Sputnik Moments

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Harvard, Boston, Northwestern, and Stanford Universities

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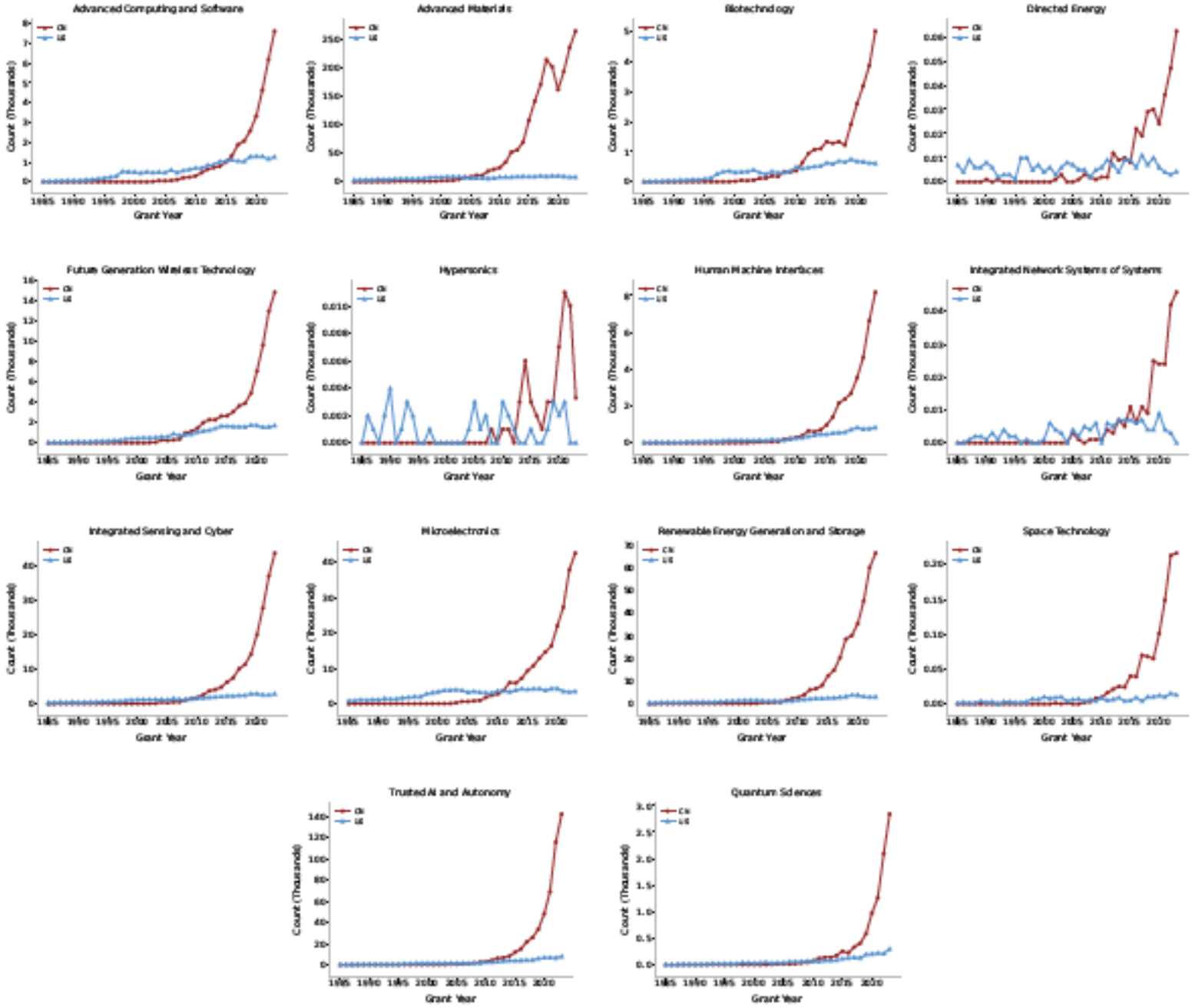
Sputnik moments

- October 2021:
  - Chinese test of DF-ZF, nuclear-capable hypersonic missile, revealed.
  - Capable of evading traditional U.S. ground and naval defenses.
- January 2025:
  - DeepSeek released its R1 large language model.
  - Competitive with OpenAI's o1 model, despite being made at a much lower cost and requiring dramatically less computing power.
- Both generated surprise and consternation from U.S. analysts.

We Warned About the First China Shock. The Next One Will Be Worse.

David Autor and Gordon Hanson July 14, 2025, 5:01 a.m. ET

Critical technology patenting



U.S. sought to limit knowledge flows to China

- Corporate transactions:
  - Reviews of proposed deals by U.S. Departments of Commerce, Defense, and Treasury, as well as Committee on Foreign Investments in the United States.
  - Special focus on targeted firms:
    - Communist Chinese Military Companies (1260H) List, the Entity List, …
  - A focus of considerable economic research (e.g., Holmes et al. (2015), Akcigit et al. (2024), Bai et al. (2025), and Paine (2025)).
- Individual mobility:
  - Regulations banning U.S. citizens and residents from certain Chinese projects.
  - Legislative efforts to limit Chinese efforts to recruit U.S. technologists.
  - Pressure on American firms to reduce headcount at Chinese research facilities.
  - Prosecutions under the Defend Trade Secrets and Economic Espionage Acts.
  - Works such as Kim and Marschke (2005), Moen (2005), Kerr (2008), Borjas and Doran (2012), and Prato (2025) examine inventor mobility in general…
    - But much less scrutiny in context of China.

Key empirical steps (1): Patent data

- Chinese patent datasets often have multiple publications of the same patent:
  - In some cases, different identification numbers!
  - And none is complete.
- Download data from three sources:
  - PATSTAT (European Patent Office), CNIPA, and Google Patents:
  - Numerous challenges in merging and deduplicating:
    - Create a map that links all 24 million patent IDs.
    - Final sample: 16.3 million unique patents after dropping duplicates (14.2m with domestic assignees).

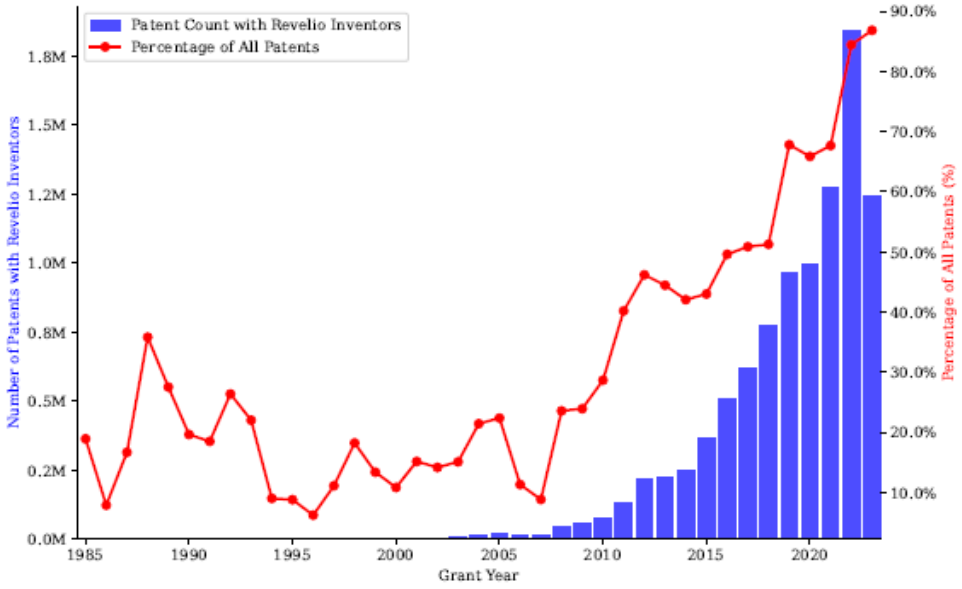
Key steps (2): Identifying critical technologies

- Use list of “Critical Technology Areas” from U.S. Office of the Undersecretary of Defense for Research and Engineering.
- For each critical technology, we observe US patents and applications “linked to DoD funding” from the Defense Technical Information Center.
- From these patents, we identify:
  - The four-digit CPC subclasses that represented the primary assignment of 80% of the DTIC-identified awards. in.
  - All destemmed bigrams and trigrams associated with the keywords listed at the top of the DTIC page uniquely associated with a category.
- We matched all Chinese and U.S. patents to one, multiple, or no critical technology(ies) if they had:
  - A primary assignment to a CPC (or IPC) subclass that was identified as major for one of the 14 DTIC-identified critical technologies, as defined above, and
  - A title and/or abstract that included at least one unique bigram associated with that critical technology.

Key steps (3): Social media profiles

- Follow Sharoni (2024), in use of Revelio Labs data, based on scraping LinkedIn and other databases:
  - Several matches in each language.
  - Worked with firm, as firms scrapes (but does not include in WRDS) the information from Maimai and TianYanCha.
- Captured ~22K movers from large U.S. innovative (DISCERN) firms to Chinese entities:
  - Old inventors, new inventors, and critical technology-linked non-patentees.

Figure 2: Chinese Patents with Revelio-Matched Inventors

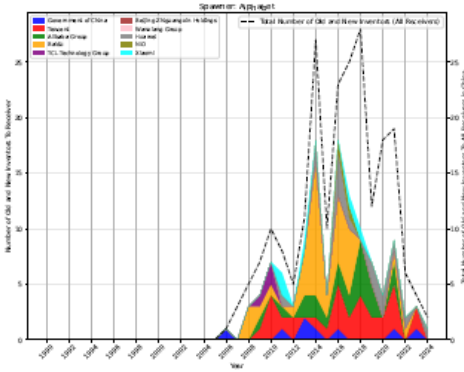


A note on patent quality

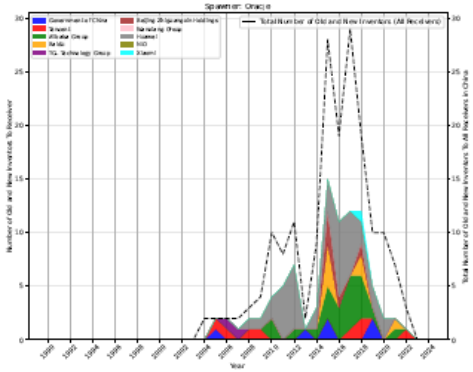
- If Chinese critical technology patents are of low quality, their growth less concerning.
- Three empirical approaches:
  - Use of disruptive bigrams in critical technology, following Kalyani et al. (2025).
  - Look at breakthrough patents, defined as those in the top decile of Kelly et al. (2021, or KPST) scores among all patents in that nation (including awards to foreign entities).
  - Cross-national KPST scores:
    - A novel alternative approach to calculating breakthrough patents, which pools U.S. and Chinese awards in a given critical technology.
    - Look at relative Chinese and U.S. scores:
      - More to come here.

No approach suggests declining quality!

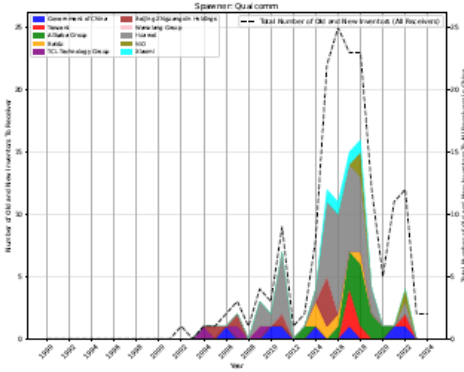
Spawners



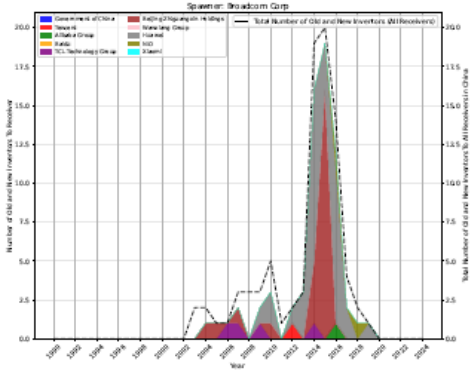
(a) Alphabet



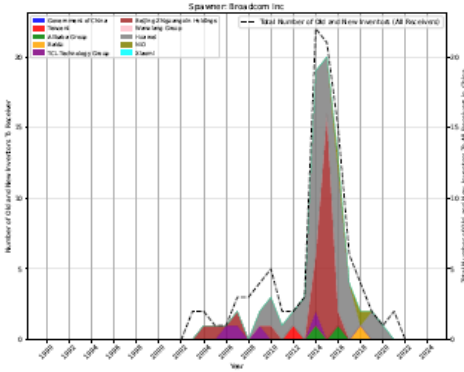
(b) Oracle



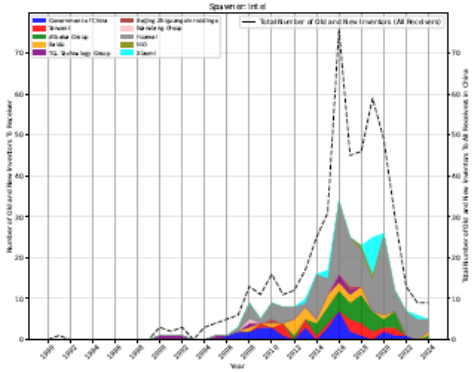
(c) Qualcomm



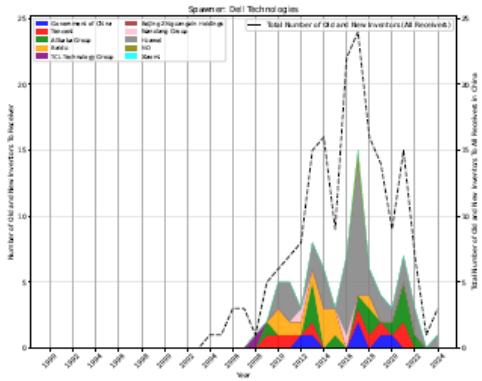
(d) Broadcom Corp



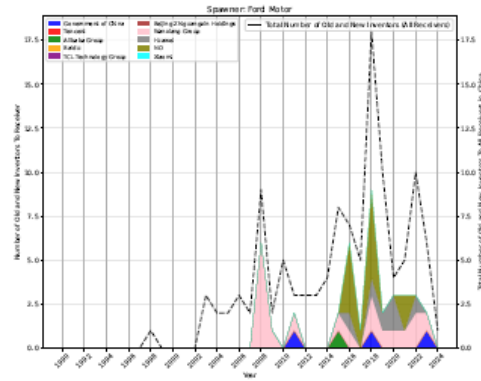
(e) Broadcom Inc./Avago



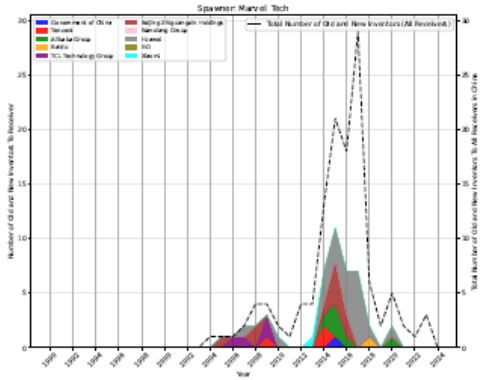
(f) Intel



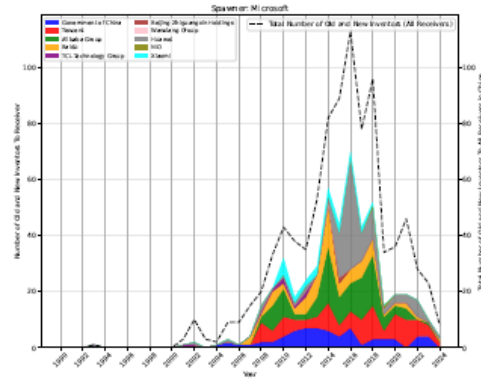
(g) Dell



(h) Ford



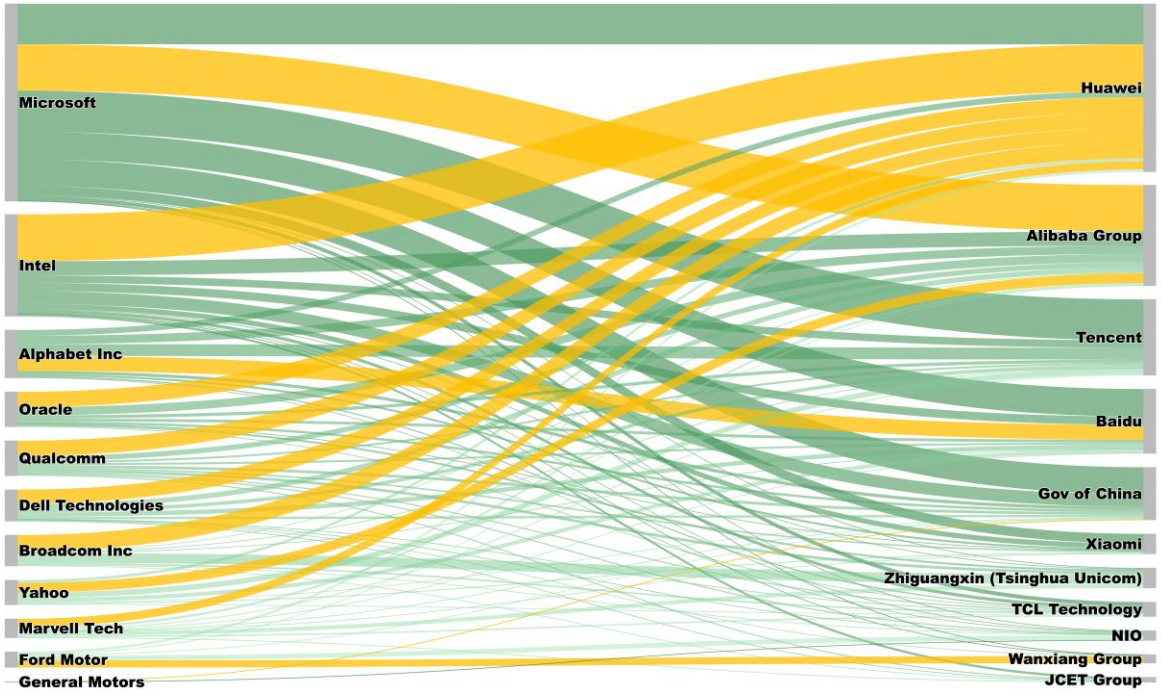
(i) Marvell



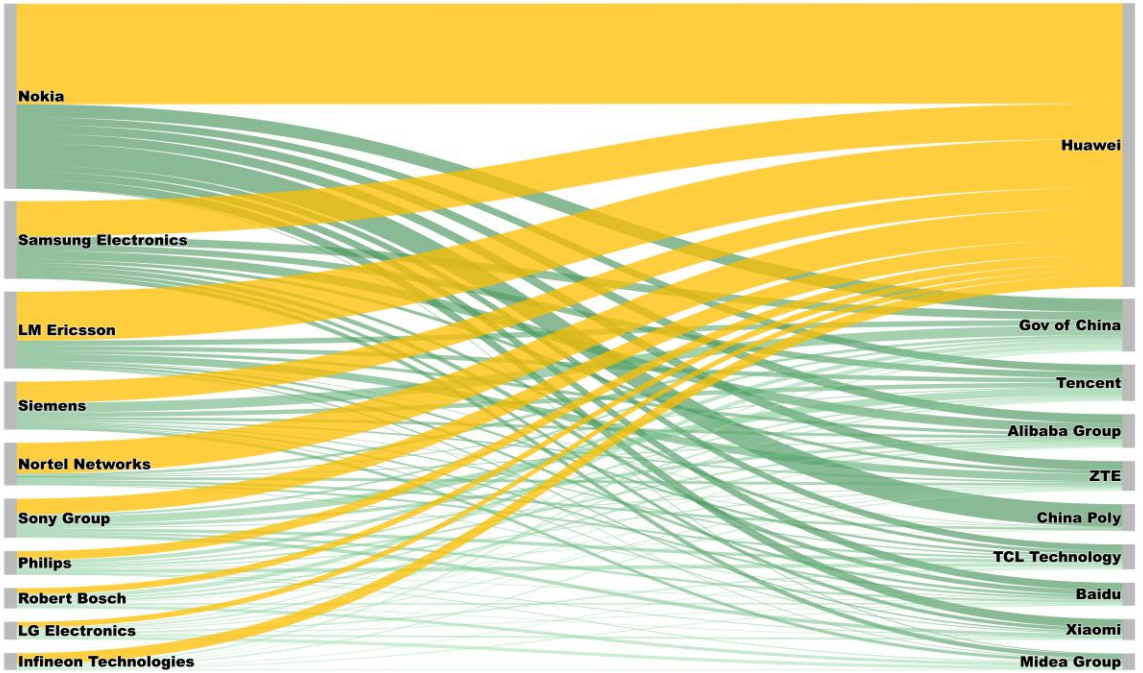
(j) Microsoft

- Flow of inventors accelerated in the early 2010s.
- Late 2010s saw a sharp drop.

Spawner-receiver pairs



U.S. Old and New Inventors



Other Old and New Inventors

Characteristics of …

Spawners

- Larger.
- Originally venture-backed.
- More profitable.
- More drug patents.
- Patent overlap with receiver.

Receivers

- Larger.
- Originally venture-backed.
- More influential patents.
- More IT and physics patents.
- Less likely to be on Entity List.

Individuals (of those with Chinese surnames)

- China educated.
- Not U.S. based.
- More educated.
- Seniority x tenure.

What are the direct effects of movers?

	All	2015-23
% of ***breakthrough patents*** that have at least one inventor who ever worked at a DISCERN 500 company	1.40%	1.50%
% of ***non-breakthrough patents*** that have at least one inventor who ever worked at a DISCERN 500 company	1.41%	1.61%
% of ***inventors with a breakthrough patent*** who ever worked at a DISCERN 500 company	0.43%	0.42%

- Limited footprint of movers in Chinese innovation.
- If anything, less representation among most important (high KPST score) patents.
- Less representation in post-2015 area.

Are there spillovers at receiving firms?

- Look at critical technology inventors moving from the U.S. to Chinese-based firms.
- Look at impact of receiving movers in 3-year periods on change in breakthrough innovation in next three years:
  - At critical technology * period * receiving entity level.
  - Use “Davis-Haltiwanger” transform to limit impact of outliers.

- Of course, may be associated with other investments at receivers.

Spillovers (2)

(a) Panel A: Impact of Old Inventors on receivers' breakthrough critical patent growth rates

	(1)	(2)	(3)	(4)
Pre-period	2008–10	2011–13	2014–16	2017–19
Post-period	2011–13	2014–16	2017–19	2020–22
Dep. Var.: DH Growth Rate of CN Breakthrough Critical Patents				
Model	WLS	WLS	WLS	WLS
No. Old Inventors	0.5305**	0.5177***	0.0362**	0.0018
(Pre-period)	(0.2248)	(0.0627)	(0.0164)	(0.0060)
No. Breakthru. Crit.	0.0768***	-0.0010***	0.0080***	0.0032***
Patents Filed (Pre-period)	(0.0266)	(0.0002)	(0.0028)	(0.0006)
No. Old Inventors ×	-0.0672**	0.0017*	-0.0008***	-0.0002***
Breakthru. Crit. Patents	(0.0317)	(0.0010)	(0.0003)	(0.0001)
Adj. R^2	0.3964	0.0890	0.2692	0.3034
No. Observations	668,906	668,906	668,906	668,906
Std. Err. Clustering (Ultimate Parent Company)	Yes	Yes	Yes	Yes

Marginal impact of one additional mover, by number of breakthrough critical patents

Additional breakthrough patents associated with one additional mover

Breakthrough critical patents in pre-period	Period 2011-13	2014-16	2017-19	2020-22
1	0.60	0.70	0.04	0.00
3	1.18	2.12	0.10	0.00
5	1.08	3.57	0.16	0.00

Implied increase in breakthrough patents

Breakthrough critical patents in pre-period	Period 2011-13	2014-16	2017-19	2020-22
1	60.3%	70.2%	3.6%	0.2%
3	39.4%	70.8%	3.4%	0.1%
5	21.5%	71.4%	3.3%	0.1%

- Association between movers and increased innovation among the recipient firms high in 2008-10 and 2011-13.
- Association drops sharply after 2013.
- Diminishing marginal returns from movers in breakthrough patents in most specifications.

Spillover effects very weak

Additional breakthrough patents, only looking at movers' colleagues

Critical (by Co-Inventors) patents in pre-period	Period 2011-13	2014-16	2017-19	2020-22
1	-0.04	0.11	-0.00	-0.02
3	-0.11	0.33	-0.01	-0.05
5	-0.18	0.55	-0.01	-0.08

Additional breakthrough patents, only looking spawners from software and technology firms

Breakthrough critical patents in pre-period	Period 2011-13	2014-16	2017-19	2020-22
1	0.00	0.01	0.00	0.00
3	0.02	0.03	0.01	0.00
5	0.04	0.06	0.01	0.00

Additional breakthrough patents, looking at critical technology * province * period level

Breakthrough critical patents in pre-period	Period 2011-13	2014-16	2017-19	2020-22
1	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00
5	0.01	0.00	0.00	0.00

- Also, no evidence of increased subsequent patent similarity for pairs of firms with more movers.

Key concerns

- Are Chinese patents reasonable measures of innovation?
- What is the impact of secret patents?
- Are social media profiles of foreign inventors censored?

Here give a brief look at the analyses we undertake address these concerns.

DEFENSE DOMAIN

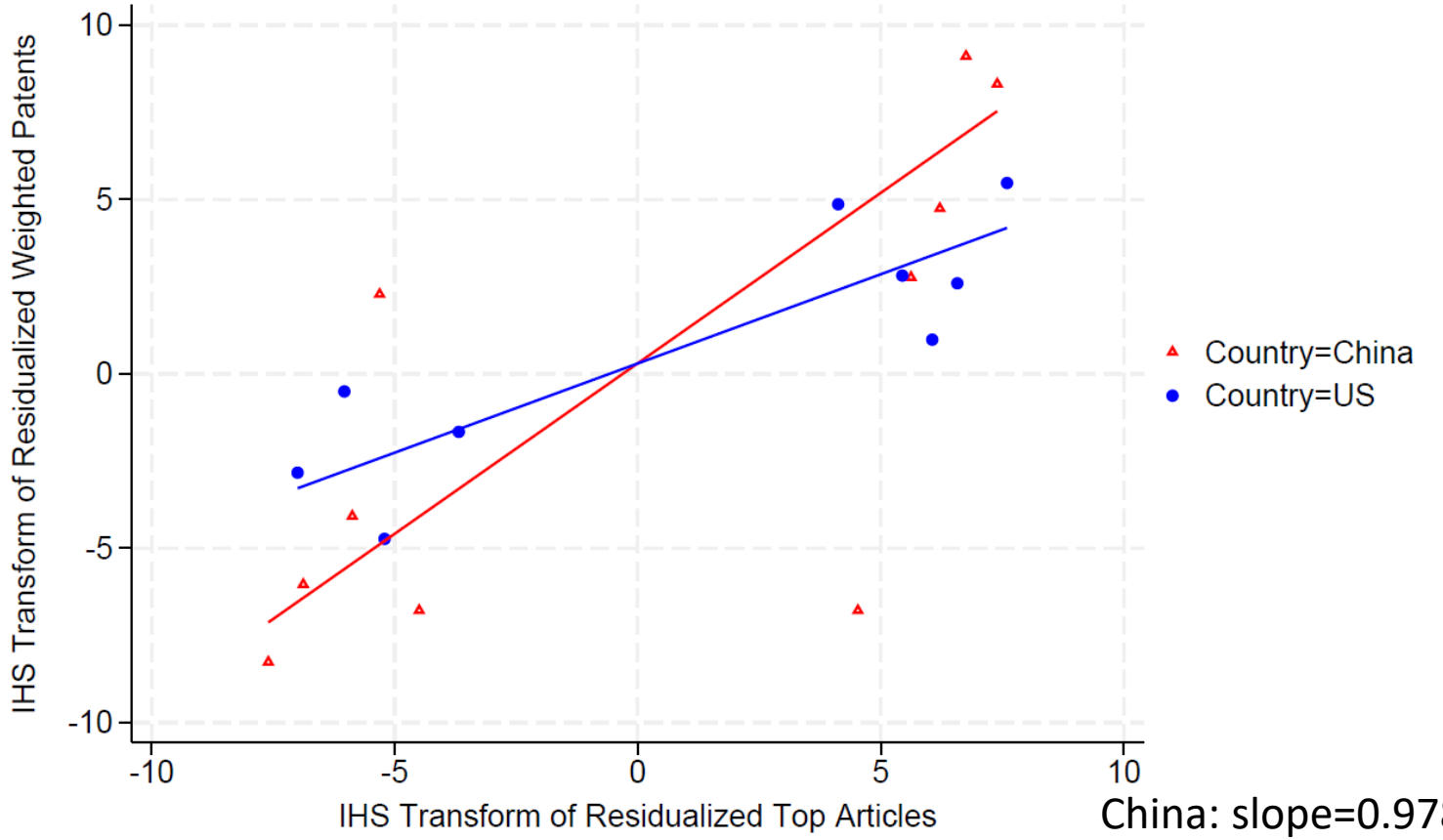
China's Semiconductor "Manhattan Project": Breaking the EUV Monopoly

By **Mustafa Kirisci** - December 26, 2025

"Key hires reportedly include experts in light-source technology who filed dozens of patents for the Chinese Academy of Sciences (CAS) ***under aliases.***"

Are Chinese patents good innovative indicators?

Weighted patenting and top articles, by technology-year level



China: slope=0.978 [0.065]; R^2=0.476
US: slope=0.512 [0.078]; R^2=0.152

Does patent secrecy affect analysis?

	Non-secret patent by inventor?	To same firm?	In same subclass?	Similar patent?	Top assignees
China	90%	88%	81%	89%	• **China Academy of Space Technology** • **Northwestern Polytechnical University** • **China Electronics Technology Group Corp.**
U.S.	90%	83%	82%	74%	• **U.S. Department of the Navy** • **U.S. Department of the Army** • **Raytheon**

- Look at declassified patents in both nations.
- In both cases, abundant similar never-classified patents.
- “Similar” patents are defined as those that share an inventor, match on assignee or CPC classification, and exhibit a qualitatively similar technical focus.

Are critical inventors on social media?

	All	2015-23
All patents	59.1%	65.9%
All critical patents	65.4%	71.5%
Breakthrough artificial intelligence patents	77.3%	78.8%
Breakthrough defense patents (directed energy, hypersonics, quantum, space)	69.3%	73.2%
Breakthrough microelectronics patents	47.6%	66.7%

- In recent years, ≥ 2/3^{rds} of breakthrough patents in key areas.
- Breakthrough patents in key areas have more social media coverage than all patents.
- More analyses to come!

A puzzle?

Seeming disconnect with the received [Washington] wisdom…

"[China] has engaged in the largest theft of intellectual property in history."

—General H.R. McMaster.

Potential explanations:

1. China successfully "covered the tracks" of critical and transplanted inventors.
2. China has continued to build off of Western technology, whether obtained from public disclosures, corporate ties, or cyber-espionage:
   - But mobility of corporate researchers is not a major channel of knowledge.
3. Rise of internally generated innovations, at least since the mid-2010s.

Explore policy implications using a stylized dynamic quality ladder model.

Thank You!

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