The Breakup of the Bell System and its Impact on Innovation

Martin Watzinger and Monika Schnitzer

University of Muenster and LMU Munich

CESifo and CEPR

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Policy debate: How to deal with big tech firms?
Breakups are popular with the media and policy makers

The Guardian
Opinion
A US antitrust suit might break up Google. Good – it's the Standard Oil of our day
Sarah Miller

BBC
Elon Musk calls for 'break up' of Amazon

But: we know little about the effects of a breakup

Reason: **Breakup of a monopolist is a rare event ⇒ Very little data**

Historical cases in the US:

- The 1910s: Standard Oil and American Tobacco
- 1984: Bell System
- 2000: Court ordered the breakup of Microsoft, overturned in appeals 2001

Research question

This paper:
What were the effects of the **breakup of the Bell System** on innovation?

Why care about the Bell case?

- The Bell System case was the **only breakup** of a monopolist in the US **in the last 100 years**
- If we contemplate breakups today, we should know what happened last time and see what we can learn
- The case was about **exclusionary conduct** - a frequent concern today

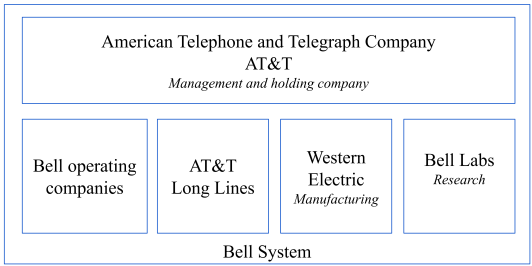
Outline of the talk

1. Institutional background: The case against Bell
2. Empirical strategy
3. The impact of the breakup on rate of US innovation
4. The impact of the breakup on the direction of US innovation
5. Conclusion

1. Institutional background: The case against Bell

The 1970s: Bell System is the dominant US telecommunications company

Bell System was the largest US company (1.7% of US GDP) with 1 million employees in 1974 (1.1% of US workforce)



Operating companies: 85% market share of local telephone calls

AT&T Long Lines: >85% market share of long-distance calls

Western Electric: 82% market share in the production of telecom equipment

Bell Labs: the powerhouse of US innovation

“How Bell Labs Invented the World We Live in Today” (Time Magazine)

Bell Labs invented **key technologies of the digital era**

- Cellular telephone technology (1947)
- Transistor (1947)
- Laser (1957)
- First communication satellite (1962)
- Unix operating system (1969)
- ...

Nine Nobel Prizes and four Turing Awards for work at Bell Labs

1974 Antitrust Lawsuit against Bell

Previous antitrust case ended with Consent Decree in 1956

"For a great many years, the FCC has struggled, largely without success, to stop [exclusionary conduct] through the regulatory tools."

"Some other remedy is plainly required; hence the divestiture of the local Operating Companies from the Bell System." (US vs. AT&T)

1974 Antitrust Lawsuit against Bell

Allegation: Bell leverages its monopoly position in the local telephone network (essential facility / bottleneck), using **exclusionary conduct**

- refusal to connect non-Bell long-distance services to Bell's local network
- refusal to connect non-Bell telecom equipment to Bell's local network

Proposed remedy: **vertical breakup** - separate operating companies from the rest

Idea: After the breakup

- local telephone companies have no incentive to prefer the long distance services of Long Lines or the telecom equipment of Western Electric over competitors
- non-Bell companies can enter the market

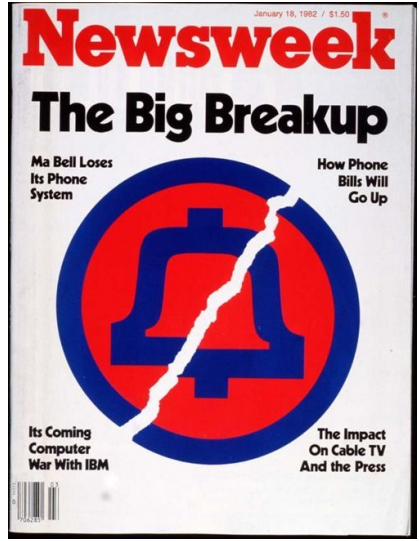
1974 Antitrust Lawsuit against Bell

1974: Bell starts lobbying campaign to stop breakup

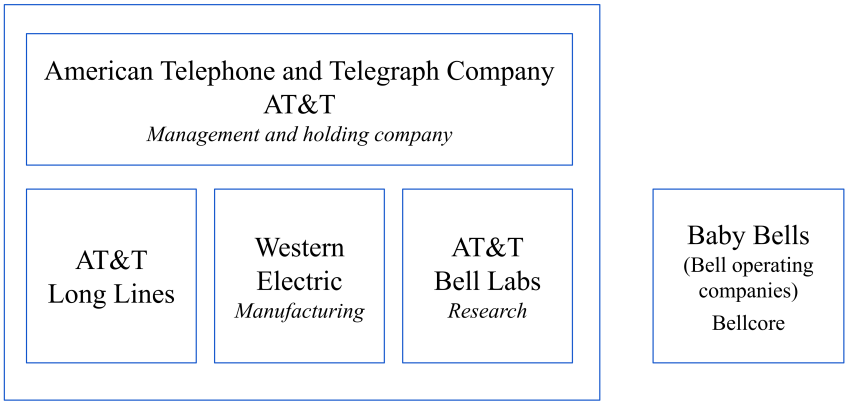
1981: Assistant Attorney General William Baxter, chief prosecutor in the Bell case, resists Reagan administration pressure and publicly vows to litigate case ″to the eyeballs.″

1982: Bell enters a consent decree and agrees to breakup

1984: Bell System is broken up



Separate operating companies are established after 1983



The New York Times | https://nyti.ms/29wQBLK

BELL SYSTEM BREAKUP OPENS ERA OF GREAT EXPECTATIONS AND GREAT CONCERN

"The breakup of the Bell System was a **dramatic and unexpected development**."

"If the telephone breakup spurs innovation, it could help all industries. (...) However, **the breakup could also impede innovation** (...) Bell Laboratories (...) might see its research funds shrink."

"It is the dumbest thing that has ever been done," said Charles Wohlstetter, chairman of Continental Telecom Inc., an independent telephone company. "**You don't have to break up the only functioning organization in the country to spur innovation.**"

Research question

What were the effects of the breakup of the Bell System on US innovation?

2. Empirical strategy

Empirical strategy: measurement

To measure innovation, we use data on US patents of US inventors from PATSTAT

United States Patent [19]

Frenkiel

[11] **4,144,411**

[45] **Mar. 13, 1979**

[54] **CELLULAR RADIOTELEPHONE SYSTEM STRUCTURED FOR FLEXIBLE USE OF DIFFERENT CELL SIZES**

[75] Inventor: **Richard H. Frenkiel,** Englishtown, N.J.

[73] Assignee: **Bell Telephone Laboratories, Incorporated,** Murray Hill, N.J.

[21] Appl. No.: **725,429**

[22] Filed: **Sep. 22, 1976**

[51] **Int. Cl.**[2] **H04Q 7/04**
[52] **U.S. Cl.** ..... **179/2 EB;** 325/53
[58] **Field of Search** ..... 179/41 A; 325/53, 51

[56] **References Cited**

U.S. PATENT DOCUMENTS

"A Look at the Future of Mobile Telephone Service", Norman A. Adams, *Telephony,* 2/17/75, pp. 37–44.

Primary Examiner—William C. Cooper
Assistant Examiner—Kenneth A. Chayt
Attorney, Agent, or Firm—Charles Scott Phelan

[57] **ABSTRACT**

The use of plural cell sizes in cellular high capacity mobile telecommunications systems is facilitated by providing dual service availability in an essentially geographically continuous large-cell grid and an overlaid and essentially geographically discontinuous small-cell grid. When using certain frequency channel set assignment plans, large-cell antenna sites employ their ordinary channel set assignments whether or not a small-cell antenna site is also present. When a large-cell site is operated in the vicinity of a co-channel small-cell site,

Empirical strategy: identification

Identification: We need a counterfactual. What would have happened to US innovation if Bell had not been split up?

To construct the counterfactual, we use the CPC technology classification of patents. The CPC is divided in classes, subclasses, groups and subgroups.

We compare

- the *number of patents* in all technology groups where Bell was active with
- the *number of patents* in technology groups within the same technology subclass where Bell was not active

before and after the breakup.
(following Moser and Voena 2012, Moser, Voena and Waldinger 2014)

Empirical strategy

Treatment definition: A technology group *"where Bell was active"* is every technology group with 5 or more Bell patents in the 10 years before 1974.

Robust to the use of other cutoffs.

Example: In the technology subclass - H04L "Transmission of Digital Information" we compare the number of patents in

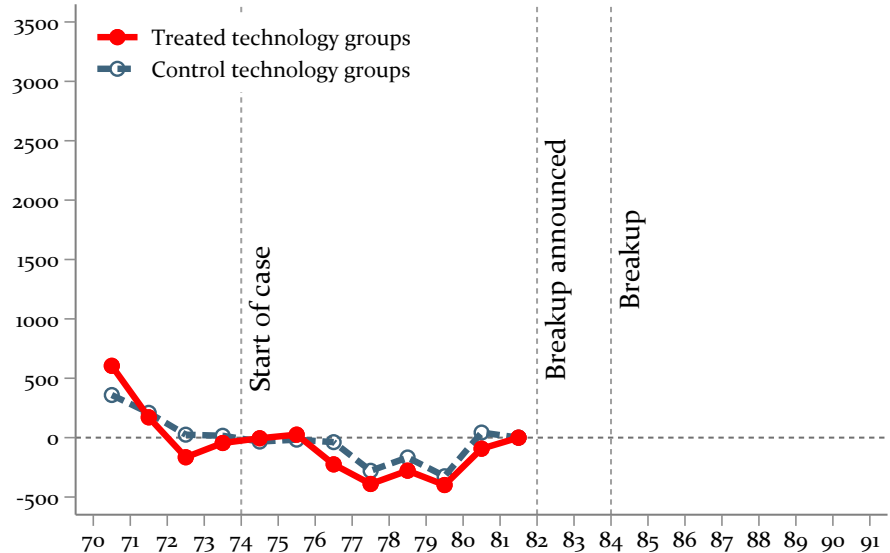
- 7 treated groups; e.g., Data Switching networks, Error detection,
- 16 control groups; e.g., Routing in packet switching networks, Cryptographic transmission

before and after the breakup and then aggregate up the effect across all subclasses.

Sample: 75 subclasses with treated and untreated technology groups - 11% of all 634 subclasses at the time

3. The impact of the breakup on the rate of US innovation

Increase in number of patents in treated (red) and control technology groups (blue) relative to 1981 by filing year



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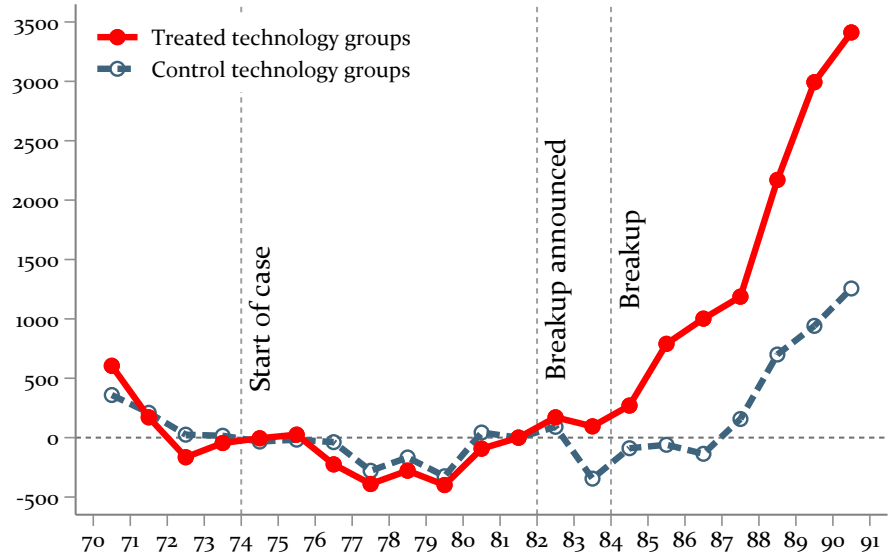
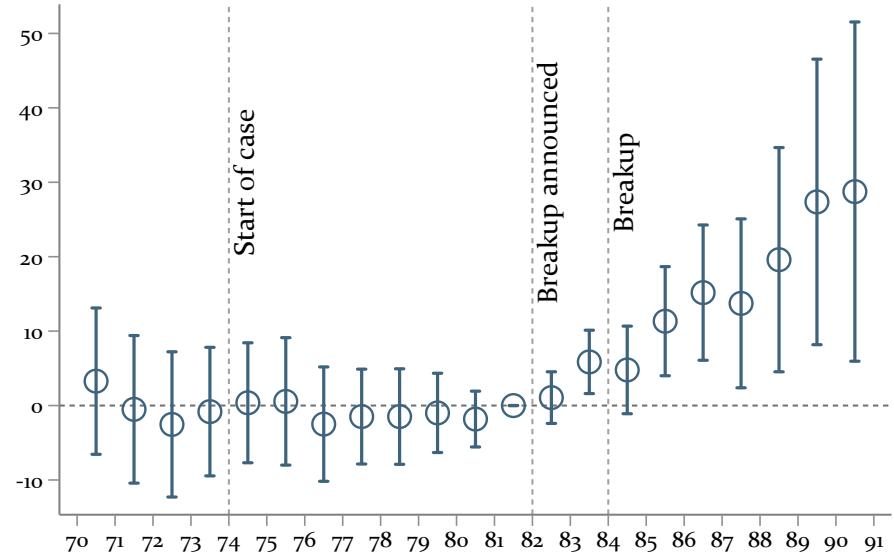


Average difference in # of patents in treated compared to control technology groups (1981 baseline)



Difference-in-Differences specification

1065 patents increase by US inventors - 2.6% of all US patents of US inventors

$$\#Patents_{i,t} = \beta_1 \cdot Treated + \beta_2 \cdot Treated \times Period\,Indicator + Year\,FE + \varepsilon_{it}$$

	(1)	(2)	(3)	(4)	(5)	(6)
	US inventors		including foreign inventors		without Bell	
	# patents	% increase	# patents	% increase	# patents	% increase
Treat x I(74-80)	-1.0	-1.4	-2.5	-2.0	-0.9	-1.2
	[-6.9,4.8]	[-9.0,6.2]	[-10.1,5.0]	[-7.8,3.8]	[-6.7,5.0]	[-9.4,6.9]
Treat x I(82-90)	14.2	19.1	29.0	23.3	14.5	20.9
	[4.5,23.9]	[7.0,31.1]	[6.9,51.2]	[7.1,39.5]	[4.7,24.3]	[7.8,34.0]
Obs.	2550	2550	2550	2550	2550	2550

More

Additional analysis

1. Increase in R&D spending More
2. Bell decreases patenting by 108 patents per year or 25% relative to synthetic control More
3. Effect is not driven by software or data-related patents More
4. Effect is robust to using
   - Alternative definitions of treatment and control More
   - Alternative estimation methods More
   - Alternative outcomes More
   - Alternative samples More

Increase suggests there was **missing innovation** before the breakup

The breakup led to more patents. This suggests that society **missed out on innovation** before the breakup.

Why?

1. *Arrow replacement effect*: e.g., Bell developed the answering machine in 1934 but kept it secret because Bell thought it reduces demand for telephone services

2. *Contestability:* No other company innovated because none could enter.

Which innovation did we miss?

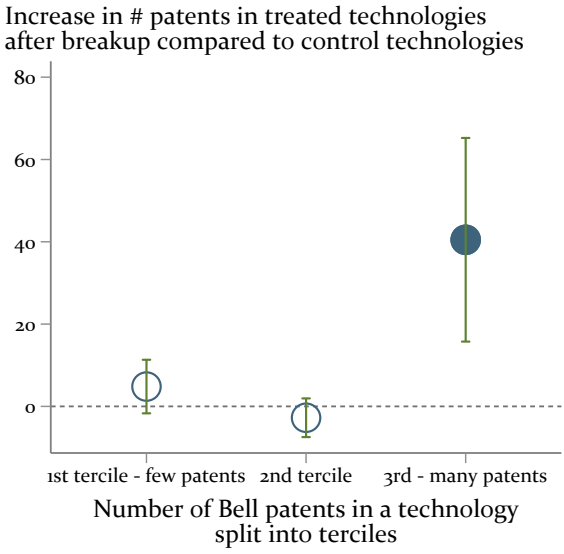
4. The impact of the breakup on the direction of US innovation

Two pieces of evidence: After the breakup

a) Innovation central to telecommunications increases

b) Diversity of innovation increases

a) Innovation central to telecommunications increases



b) Diversity of innovation increases

Idea: More entry might had led to more "diverse" technologies.

One way to see whether technologies become more diverse **is to count the number of subgroups (in a technology group) with at least one patent** in a filing year.

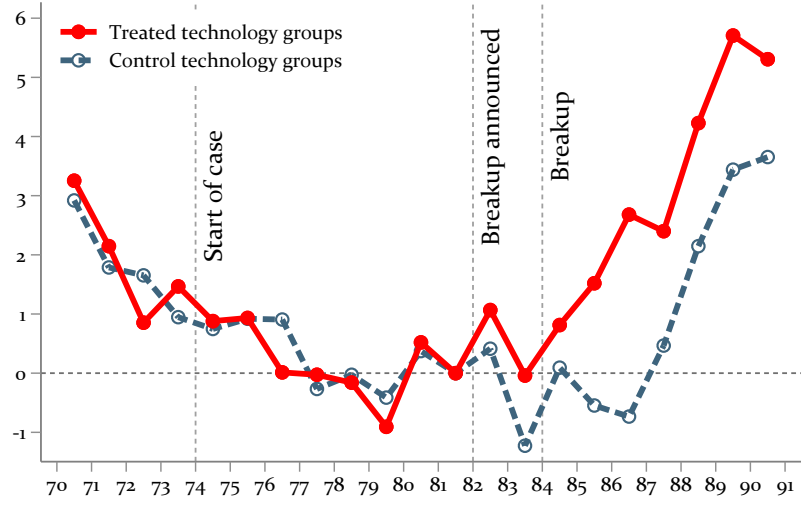
Example: The technology group H04M 3 "Telephonic communication - Automatic or semi-automatic exchanges" has 59 subgroups, e.g. "Arrangements for automatic redialing"

We say that diversity in group H04M 3 increased between 1980 and 1984 e.g., if patents are filed

- in 30 of the 59 subgroups in 1980 and
- in 50 of the 59 subgroups in 1984.

Diversity of innovation increases after the breakup

Average increase in the number of subgroups with patents in treated and control tech groups relative to 1981



Additional results consistent with a change in diversity

After the breakup, in treated technology groups

- the share of citations to non-Bell patents went up
- the text of patents becomes on average more disimilar to past patents

relative to control technology groups. More details

Narrative evidence: Forbes Magazine looks back in 1989

WAS BREAKING UP AT&T A GOOD IDEA? The answer, on balance, is yes. By Kenneth Labich

"Today the great majority (...) declare themselves satisfied with the service they receive."

"[T]he industry has evolved into an entrepreneurial, freewheeling marketplace (...) the new competition has forced rapid technological change, in fact, a flowering of communications research."

"Divestiture has clearly accelerated the pace of some crucial new communications developments."

The breakup of Standard Oil

5. Conclusion

Takeaways

Our analysis shows that the rate, the direction and the diversity of innovation in telecommunications changed significantly after the breakup.

1. Exclusionary conduct can harm innovative activity and should be a key concern for antitrust authorities in high tech sectors (Backer 2012, 2019)

2. Bell was a regulated monopolist. The breakup increased innovation over and above regulation. So regulation should not be the only tool of antitrust authorities.

3. Competition increases innovation diversity even if the monopolist has the best industrial laboratory in the world.

Thank you

Martin Watzinger (martin.watzinger@wiwi.uni-muenster.de)

Monika Schnitzer (schnitzer@econ.lmu.de)

5. How special is the Bell case? The breakup of Standard Oil 1911

How the breakup of Standard Oil happened

John D. Rockefeller's Standard Oil controlled 85% of the oil market in the first decade of the 1900s.

Standard Oil was able to exclude competitors by controlling transportation of oil by railroads and pipelines.

In 1909, Standard Oil was accused of illegally monopolizing the oil market and in 1911 the Supreme Court ordered its breakup.

Successor companies today: ExxonMobile, Chevron, Marathon and parts of BP.

Empirical strategy

Three main differences to the empirical setup used for the Bell case due to data limitations:

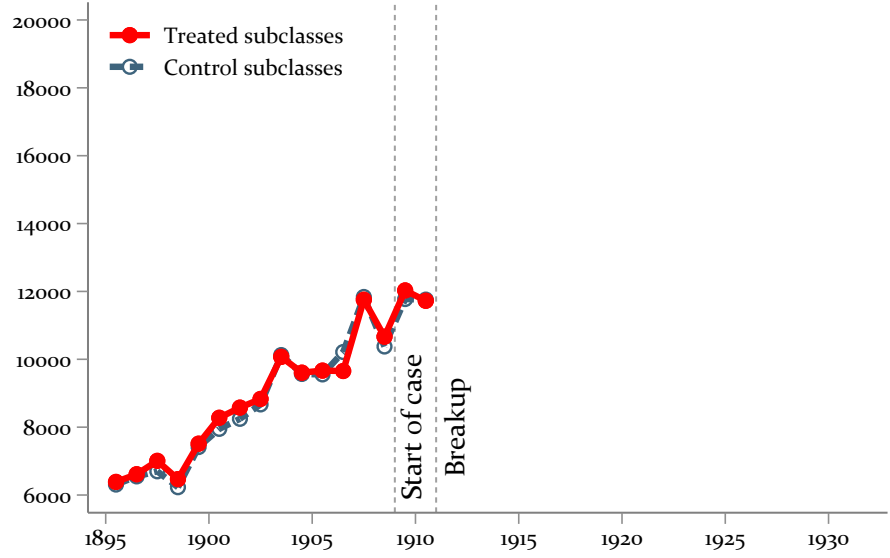
1. We use grant year instead of filing year
2. We use the USPC technology classification instead of CPC
3. A patent subclass is treated if the word "oil" is in the name of the assignee or in the title of at least one patent filed in this subclass from 1931 to 1940.

We compare

- the *number of patents* in all technology subclasses related to the oil industry
- the *number of patents* in technology subclasses within the same technology class unrelated to the oil industry

before and after the breakup.

Increase in number of patents in treated (red) and control subclasses (blue) by grant year



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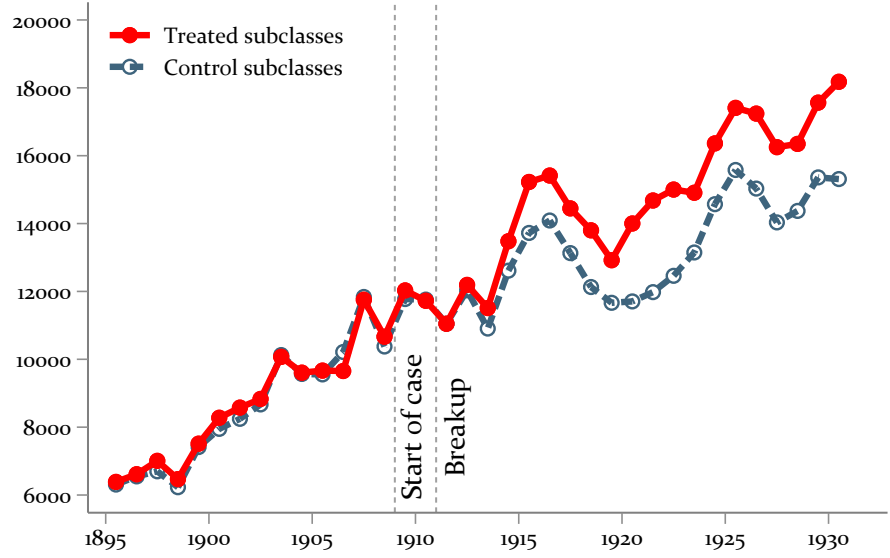
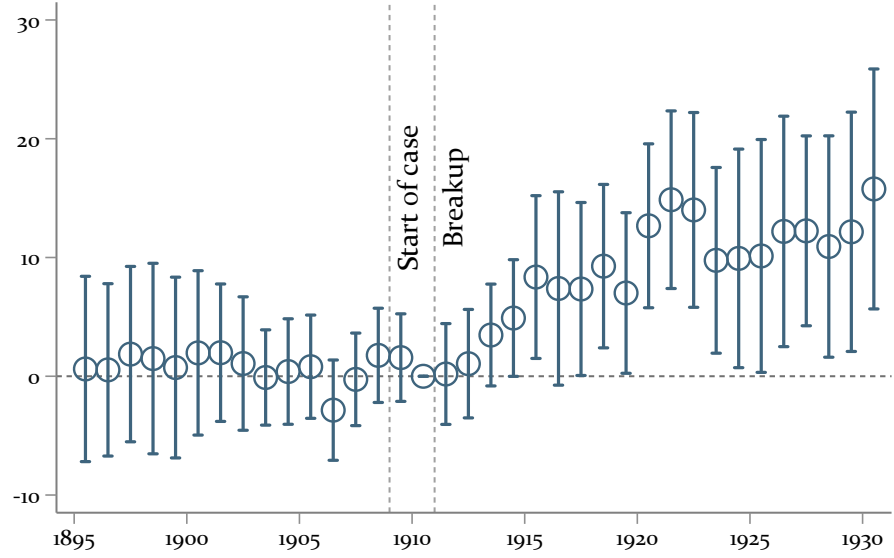


Average difference in # patents in treated compared to control subclasses by grant year (1908 baseline)



6. Conclusion

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Our analysis shows that the rate, the direction and the diversity of innovation in telecommunications changed significantly after the breakup.

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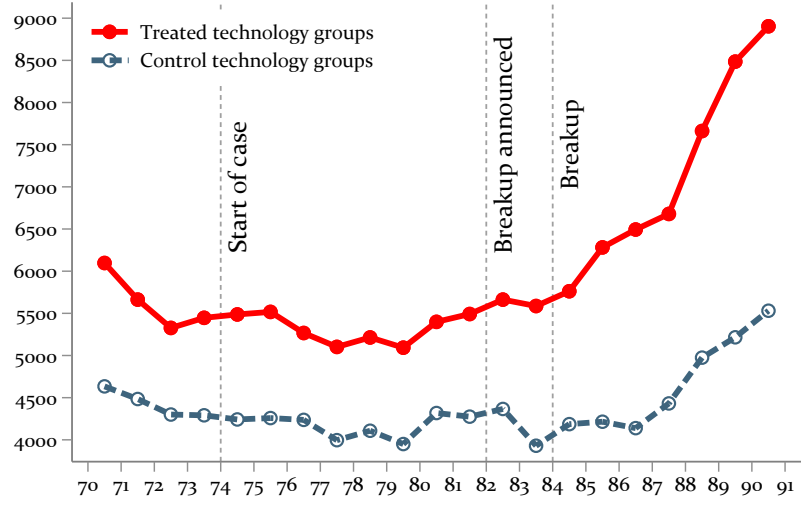
Appendix

Increase in total patents - not normalized

Back

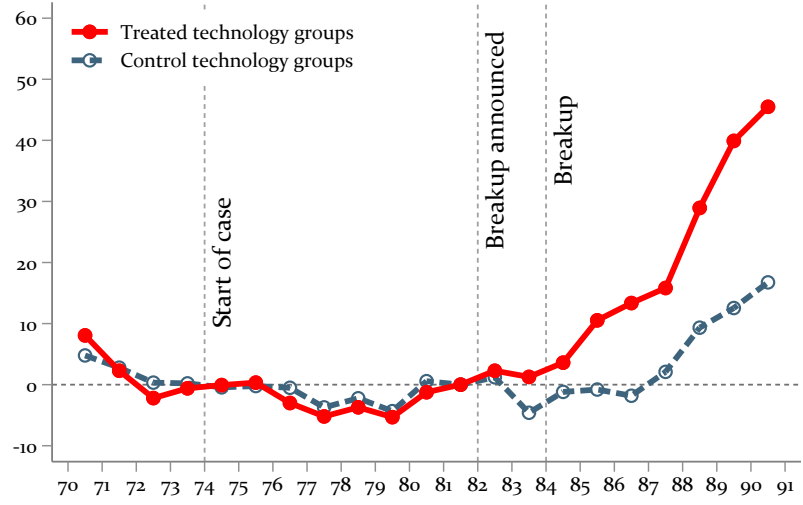
Increase in number of patents in treated (red) and control technology groups (blue) by filing year



Increase in average number patents per subclass

Back

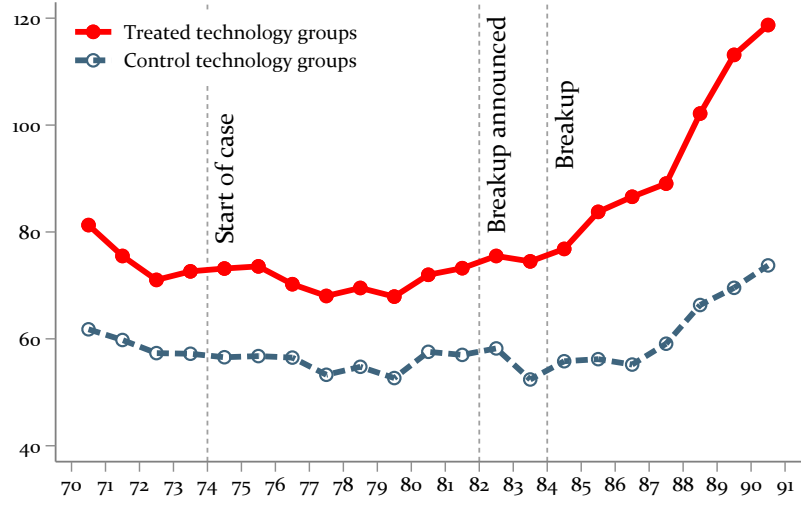
Average number of patents in treated (red) and control technology groups (blue) relative to 1981 by filing year



Increase in average number patents per subclass - not normalized

Back

Average number of patents in treated (red) and control technology groups (blue) by filing year



Innovation of existing companies increases

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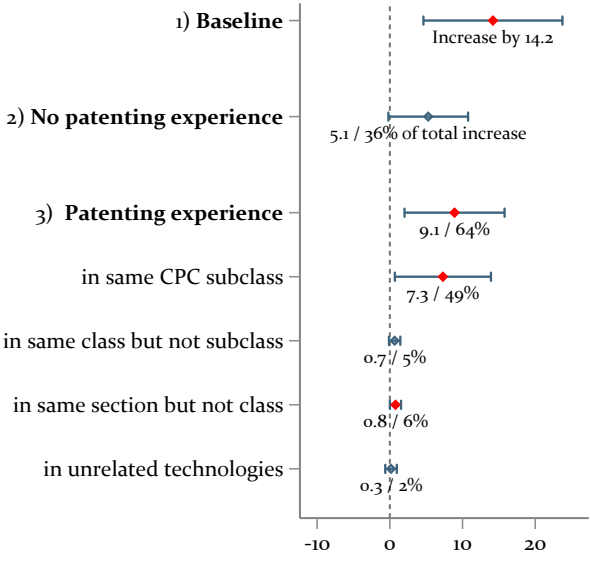
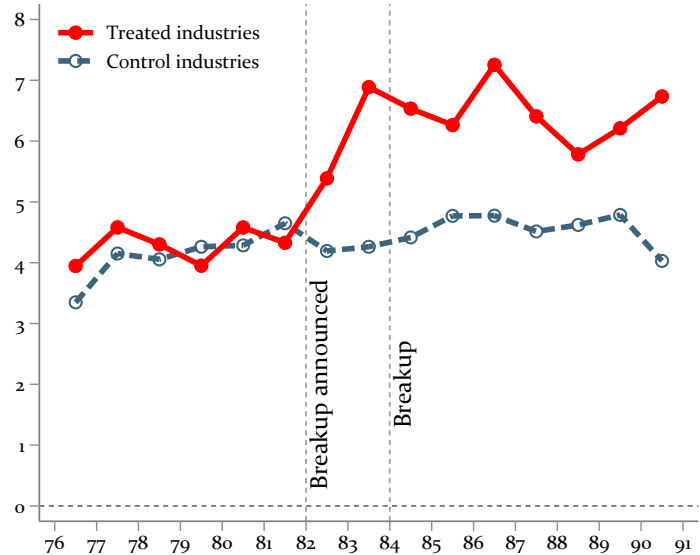


Effect on R&D Spending

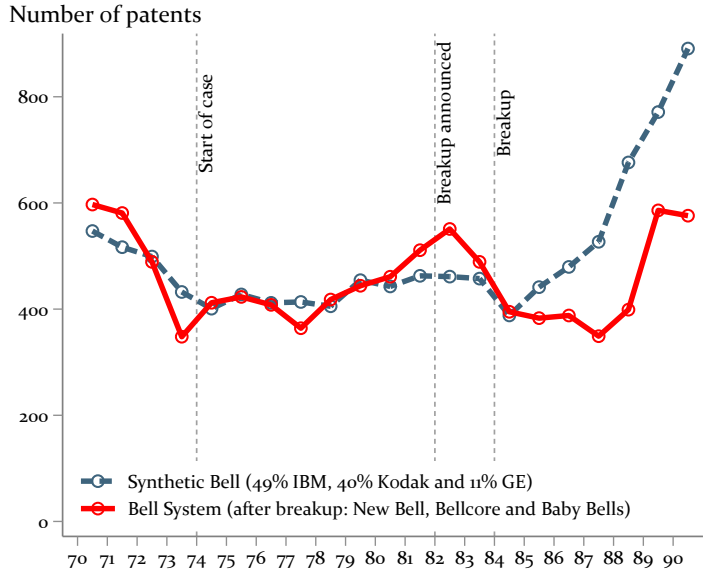
Back

Average R&D/Sales in treated (red) and control industries (blue)



Effect on Bell: Temporary decrease by 108 patents per year

Back



Excluding software and data patents

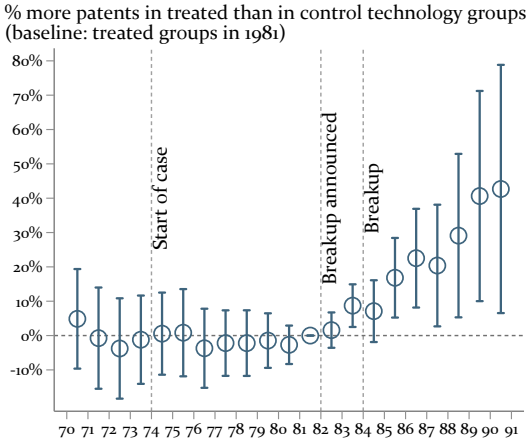
Back

- We use the methods of Graham and Mowery (2003), Graham and Mowery (2005), and Bessen and Hunt (2007) to identify software patents.
- To identify data patents we search for the word "data" in title, abstract and claims.

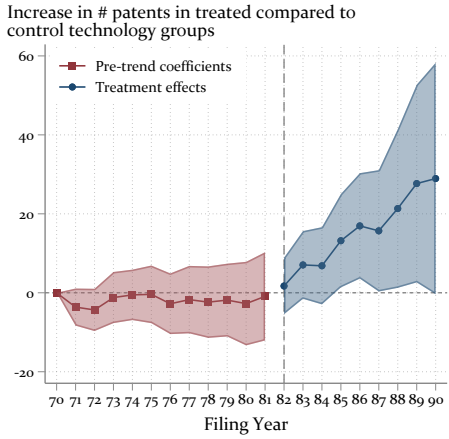
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	US inventors		Excl. software patents		Excl. data patents		Excl. software & data patents	
	# patents	% increase	# patents	% increase	# patents	% increase	# patents	% increase
Treat x I(74-80)	-1.0	-1.4	0.0	0.0	-0.2	-0.3	-0.2	-0.4
	[-6.9,4.8]	[-9.0,6.2]	[-5.1,5.1]	[-8.0,8.1]	[-5.0,4.6]	[-7.8,7.2]	[-5.0,4.5]	[-8.3,7.5]
Treat x I(82-90)	14.2	19.1	10.6	17.0	11.4	18.2	9.4	16.1
	[4.5,23.9]	[7.0,31.1]	[2.3,18.9]	[4.3,29.7]	[2.5,20.3]	[4.7,31.8]	[1.1,17.7]	[2.5,29.7]
Obs.	2550	2550	2550	2550	2550	2550	2550	2550

Alternative estimation methods I

Back



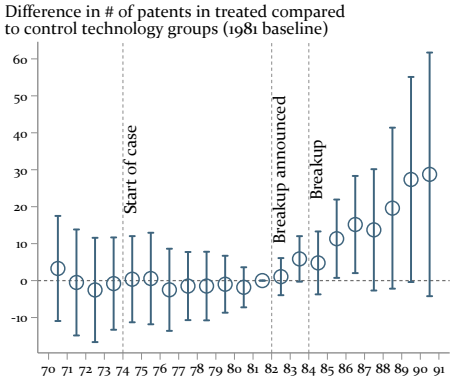
(a) Treatment effects in percent



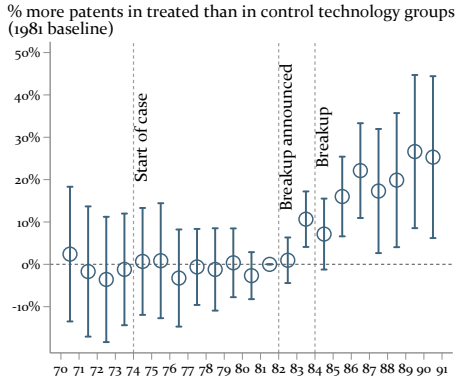
(b) Patent levels with Borusyak et al (2021)

Alternative estimation methods II

Back



(c) Standard errors following Montiel Olea and Plagborg-Moller (2019)



(d) Percent - Poisson pseudolikelihood regression

Alternative treatment definitions I

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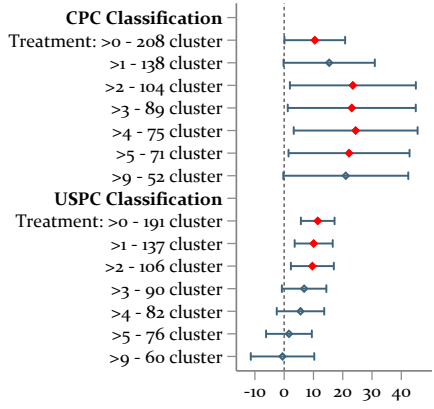
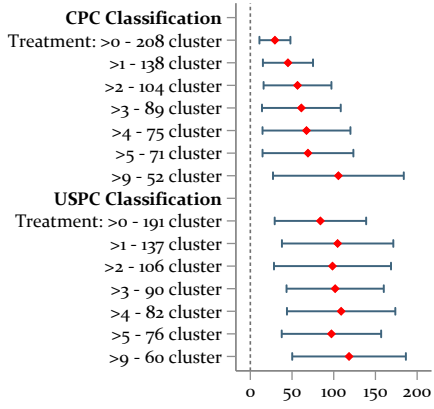


(e) Tech groups aggregated



(f) Tech groups not aggregated

Alternative treatment definitions II

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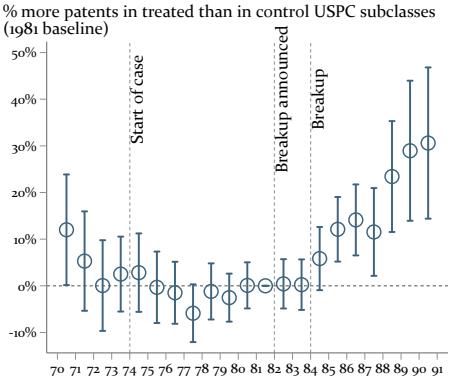
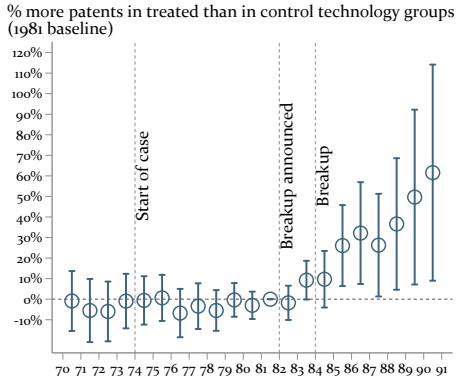


(g) USPC classification - aggregated - treatment >0



(h) Drop tech groups with zero Bell patents as control

Alternative treatment definitions III

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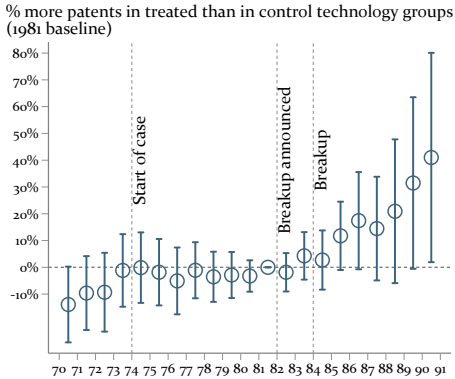
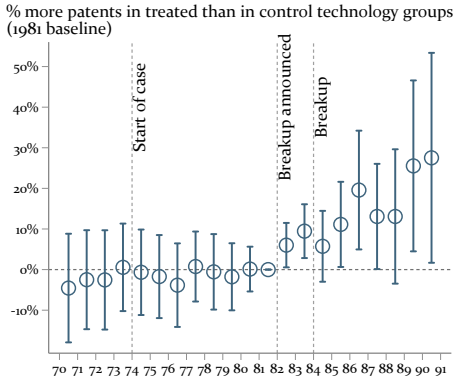


(i) Treatment defined by Bell patents granted 74-81



(j) Treatment defined by patents of foreign telecommunications companies in foreign patent offices

Alternative Samples I

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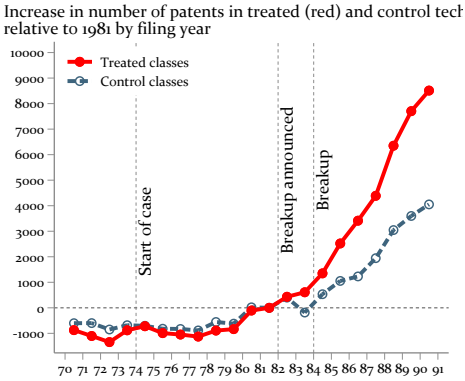
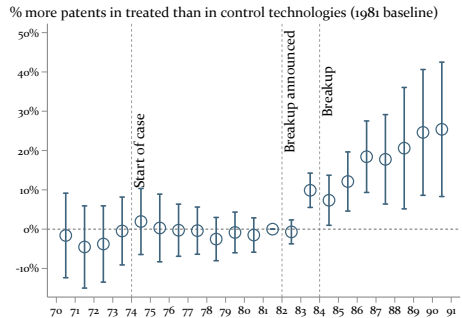


(k) Including foreign inventors - Total patenting



(l) Incl. foreign inventors - Treatment effects

Alternative Samples II

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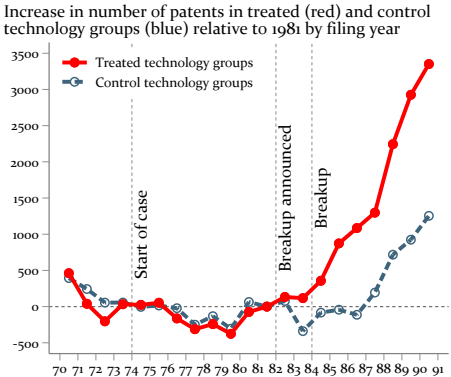
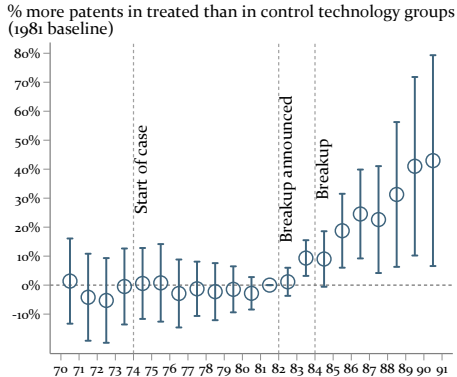


(m) Without Bell - Total patenting



(n) Without Bell - Treatment effects

Alternative Samples III: Leave-one-out

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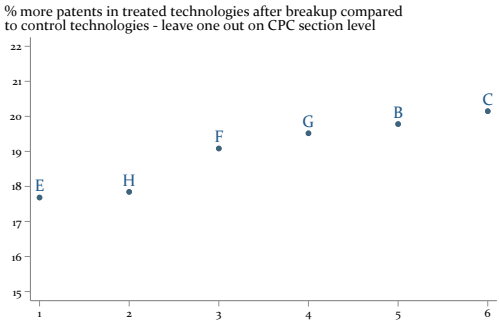
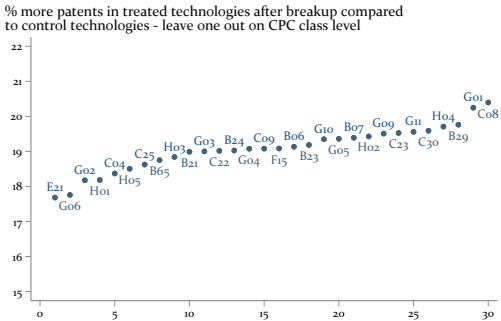


(o) CPC section level



(p) CPC class level

Alternative Samples IV: Leave-one-out

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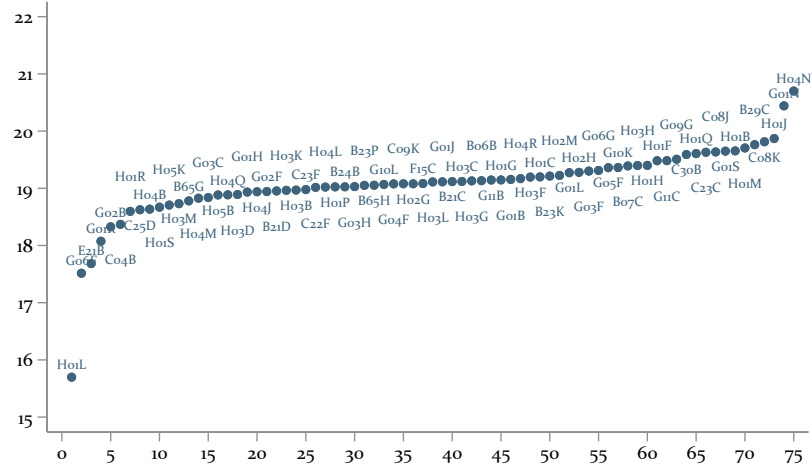
% more patents in treated technologies after breakup compared to control technologies - leave one out on CPC subclass level



Alternative outcomes: Patent quality

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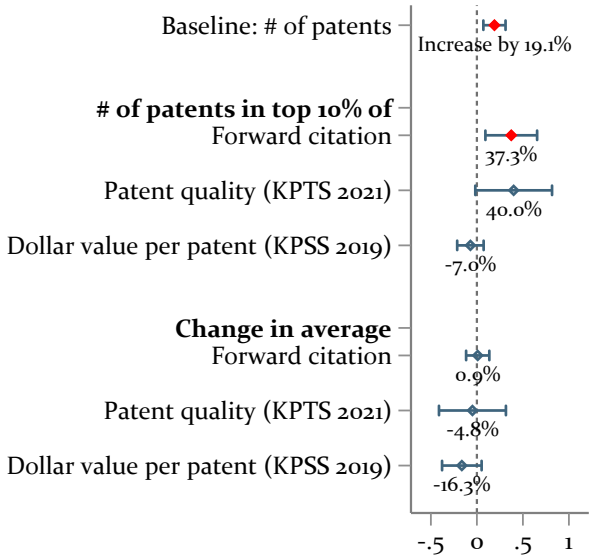

Diversity of innovation increases after the breakup

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