Does Chinese Research Hinge on US Coauthors? Evidence from the China Initiative

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The rise of China

Two coexisting views:

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- China will **soon overtake** advanced Western countries.

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Two coexisting views:

- China will **soon overtake** advanced Western countries.
- Without democracy and freedom, China will not be able to move from **imitation-based growth** to growth based on frontier innovation (Acemoglu et al., 2006).

In this paper: China benefits heavily from collaborations with Western scientists.

Evidence of China's catch-up

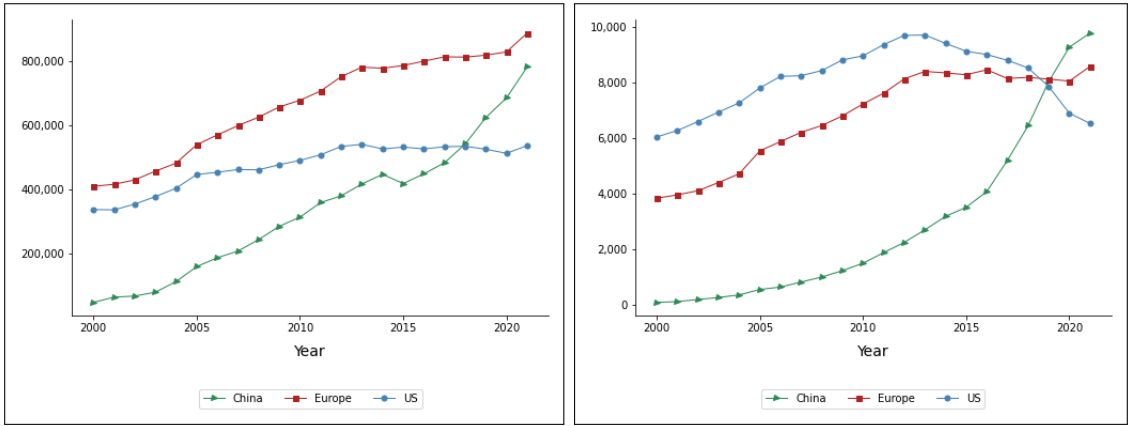

Figure 1: Total number publications (left) and top 1% cited publications (right), per country

The China Initiative

We exploit the implementation of the so-called **"China Initiative"** against Chinese Economic Espionage, launched in 2018.

In practice, the China Initiative meant:

- More complicated administrative procedures
- Reduced access to funding
- Exclusion of targeted researchers from the US

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In practice, the China Initiative meant:

- More complicated administrative procedures
- Reduced access to funding
- Exclusion of targeted researchers from the US

We consider the implementation of China Initiative as a **quasi-natural experiment**.

$\Longrightarrow$ We look at the impact of the China Initiative on the **volume**, **quality** and **direction of Chinese research**.

Main findings

No major quantitative impact of the China Initiative on the volume of publications for affected Chinese authors.

Significant decrease in publication quality:

- Results constant across all measures of quality.
- Top Chinese researchers and those working on US-dominated topics particularly affected.

Chinese researchers' ties to non-US researchers, appear to partly compensate the loss of US coauthorship

Literature review

▸ More details in the appendix

Imitation vs innovation-led growth: is China in the middle-income trap (Acemoglu and Robinson, 2012 Acemoglu et al., 2006, Zilibotti, 2017, Qiu et al., 2021, Roland, 2023)

Chinese catch-up: Bergeaud and Verluise, 2022

Chinese-US collaborations: Veugelers, 2010, Veugelers, 2017, Han et al., 2020.

China initiative: Schiavenza, 2022, Gilbert and Kozlov, 2022, Lee, 2022, Jia et al., 2022.

Innovation and research networks: Azoulay et al., 2010, Jaravel et al., 2018, Aghion et al., 2023.

Doubly-robust diff-in-diff estimator: Callaway and Sant'Anna, 2020.

Outline

Outline

An underused database: *Scopus*

- Scopus is a **bibliometric database**, released by Elsevier in 2004, reported by all journals referenced in it.
- Most recently 43,132 journals, 78M publications, 16M authors
- Datasets we use:
  - **Article-level** dataset including information about authors, their affiliation, journal of publication, total citations, ASJC codes, subject areas...;
  - **Author-level** dataset including last affiliation and main subject of publications;
  - **Journal-level** dataset, including place of publication and "cite-score" metric of journal quality.

China's catch-up is dependent on the US

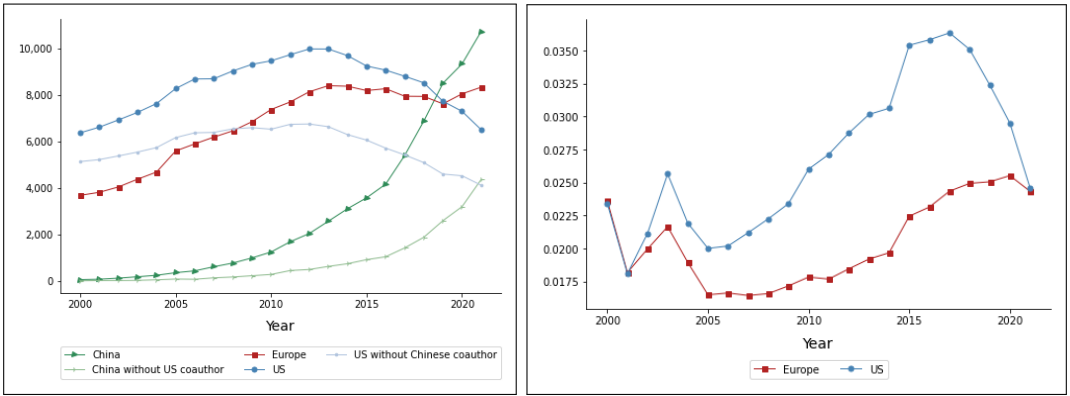


Figure 2: Number of top 1% cited papers (left) and shares of European and US partnerships in all Chinese publications (right) ▸ Frequency of publications

How do we select our sample?

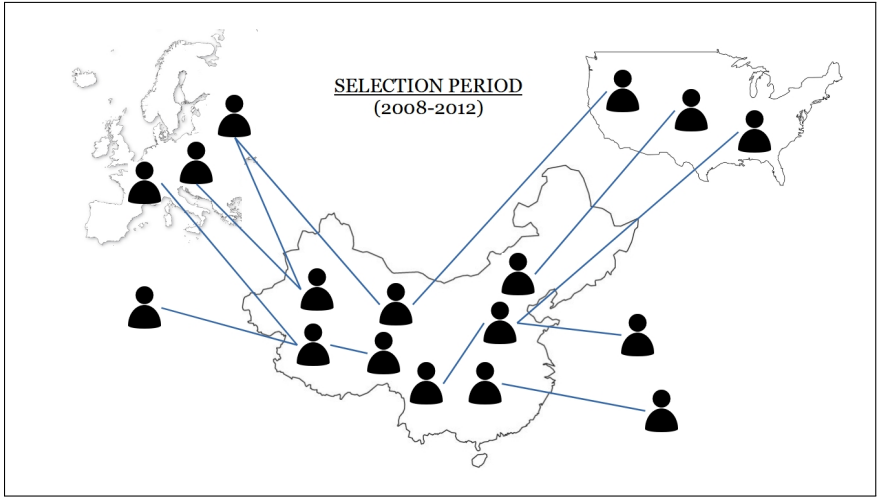
We first identify **active Chinese researchers** during the period:

1. We select researchers with at least **3 publications** reported in the database during the period 2008-2012.
2. Within that subset, we further narrow down our selection to identify **Chinese researchers**:
   - that have published 80% of their papers while affiliated to a Chinese institution during the period,
   - have a name indicating Chinese descent,
   - had a Chinese affiliation until 2012 for at least two years and remained affiliated in China until 2014.

In that group, we select those whose main subject is not in social sciences and who published first after 1999.

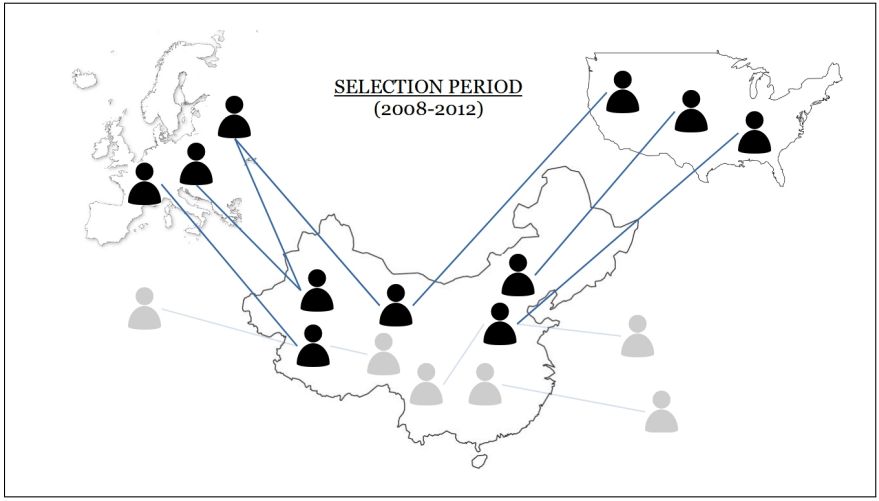
How do we select our sample?

$\Longrightarrow$ First step: **active Chinese researchers** during 2008-2012.



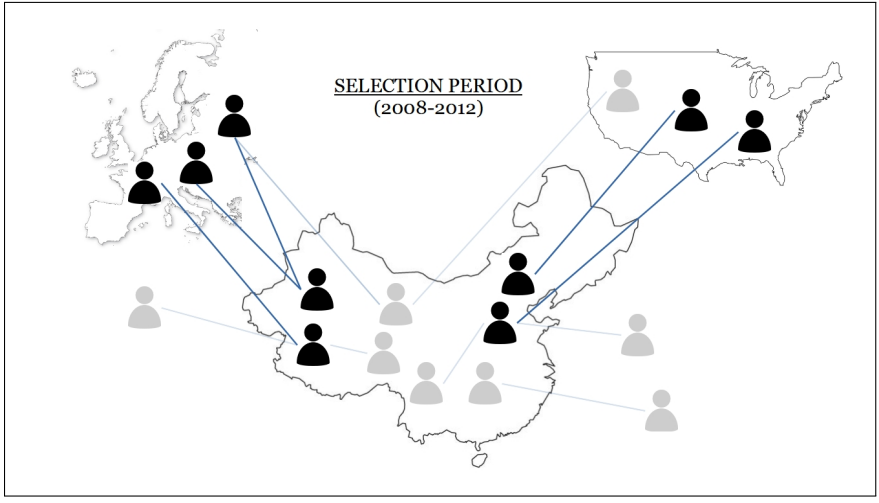
How do we select our sample?

$\Longrightarrow$ Focus on **Chinese authors dependent on Europe/the US**. ▸ Dependency on type of coauthors



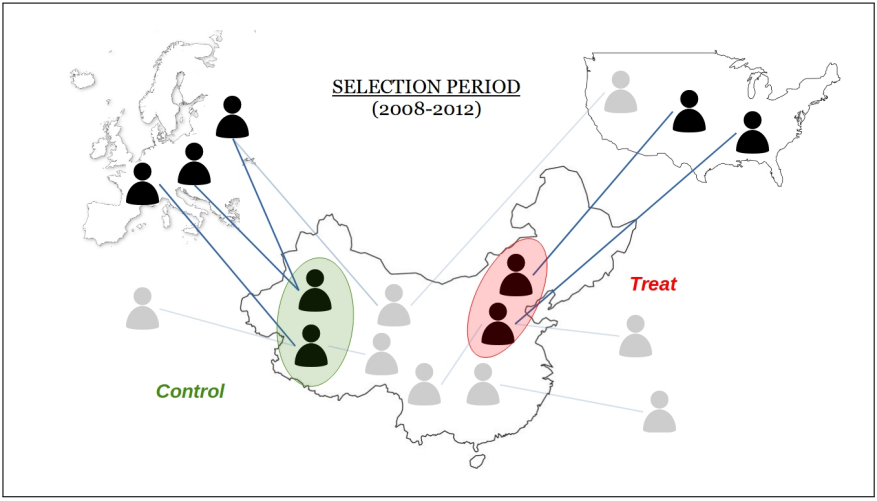
How do we select our sample?

$\Longrightarrow$ We **remove** Chinese authors being **dependent on both** US and Europe. ▸ Mutual dependency



How do we select our sample?

$\Longrightarrow$ Treated = **23,662 authors**, Control = **17,858 authors**.



Our baseline theoretical model for the effect of the measure is:

$$y_{i,t} = \beta_1 * Treated_i * Post_t + \beta_2 * Treated_i + \beta_3 * Post_t + \epsilon_{i,t}$$

- i, author; t, year
- $Treated = 1$, if an author is in the treated group; $Treated = 0$, if the author belongs to the control group
- $Post_t = 0$, for $t < 2018$; $Post_t = 1$, for $t > 2018$
- $y_{i,t}$: an outcome variable (includes publication quantity, coauthor activity and research direction)

▸ More info about the estimation method

Outline

Productivity of scientists: same quantity, lower quality?

No significant trend break in the **quantity of publications** for treated authors

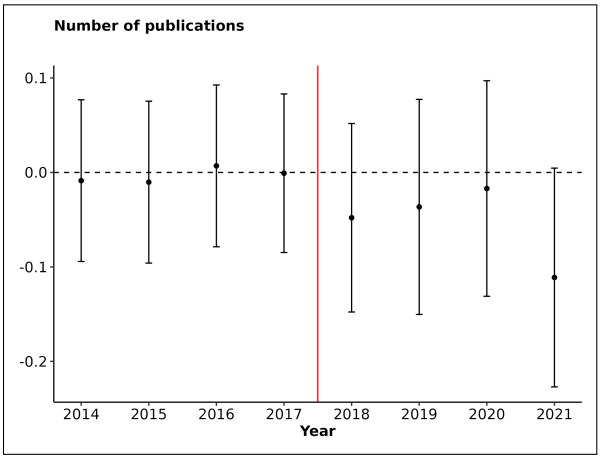
Productivity of scientists: same quantity, lower quality?

No significant trend break in the **quantity of publications** for treated authors

Decline in quality:

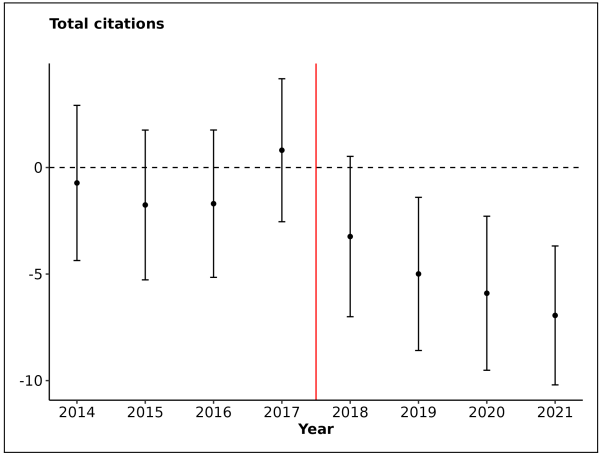
1. Negative trend break in the **number of citations and number of publications in top journals**
2. Negative effect on the quality of **treated Chinese authors' co-authors** (predictor of future citations, at the article and author level).

Small effect on total number of publications

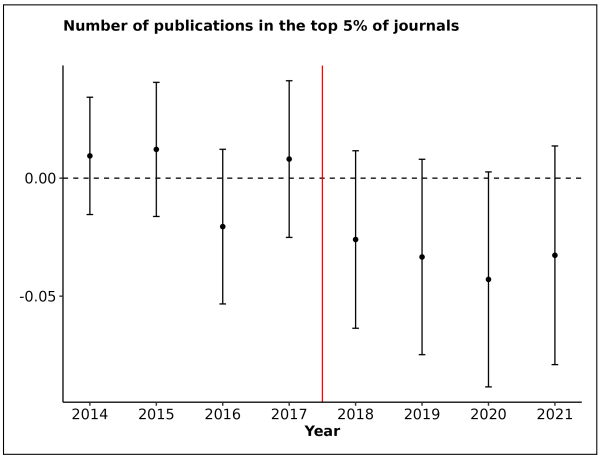


Effect on quality - number of citations

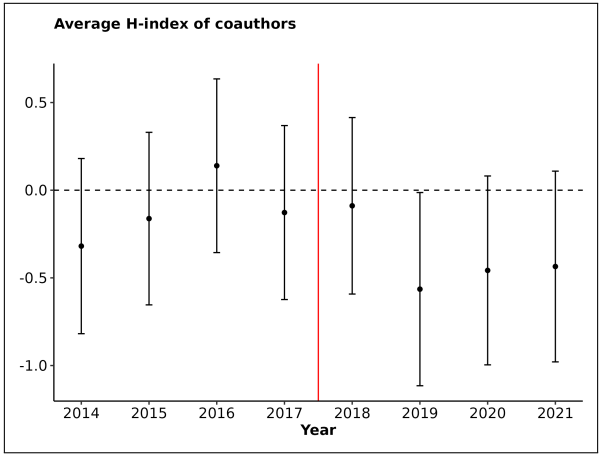
Treated authors **lose on average 5.27 citations** per year compared to their control counterparts. ▸ Citations from China



Effect on quality - number of publications in top 5% journals



Effect on the overall quality of coauthors



▸ More about coauthor quality

Average Treatment Effects

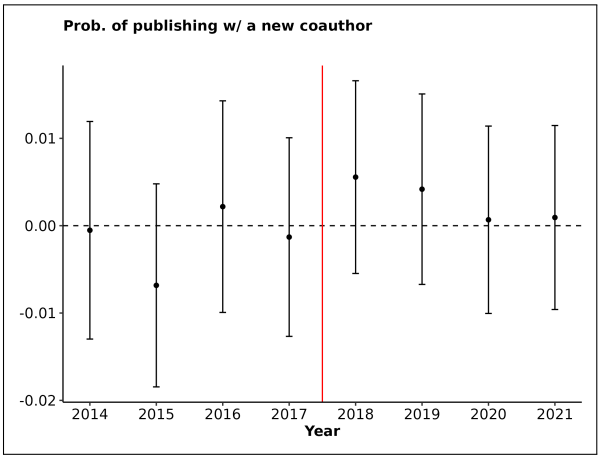
	publications	citations	pub. top 5% journals	avg H index co-authors
	(1)	(2)	(3)	(4)
ATT	-0.053	-5.269***	-0.018*	-0.386**
	(0.035)	(1.196)	(0.010)	(0.169)
Mean.Dep.Var.Pre	3.117	98.809	0.279	14.928
Pvalue.PreTrend	0.990	0.063	0.471	0.161
N.authors	39858	39799	39799	39623
N.obs	358722	255653	255653	251553
Controls	Yes	Yes	Yes	Yes
Cond. on publishing				Yes

Table 1: ATT - Productivity measures

Channels of the effect of the shock

What is the effect of the China Initiative on **future co-authorships** of treated Chinese researchers ?

Channels of the effect of the shock



Channels of the effect of the shock

Do Chinese researchers reallocate away from US coauthors following the shock?

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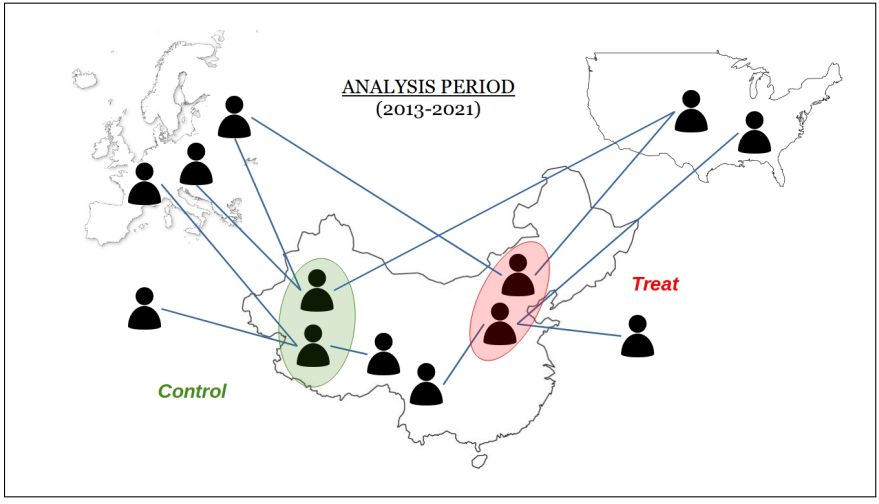
For different outcomes, we compare between:

- post-shock collaborations of treated Chinese authors with US coauthors
- post-shock collaborations of control Chinese authors with European coauthors

$\Longrightarrow$ We call the corresponding outcome variables the *same country* variables.

Channels of the effect of the shock



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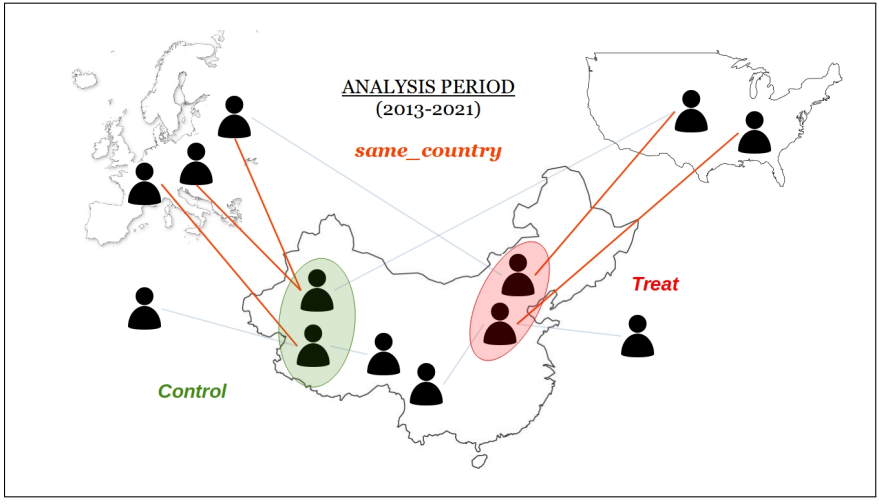

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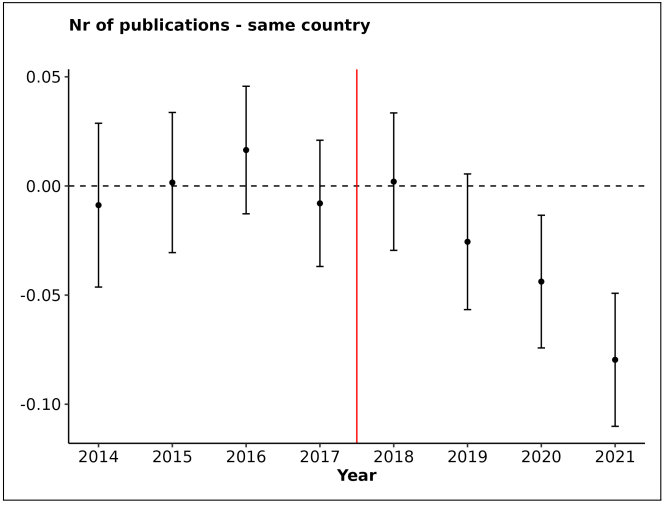

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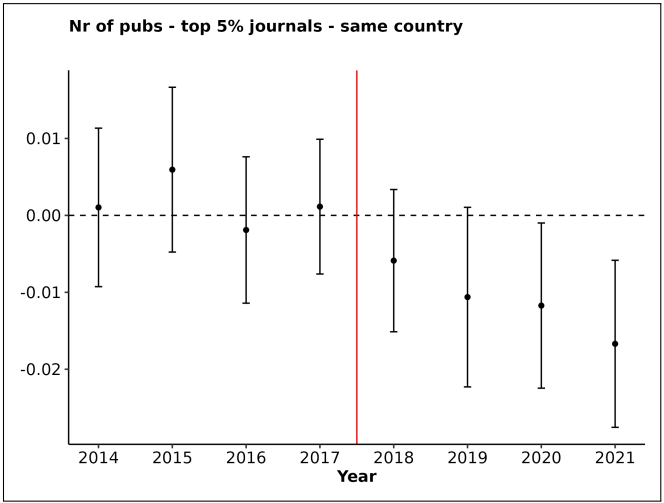

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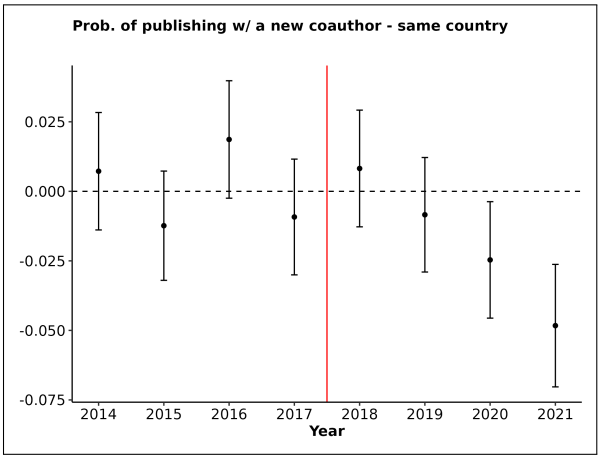

New research directions

How has the direction of Chinese research been affected by US sanctions?

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We look at **basic** versus **applied research**.

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We use the CHI Basicness Index (Murray et al., 2016)

No change overall, but uncompensated shift away from US in basic research

		with coau from same country
	any basic pub.	any basic pub.
	(1)	(2)
ATT	-0.009	-0.022**
	(0.006)	(0.011)
Mean.Dep.Var.Pre	0.237	0.143
Pvalue.PreTrend	0.559	0.423
N.authors	39799	26414
N.obs	255653	90846
Controls	Yes	Yes
Cond. on publishing	Yes	Yes

Table 2: ATT for research direction

Analysis by quantiles

Are top-researchers more impacted by US sanctions?

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- We run separate regressions on different sub-samples (same specification), defined by **pre-treatment quality of authors** (number of citations)

$\Longrightarrow$ Bottom researchers seem to be **less impacted** by the shock, both in quantity and quality.

Higher quantiles' publications in top cited sources are more affected

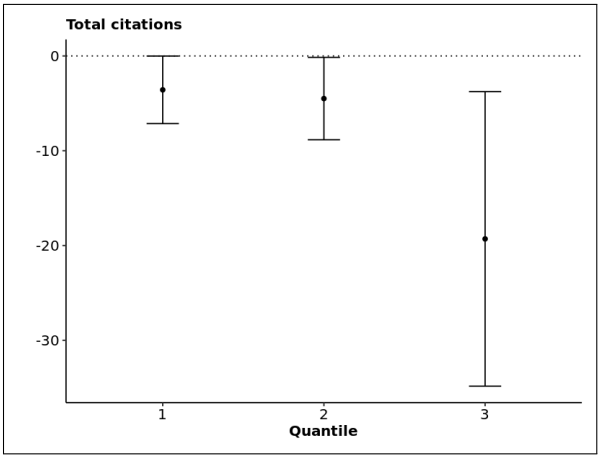

Figure 3: Estimates for citations by quantiles

Writing on US-dominated fields

Are Chinese researchers in US-dominated fields more impacted?

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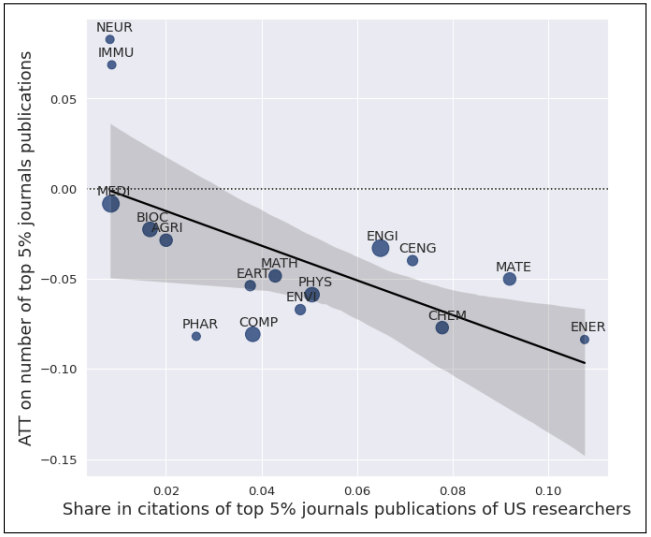
$\Longrightarrow$ Both in quality and in quantity, we find **stronger effects** when US dominance **increases**.

Writing in US-dominated fields

▸ ATT by field



Robustness tests

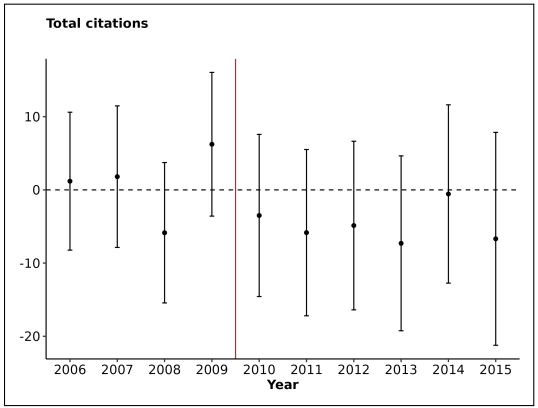
We perform several robustness tests:

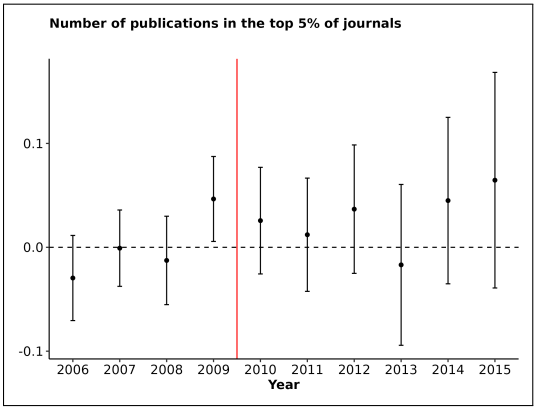
- We run same analysis with alternative rules of sample selection ▸ Robustness to sample selection
- Our results are robust to alternative measures of quality
  ▸ Robustness of our variables
- Placebo test results varying the time of treatment validates our main analysis

Robustness

Placebo test

Sample = active Chinese authors between 2001-2005. Same definition of dependency and of treatment and control groups. **Event year** = 2010.





Outline

Conclusion

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4. Chinese research direction: treated authors tend to especially publish **less basic research** with US coauthors.

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3. Reallocation of collaborations: **reduced fraction of US coauthorship** for treated Chinese researchers following the China Initiative shock.
4. Chinese research direction: treated authors tend to especially publish **less basic research** with US coauthors.
5. Heterogeneous effects: effects are strongest for treated Chinese researchers in **top quantile** in citations and in **US-dominated fields**.

Conclusion

Potential extensions:

- Heterogeneous effects depending on alignment with strategic priorities of the Chinese government ? ▸ Preliminary results
- Role of freedom and mobility as determinants of quality and direction of research
- Bridging the gap between Scopus information on publications and existing patent information (see Bergeaud and Verluise, 2022)

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Appendix

Sample selection

The index for selection into treatment and control groups

back

We select individual i as:

- **treated** if C_i^{US} is above 95$^{\text{th}}$ percentile over period T (2008-2012).
- **control** if C_i^{Europe} is above 95$^{\text{th}}$ percentile over period T (2008-2012).

$$C_i^g = \frac{1}{\omega_i} \sum_{l \in A_{i,T}} \frac{\omega_l}{|a_l/i|} \sum_{j \in a_l/i} \mathbf{1}\{g_j = g\}, \quad g \in \{US, Europe\}$$

- i: A researcher of the sample, g: a country group, j: a coauthor of i
- ω_i: The number of citations received by author i over the period
- $A_{i,T}$: The set of papers l of author i for the period T over which the index is calculated
- ω_l: The amount of citations received by paper l
- a_l/i: The set of all authors of paper l aside from i

Timing: Frequency of Publications

Table 3: Average time between years in which sample authors publish, in years

Statistic	Min	Median	Mean	St. Dev.	Max
Avg time between pub.	1.000	1.200	1.332	0.446	9.000
Avg time between pub. (same country co-author)	1.000	1.571	2.030	1.328	12.000
Avg time between pub. (Chinese co-author)	1.000	1.214	1.373	0.517	12.000
Avg time between pub. in top 5% papers	1.000	2.000	2.387	1.785	17.000
Avg time between top. 1% cited publications	1.000	2.000	2.559	1.954	15.000

- Explain the sharp decline in publications just after the China Initiative in 2018

The Callaway Sant'Anna doubly robust estimator

The doubly robust estimator performs two computations at the same time:

- Comparison of outcomes between groups: the usual differences-in-differences estimation (what is inside the second bracket)
- Inverse probability weighting (based on values of outcome variables for the period of selection): the weight put on observations is higher for those that look most like those of the control group

We calculate this both for each year, and as an aggregate treatment across years (here the average of all yearly estimates). We do not consider the years 2016 and 2017 due to Trump's election possibly allowing researchers to anticipate such kind of policy.

Contamination bias

No evidence of more or less cross-group publications

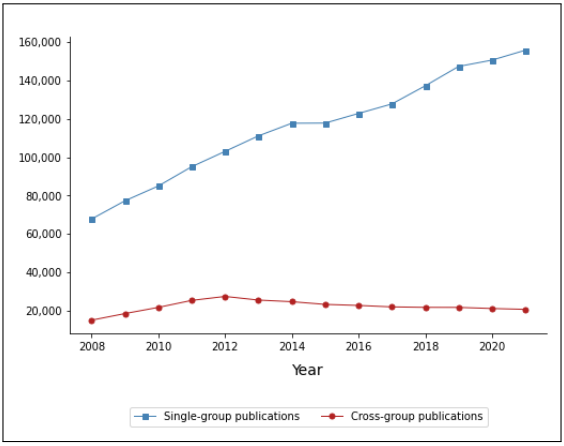


Figure 4: Number of publications without and with a member of the other group in our sample by year

Where does reallocation go?

No evidence of shift towards China or the ROW

back

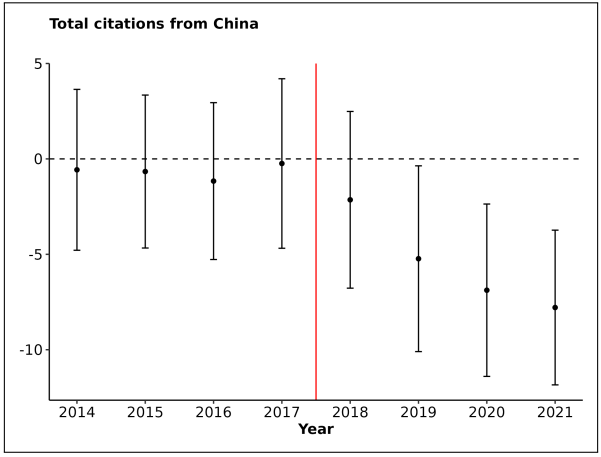
	with co-author from China	with co-author from the ROW	with co-author from China	with co-author from the ROW
	publications	publications	pub. in top 5% journals	pub. in top 5% journals
	(1)	(2)	(3)	(4)
ATT	-0.095	-0.011**	-0.006	-0.001*
	(0.060)	(0.005)	(0.014)	(0.001)
Mean.Dep.Var.Pre	5.067	0.146	0.389	0.030
Pvalue.PreTrend	0.678	0.966	0.033	0.921
N.authors	39858	39858	39799	39799
N.obs	358722	358722	255653	255653
Controls	Yes	Yes	Yes	Yes
Cond. on publishing				

Table 4: ATT on publications and top publications by place of affiliation of coauthor

Citations and quality of authors

Loss in quality: effect on Chinese citations

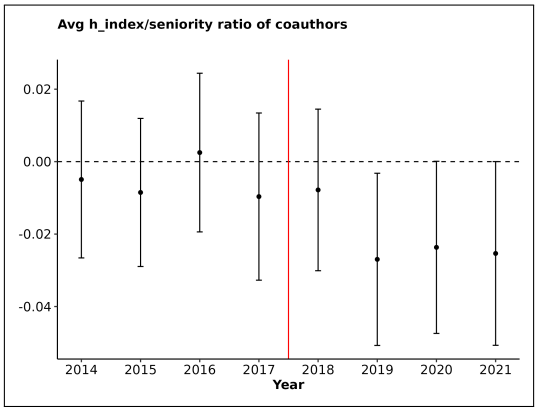
Treated authors **lose on average 5.51 citations from Chinese authors** per year compared to their control counterparts. Back to main results



Citations and quality of authors

Effect on the overall quality of coauthors

Robustness Return to coauthor quality



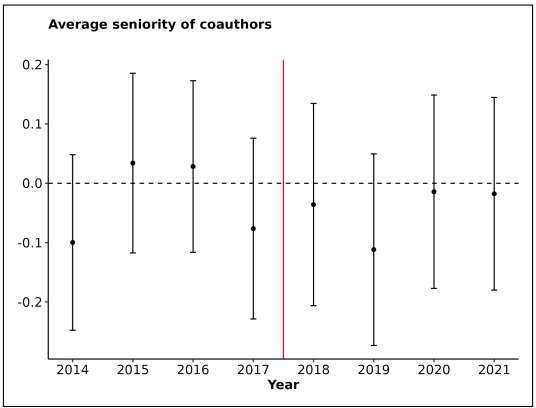
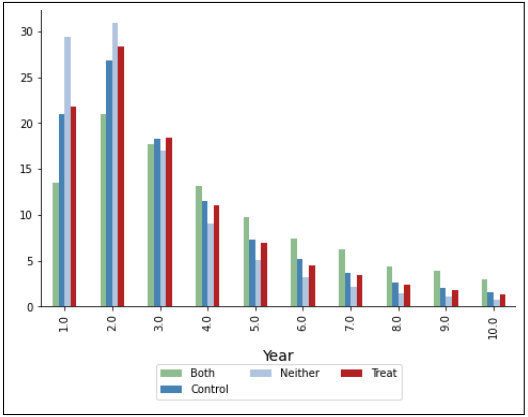


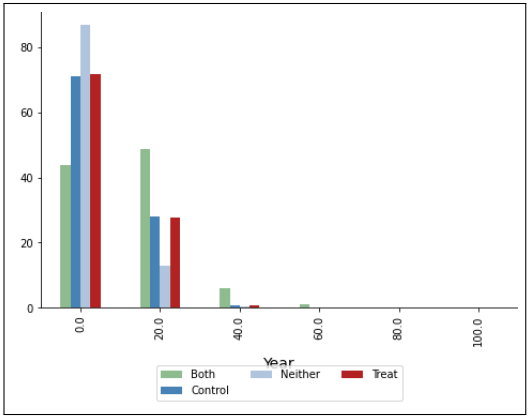
Figure 5: Effect on quality of coauthors: average H-index/age ratio and average age of coauthors

Mutual group

Balance between the control and the treated

back





Results - research direction based on funder of topics

back to results

back to the conclusion

$\Longrightarrow$ No effect on probability to publish in a topic **highly funded by the US**, but **higher** probability to publish in a topic **highly funded by the US military**, **in particular with Chinese coauthors**

	with co-author from " same country"		with co-author from China	with co-author from " same country"		with co-author from China
	Prob. of publishing in a highly US-funded topic			Prob. of publishing in a highly US military-funded topic		
	(1)	(2)	(3)	(4)	(5)	(6)
ATT	-0.007	0.008	-0.004	0.010***	-0.004	0.012***
	(0.006)	(0.011)	(0.006)	(0.004)	(0.006)	(0.004)
Mean.Dep.Var.Pre	0.272	0.162	0.265	0.224	0.111	0.218
Pvalue.PreTrend	0.933	0.152	0.881	0.768	0.865	0.485
N.authors	39799	26414	39577	39799	26414	39577
N.obs	255653	90846	249952	255653	90846	249952
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Cond. on publishing	Yes	Yes	Yes	Yes	Yes	Yes

Table 5: ATT on publishing in topics highly funded by the US or the US military in the selection period

Robustness

back to robustness tests

Robustness to sample selection

We alternatively select our sample by simply conditioning on publishing with the US. Results are similar.

				with co-authors from the "same country"			with co-authors from the "same country"	
	publications	citations	pub. top 5% journals	publications	pub. top 5% journals		any new co-authors	avg H index co-authors
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ATT	-0.053	-3.741***	-0.036***	-0.015**	-0.004**	0.004	-0.014***	-0.386**
	(0.032)	(1.035)	(0.011)	(0.006)	(0.002)	(0.003)	(0.005)	(0.175)
Mean.Dep.Var.Pre	3.007	91.136	0.237	0.358	0.072	0.945	0.214	14.928
Pvalue.PreTrend	0.112	0.209	0.045	0.095	0.002	0.043	0.246	0.161
N.authors	47242	47186	47186	47242	47186	47186	47186	39623
N.obs	425178	300196	300196	425178	300196	300196	300196	251553
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cond. on publishing								Yes

Table 6: ATT for main outcomes - Alternative sample (simple selection)

Robustness of our variables

back to robustness part

Top 5% of journals

Sensitivity to the threshold:

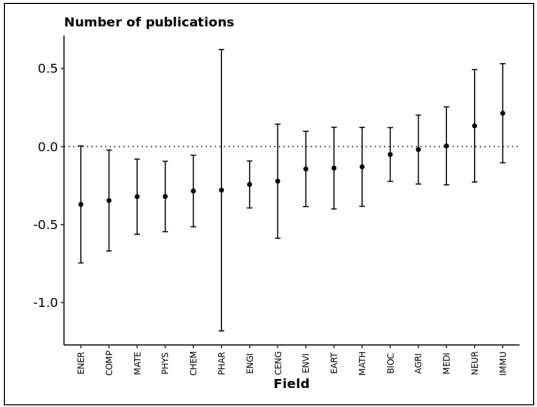
- With a 1% threshold, we do not have an effect (scarcity of non-zero observations, possible protections for the very top of the sample).
- With a 10% threshold: significant effect for publications with US authors for the treated and European for the control.

Sensitivity to the metrics:

We also run the regressions on the CiteScore measure provided by Scopus, but we believe that it does not pick up rising newspapers as well as our metrics.

Writing in US-dominated fields

back



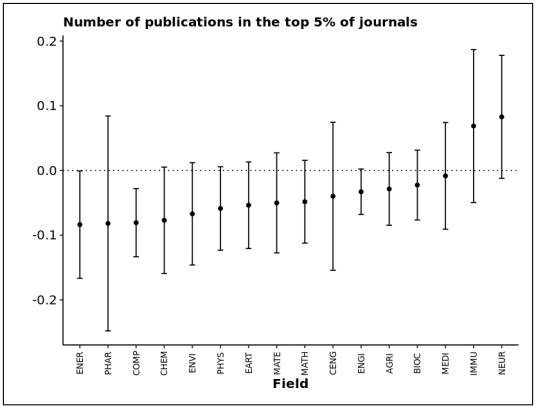


Figure 6: Estimates value for field regressions

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