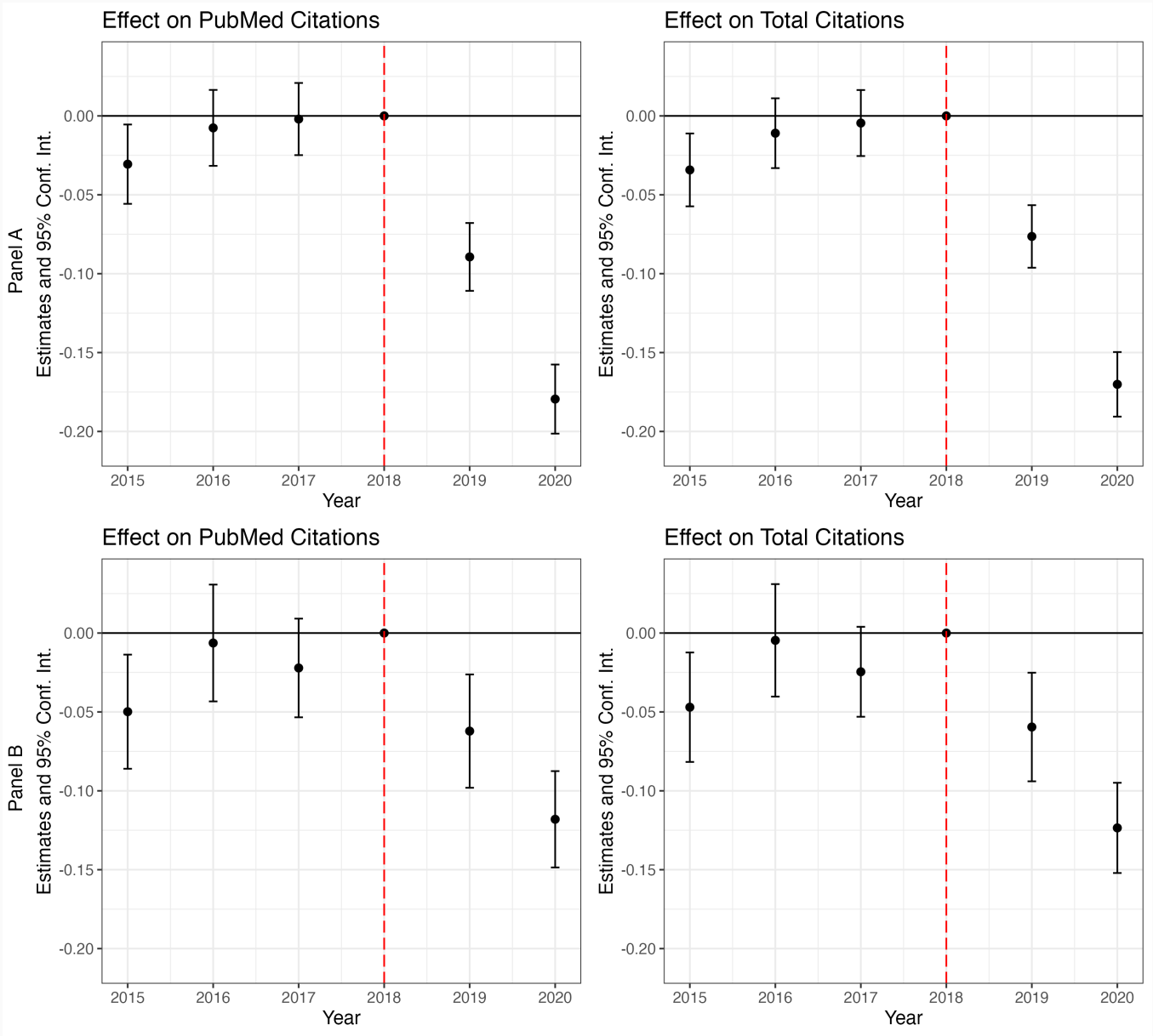
- Standard errors are clustered at PI level.
- + entropy balancing, event study

Main results

TABLE 2. THE IMPACTS ON PRODUCTIVITY: MAIN RESULTS

	(1)	(2)	(3)	(4)	(5)	(6)
Panel A	PubMed Publications			PubMed Citations		
Ties to China × Post	-0.020	-0.018	-0.019	-0.124	-0.066	-0.071
	(0.003)	(0.004)	(0.005)	(0.008)	(0.009)	(0.011)
Pre-treatment avg.	1.557	1.557	1.557	4.17	4.17	4.17
R2	0.754	0.754	0.81	0.687	0.688	0.735
No. of obs.	616812	616812	616812	616812	616812	616812
Scholar FE	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y
Baseline Covariates*Year FE		Y			Y	
Entropy Balancing			Y			Y
Panel B	Non-PubMed Publications			Non-PubMed Citations		
Ties to China × Post	0.035	0.017	0.017	-0.052	-0.059	-0.054
	(0.004)	(0.004)	(0.008)	(0.006)	(0.006)	(0.016)
Pre-treatment avg.	1.011	1.011	1.011	1.394	1.394	1.394

Event study analysis on citations



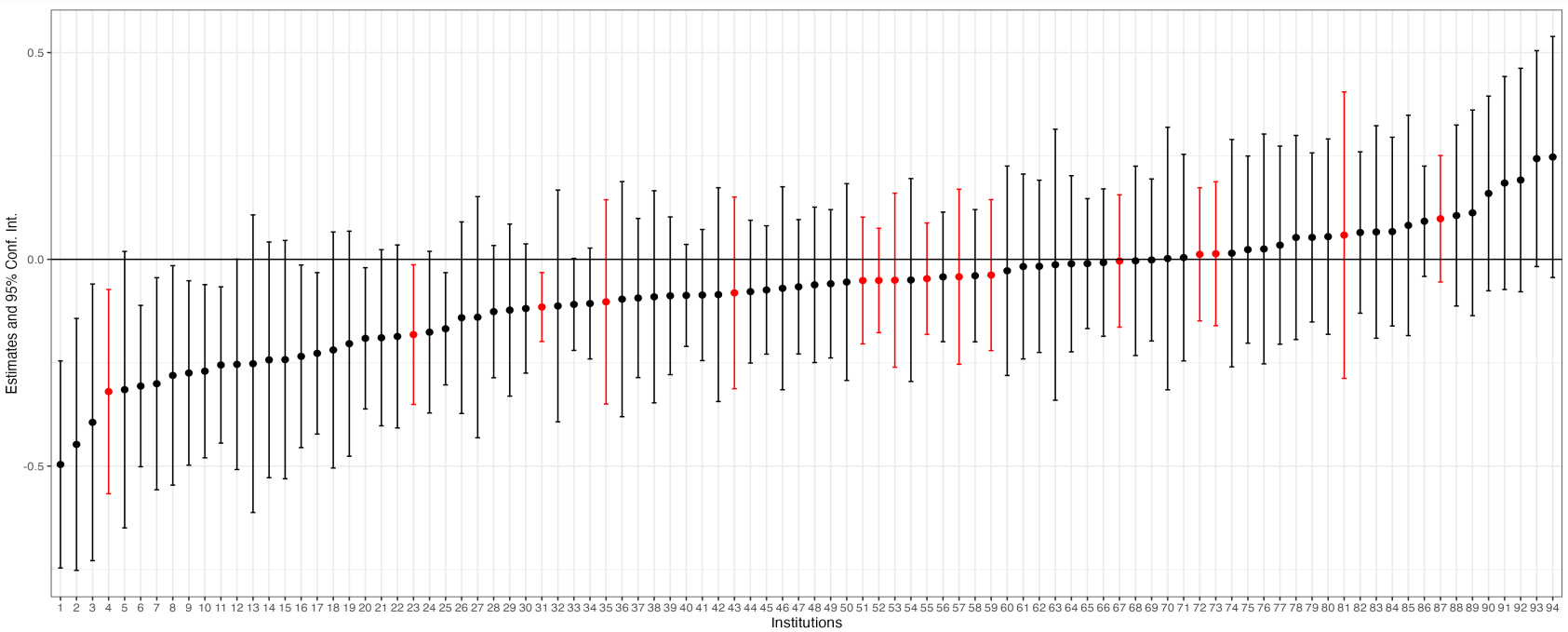
Heterogeneous treatment effects: Asian researchers

Racial profiling is an salient issue. Is the effect larger for scientists with Asian names? – We predict the ethnicity.

TABLE 3. HETEROGENEOUS TREATMENT EFFECTS BY ETHNICITY

	Citations by Nature of Publication				
	(1) All	(2) NIH-Funded	(3) Non NIH-Funded	(4) China-Funded	(5) Non China-Funded
Ties to China × Post × Asian	-0.008	-0.070	0.034	-0.196	-0.004
	(0.019)	(0.020)	(0.020)	(0.013)	(0.020)
Ties to China × Post	-0.070	-0.057	-0.043	-0.117	-0.058
	(0.009)	(0.010)	(0.010)	(0.006)	(0.009)
Post × Asian	0.058	0.019	0.078	0.009	0.056
	(0.014)	(0.014)	(0.014)	(0.003)	(0.014)
R2	0.704	0.712	0.683	0.657	0.698
No. of obs.	616812	616812	616812	616812	616812
Scholar FE	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y
Baseline Covariates*Year FE	Y	Y	Y	Y	Y

Heterogeneous treatment effects: institutions

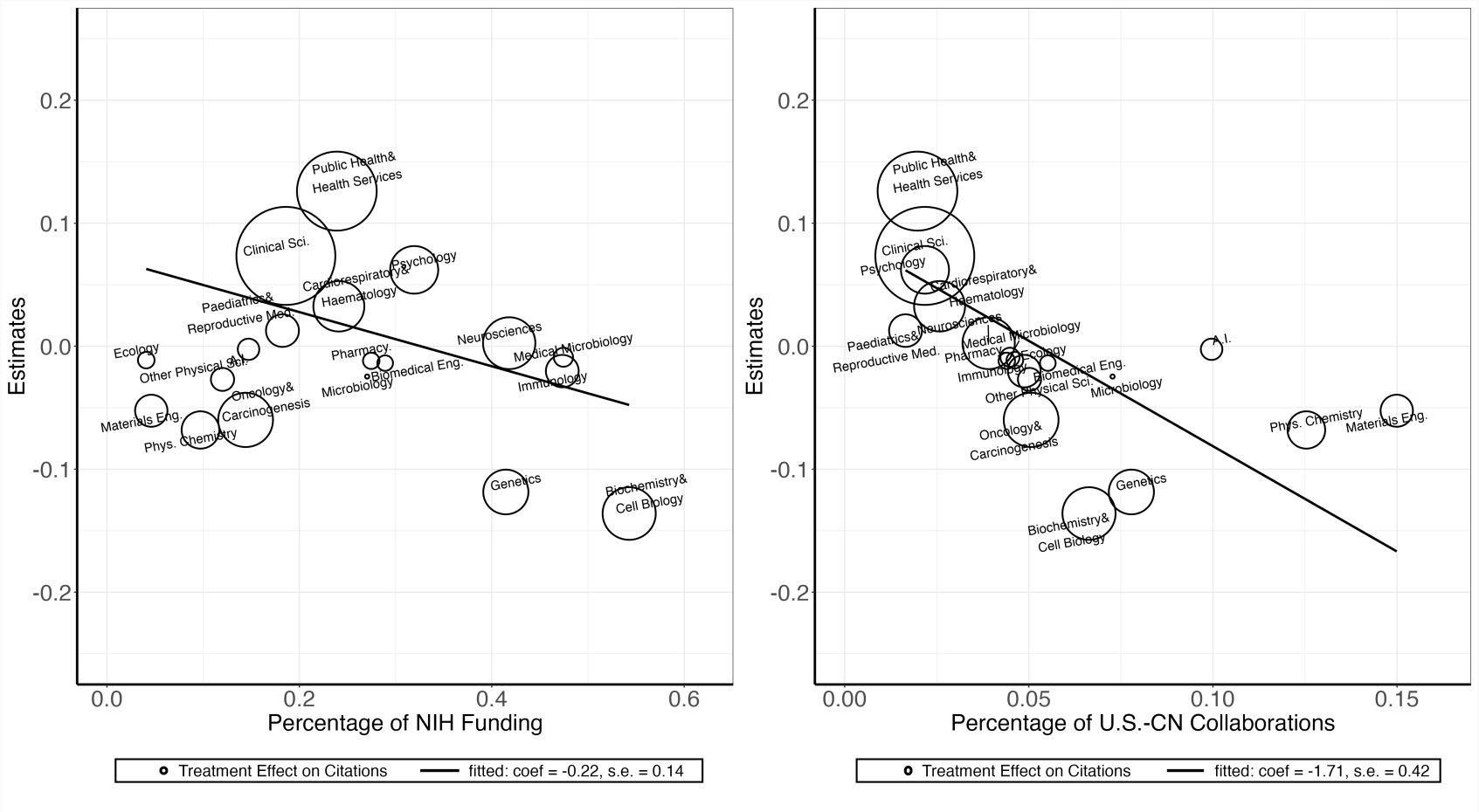


Institutions

- 1=Icahn School of Medicine at Mount Sinai
- 2=Cedars-Sinai Medical Center
- 3=UC Riverside
- 4=Beth Israel Deaconess Medical Center
- 5=Albert Einstein College of Medicine
- 6=Baylor College of Medicine
- 7=U at Buffalo
- 8=Virginia Commonwealth U
- 9=UT Southwestern Medical Center
- 10=U of Cincinnati
- 11=U of Alabama at Birmingham
- 12=UT Health Science Center at Houston
- 13=Augusta U
- 14=UT at Austin
- 15=UT Health Science Center at San Antonio
- 16=U of Illinois at Chicago
- 17=U of Illinois Urbana-Champaign
- 18=Georgia Institute of Technology
- 19=Boston Children's Hospital
- 20=Brigham and Women's Hospital
- 21=UC Irvine
- 22=Case Western Reserve U
- 23=Emory U
- 24=NYU
- 25=U of Washington
- 26=National Cancer Institute
- 27=Massachusetts Institute of Technology
- 28=U of Wisconsin–Madison
- 29=U of Colorado Anschutz Medical Campus
- 30=Northwestern U
- 31=Harvard U
- 32=Virginia Tech
- 33=Johns Hopkins U
- 34=U of Pennsylvania
- 35=U of Virginia
- 36=Wayne State U
- 37=Rutgers
- 38=North Carolina State U
- 39=Pennsylvania State U
- 40=U of Michigan–Ann Arbor
- 41=Cornell U
- 42=Medical College of Wisconsin
- 43=Texas A&M U
- 44=Duke U
- 45=U of Minnesota
- 46=UC Berkeley
- 47=Columbia U
- 48=U of Sourn California
- 49=UNC at Chapel Hill
- 50=Oregon Health & Science U
- 51=Stanford U
- 52=UC Los Angeles
- 53=Cleveland Clinic
- 54=Medical University of South Carolina
- 55=UC San Francisco
- 56=Mayo Clinic
- 57=Boston U
- 58=Massachusetts General Hospital
- 59=UT MD Anderson Cancer Center
- 60=IUPUI
- 61=U of Maryland, Baltimore
- 62=U of Chicago
- 63=Arizona State U
- 64=Brown U
- 65=Yale U
- 66=Washington University in St. Louis
- 67=U of Florida
- 68=U of Iowa
- 69=Duke University Hospital
- 70=U of Nebraska Medical Center
- 71=U of Rochester
- 72=UC Davis
- 73=The Ohio State U
- 74=Dana-Farber Cancer Institute
- 75=Memorial Sloan Kettering Cancer Center
- 76=Centers for Disease Control and Prevention
- 77=U of Georgia
- 78=U of Miami
- 79=Vanderbilt U
- 80=UNC System
- 81=U of Tennessee at Knoxville
- 82=U of Utah
- 83=U of Kentucky
- 84=U of Arizona
- 85=U of Maryland, College Park
- 86=U of Pittsburgh
- 87=UC San Diego
- 88=Michigan State U
- 89=Vanderbilt University Medical Center
- 90=Purdue University West Lafayette
- 91=National Institutes of Health
- 92=U of Rochester Medical Center
- 93=U of Missouri
- 94=Iowa State U

Heterogeneous treatment effects: fields

Figure 2: Citation Estimates vs. NIH Funding and US-China Collaborations



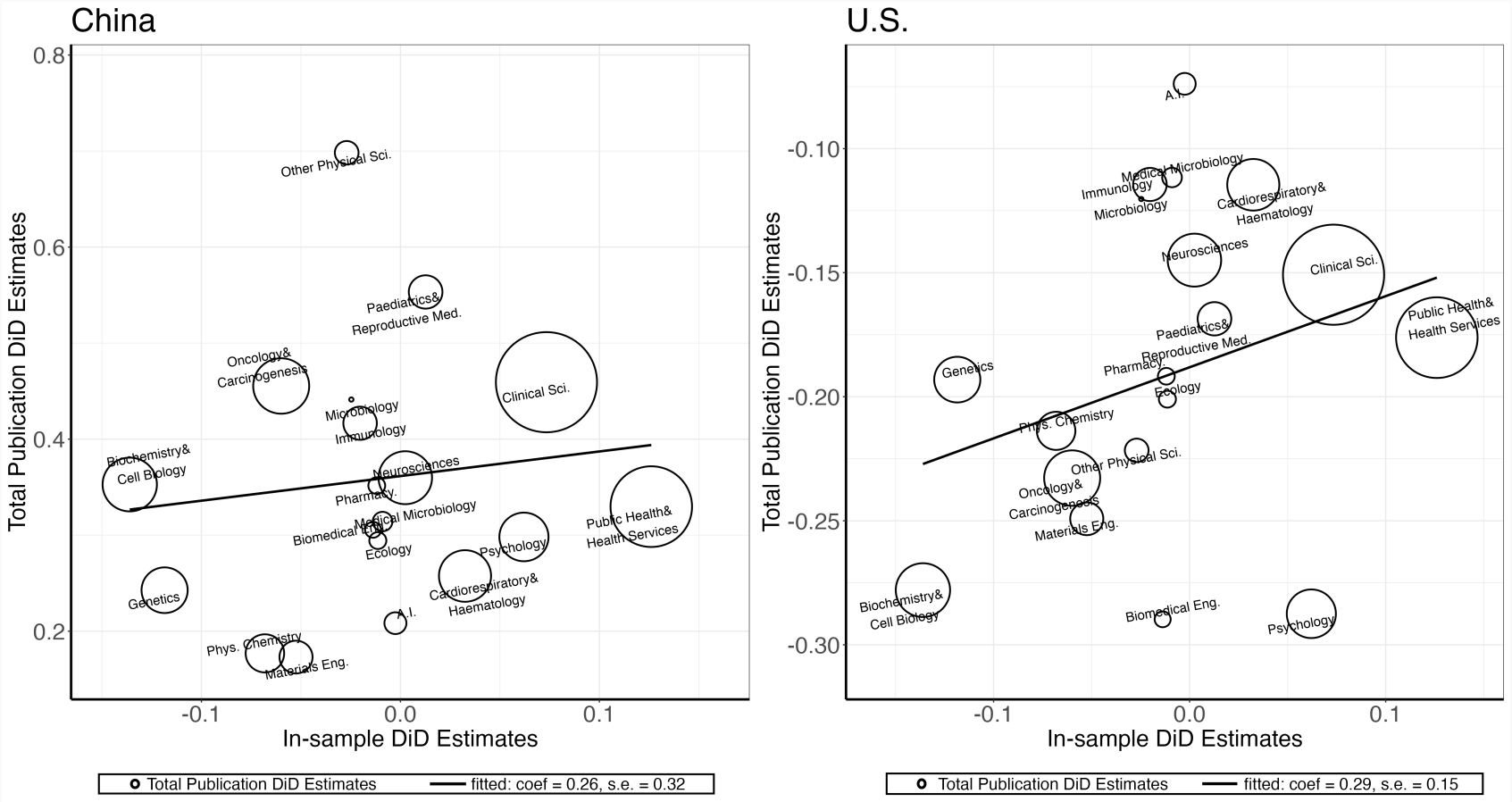
Impact on U.S. and China Competitiveness in Science

- Dimensions: get total counts of papers in each field by:
  - U.S. authors 2010-2020
  - China authors 2010-2020
  - authors from 48 other countries 2010-2020
- For each field:
  - Use a diff-in-diff to estimate relative increase or decrease in growth of China/U.S. in comparison to other countries

$$
\begin{aligned}
Y_{c,t} &= \mu + \beta_{f,China} 1\{China\} * 1\{Post_t\} + \alpha_c + \xi_t + \varepsilon_{c,t} \\
Y_{c,t} &= \mu + \beta_{f,US} 1\{US\} * 1\{Post_t\} + \alpha_c + \xi_t + \varepsilon_{c,t}, \qquad (1)
\end{aligned}
$$

U.S. and China Competitiveness in Science

- Correlation between:
  - in-sample estimates (impact of N.I.H. investigations on fields)
  - diff-in-diff estimates on total U.S. publications in each field



Interviews of U.S. scientists

We have interviewed 12 scientists.

- U.S.-China tensions: scientifically costly for those with existing collaborations
  - Administratively costly
  - Loss of access to resources from China
    - machines, students, funds, ideas
  - Requires reorienting research toward other topics
  - Requires looking for new sources of funding, new collaborators

Clear reticence to start new collaborations with scientists in China.

- Our estimate is a lower bound.

They expect U.S.-China tensions to last.

- The official China Initiative ended in February 2022.

Summary

- The NIH investigations impacted the productivity of scientists with previous ties to China
- The impacts are larger for certain fields with high U.S.-China collaboration, high NIH funding
- May have implications for U.S. and China competitiveness

Future work: flow of talent, longer-term impacts.