Polarized Technologies
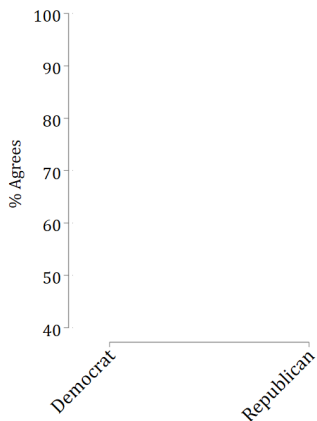
Gaia Dossi
UCL

Marta Morando
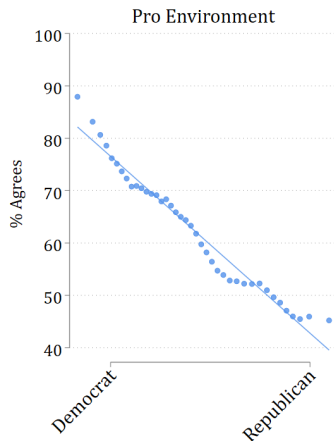LSE

April 2025

Democrats and Republicans Have Different Views on Fundamental Issues
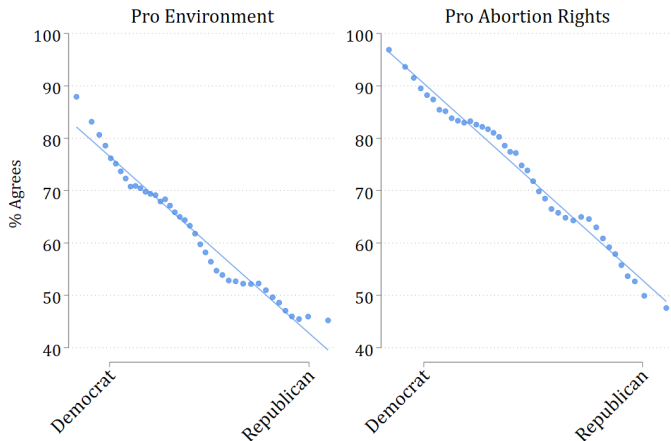
Democrats and Republicans Have Different Views on Fundamental Issues

Notes. ≈ 500,000 US citizens from CCES (2006-2023). All plots control for age, sex, county FE, year FE, employment status FE, race FE, education FE, and income bracket FE.

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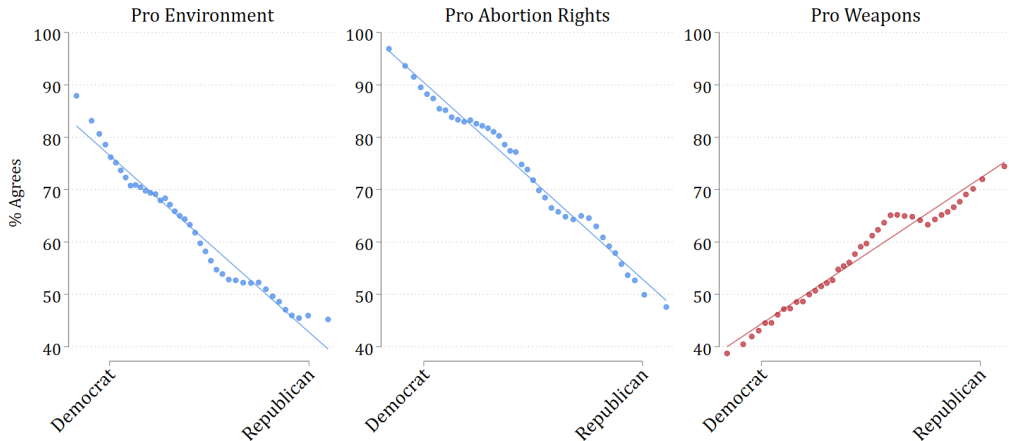# Democrats and Republicans Have Different Views on Fundamental Issues

▶ Views polarized by party (Gentzkow, 2016; Bertrand and Kamenica, 2023; Desmet et al., 2024)

Democrats and Republicans Have Different Views on Fundamental Issues

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▶ What are the implications of this divide?

   – Impact on individual decisions (e.g., consumption, health, fertility)

▶ This paper: This divide is reflected in the content and diffusion of new technologies

This Paper: Party Affiliation and Production and Diffusion of Innovation

▶ <u>Setting</u>: United States in years 2001–2023

▶ <u>Data</u>: Assemble a novel dataset of patents linked to political affiliation of inventors

▶ <u>Analysis</u>: How party affiliation shapes content and diffusion of new technologies

Preview of Findings

1. Inventors patent technologies aligned with the views of their political party
   1.1 Democrat and Republican inventors 1/3 differently likely to patent green innovation
   1.2 Similar gap for other polarized technologies: female health and weapons

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3. The diffusion of innovation is polarized
   3.1 Inventors are 20% more likely to cite technologies aligned with views of their party
   3.2 Similar pattern for citations from patents outside those technologies

Contributions to the Literature

▶ Party affiliation matters for household decisions and labor market outcomes

  – Consumption (e.g., Mian et al., 2023; Conway and Boxell, 2024), investment (e.g., Meeuwis et al., 2021), health and fertility (e.g., Allcott et al., 2020; Bursztyn et al., 2022; Dahl et al., 2022), productivity (e.g., Colonnelli et al., 2022; Teso et al., 2023; Engelberg et al., 2024), on-the-job decisions (e.g., Cohen and Yang, 2019; Jelveh et al., 2024)

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⇒ This paper: Link between views of inventors' political party and direction of innovation

▶ Individuals' networks shape the diffusion of innovation

– Networks (e.g., Jaffe et al., 1993, 2000), **interaction** (e.g., Singh, 2005), **gender homophily** (e.g., Koffi, 2024; Subramani and Saksena, 2024)

⇒ This paper: Inventors' political affiliation shapes the diffusion of new technologies

Outline

Outline

A New Dataset of Inventors Matched with Party Affiliation

▶ USPTO patents and inventors between 2001 and 2023

▶ Match inventors resident in the US to Voter Register Data (▸ Matching Algorithm)

    – In 2020, 73% of eligible voters were registered to vote

    – Registration rates higher for people with demographics similar to inventors

    – Upon registering, one can declare affiliation with a party (or remain unaffiliated)

▶ Information in voter records:

Last Name	First Name	Middle Name	City	ZipCode	Birth Date	Gender	Party	Registration Date
JOHN	SMITH	P	OAKLAND	941624	19250630	M	DEM	20071016

Focus on Florida, New Jersey, New York, Pennsylvania

▶ Merge patents and inventor records to voter registration data for FL, NJ, NY, & PA

  1. Top quartile of US states by total innovation (▸ Figure)

  2. States with closed primary system: Registration with a party is 4X higher

▶ Match rate: 53% of patents granted over the period

▶ Matched and unmatched inventors have similar characteristics (▸ Balance Table)

▶ Robustness & external validity: Match w/ Campaign Contributions data (Bonica, 2019)

Linking Technologies to Views of Political Parties

▶ Focus on politically polarized issues that can be mapped to technologies (▸ Topics)

▶ Dictionary approach on patents' abstracts to define three dummies:

   – Green

   – Female health

   – Weapons

▶ Robustness checks with non-dictionary measures: CPC classification

Outline

Empirical Specification

Define Y as $= 1$ if inventor i ever patented in technology j, $= 0$ otherwise

$$y_{i,t,c,s,a} = \beta_1 \text{Democrat}_i + \beta_2 \text{Other}_i + \beta_3 \text{Female}_i + \gamma_t + \delta_c + \zeta_s + \mu_a + \epsilon_{i,t,c,s,a}$$

- ▶ t represents year, c county, s CPC section, a birth year
- ▶ Other_i: small parties (e.g., Independent) and unaffiliated inventors
- ▶ Omitted party category: Republicans
- ▶ $\hat{\beta}_1 = \Delta$ propensity of Democrat and a Republican to ever patent technology j
- ▶ Standard errors clustered at county level

Inventors Patent Technologies Aligned With Views of their Political Party

	Green Technologies	
	(1)	(2)
Democrat	0.0024***	0.0034***
	(0.0009)	(0.0009)
N. of Inventors	95,595	95,302
Scaled Difference	21.61%	31.48%
Patent Year FE	✓	✓
County FE	✓	✓
Section FE	✗	✓
Inventor-level Controls	✗	✓

▸ Full Table

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Inventor-level Controls	✗	✓

▶ Democrat inventors: 22% more likely to patent green technologies. After FEs: 31%

[▸ Full Table]

Inventors Patent Technologies Aligned With Views of their Political Party

	Green Technologies		Female Health Technologies	
	(1)	(2)	(3)	(4)
Democrat	0.0024***	0.0034***	0.0037***	0.0019***
	(0.0009)	(0.0009)	(0.0008)	(0.0007)
N. of Inventors	95,595	95,302	95,595	95,302
Scaled Difference	21.61%	31.48%	68.12%	34.72%
Patent Year FE	✓	✓	✓	✓
County FE	✓	✓	✓	✓
Section FE	✗	✓	✗	✓
Inventor-level Controls	✗	✓	✗	✓

▶ Democrat inventors: 68% more likely to patent female technologies. After FEs: 35%

▸ Full Table

Inventors Patent Technologies Aligned With Views of their Political Party

	Green Technologies		Female Health Technologies		Weapon-related Technologies	
	(1)	(2)	(3)	(4)	(5)	(6)
Democrat	0.0024***	0.0034***	0.0037***	0.0019***	-0.0099***	-0.0067***
	(0.0009)	(0.0009)	(0.0008)	(0.0007)	(0.0014)	(0.0010)
N. of Inventors	95,595	95,302	95,595	95,302	95,595	95,302
Scaled Difference	21.61%	31.48%	68.12%	34.72%	-57.74%	-39.40%
Patent Year FE	✓	✓	✓	✓	✓	✓
County FE	✓	✓	✓	✓	✓	✓
Section FE	✗	✓	✗	✓	✗	✓
Inventor-level Controls	✗	✓	✗	✓	✗	✓

▶ Democrat inventors: 58% less likely to patent weapons. After FEs: 39% less likely

(▸ Full Table)

Comparison with Match by Gender

	Green Technologies		Female Health Technologies		Weapon-related Technologies	
	(1)	(2)	(3)	(4)	(5)	(6)
Democrat	0.0024***	0.0034***	0.0037***	0.0019***	-0.0099***	-0.0067***
	(0.0009)	(0.0009)	(0.0008)	(0.0007)	(0.0014)	(0.0010)
Female		0.0012		0.0069***		-0.0027***
		(0.0010)		(0.0011)		(0.0007)
N. of Inventors	95,595	95,302	95,595	95,302	95,595	95,302
Scaled Difference	21.61%	31.48%	68.12%	34.72%	-57.74%	-39.40%
Patent Year FE	✓	✓	✓	✓	✓	✓
County FE	✓	✓	✓	✓	✓	✓
Section FE	✗	✓	✗	✓	✗	✓
Inventor-level Controls	✗	✓	✗	✓	✗	✓

▶ Female health: Size of match by political party is 1/3 of match by gender

(▸ Male/Female) (▸ Full Table)

Robustness Checks: Alternative Specifications

▶ Additional Fixed Effects (▸ Figure)

    – Zip code of residence

    – County-by-year

    – CPC class

▶ Alternative Dependent Variables (▸ Figure)

    – LHS defined as $= 1$ if inventor i ever patented in technology j as first author

    – LHS defined as % of patents in technology j by inventor i

    – Using a Poisson count model on total n. of patents in technology j by inventor i

▶ Alternative Units of Observation (▸ Table)

    – Estimating a regression at the patent level (instead of inventor level)

Robustness Checks: Alternative Samples

▶ Is the match driven by inventors adopting the views of the firm? (▸ Figure)
  – Similar results for sample who registered young (before entering labor market)

▶ Is the match driven by patent examiners selectively granting patents? (▸ Figure)
  – Similar results in sample of patent applications

▶ Is the match limited to four US states? (▸ Figure)
  – Similar results across all US states using Campaign Contributions data

Outline

What Drives the Match Between Inventors and Technologies?
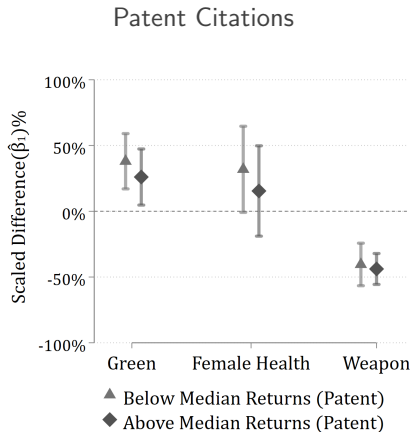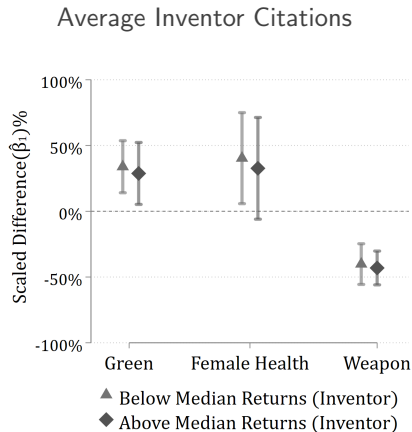
▶ <u>The Role of Returns</u>

    – Match persists across low- and high- inventor and patent economic returns

    – Inventor "quality" does not drive match with polarized technologies

▶ <u>The Role of Organizations</u>

    – Match persists across organization characteristics and within organizations

    – Match is mostly driven by inventors sorting into technologies, not organizations

The Role of Returns

Differential Returns Do Not Explain Match With Polarized Technologies

Average Inventor Citations

Patent Citations

- ▶ We proxy returns with patent citations (Akcigit et al., 2016)
- ▶ Measure of patent economic value and therefore of inventor income (Trajtenberg, 1990)
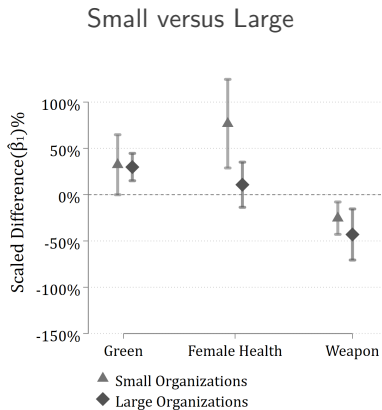
The Role of Organizations

Match with Polarized Technologies Persists Across Assignee Characteristics
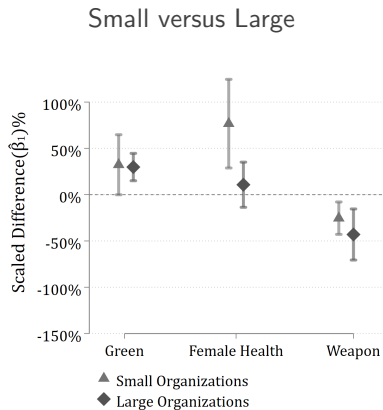
Small versus Large

► Match holds in small assignees: unlikely to be due to networks in hiring (Colonnelli et al., 2022)

Match with Polarized Technologies Persists Across Assignee Characteristics
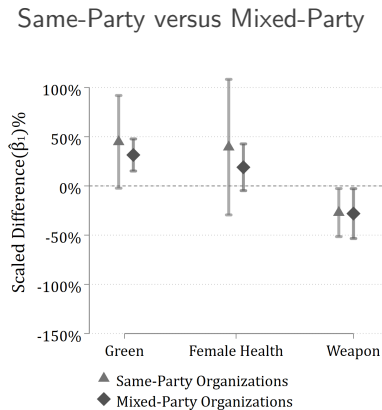

Small versus Large

Same-Party versus Mixed-Party

▶ Match holds in small assignees: unlikely to be due to networks in hiring (Colonnelli et al., 2022)

▶ Also holds in politically-homogeneous assignees: unlikely to be driven by homophily in hiring

Match with Polarized Technologies Persists Across Assignees

Assignee Fixed Effects
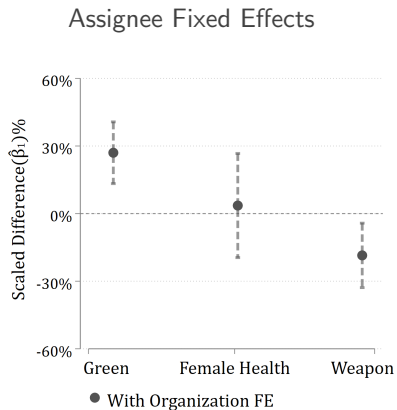
▶ Match holds within assignees (caveat: sample only includes large assignees)

Match with Polarized Technologies Persists Across Assignees

Assignee Fixed Effects

Academic versus Non-Academic
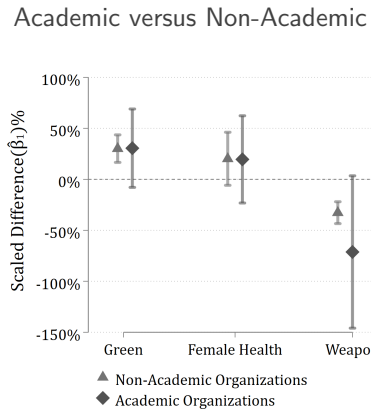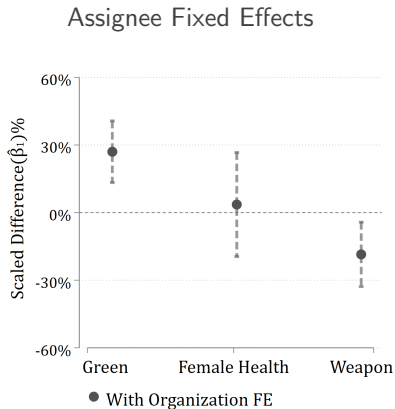
- ▶ Match holds within assignees (caveat: sample only includes large assignees)
- ▶ Also holds in universities: inventors have more freedom to choose direction of research
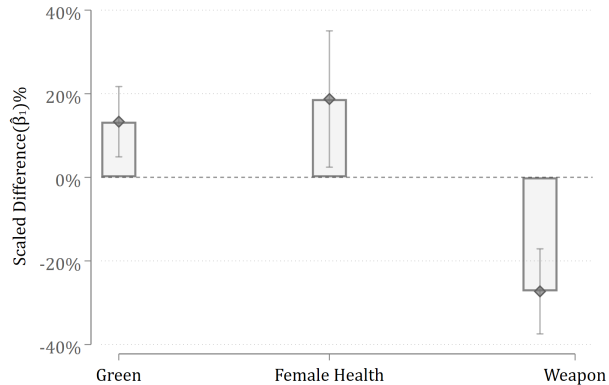
Outline

How Party Affiliation Shapes the Diffusion of Innovation

▶ So far: party affiliation shapes the propensity to patent polarized technologies

▶ Does party affiliation shape the diffusion of polarized technologies?

▶ Measure diffusion using patents' forward citations (e.g., Jaffe et al., 1993, 2000)

▶ Estimate same specification but $Y = \Pr(\text{Ever cite technology } j)$

$$y_{i,t,c,s,a} = \beta_1 \text{Democrat}_i + \beta_2 \text{Other}_i + \beta_3 \text{Female}_i + \gamma_t + \delta_c + \zeta_s + \mu_a + \epsilon_{i,t,c,s,a}$$

Inventors Cite Technologies Aligned With Views of their Political Party

Inventors Cite Technologies Aligned With Views of their Political Party
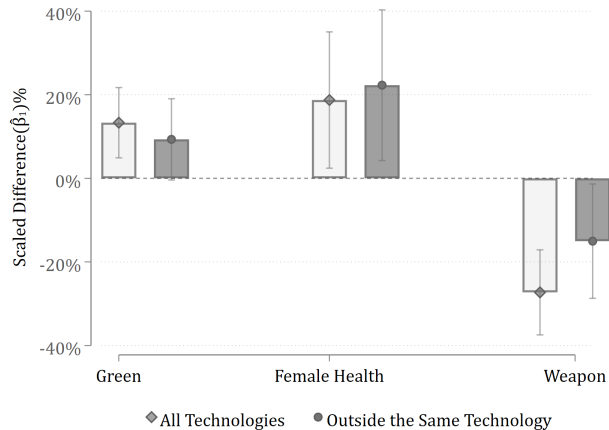
Outline

Discussion: What Drives Match with Polarized Technologies?

▶ Importance of inventor-level decisions, beyond product and labor market demand

▶ Why do inventors select different technologies depending on their party affiliation?

   1. Different information or beliefs on technology-specific returns (e.g., Alesina et al., 2020)

   2. Intrinsic motivation (e.g., Stern, 2004; Cassar and Meier, 2018) linked to content of work

   3. Childhood environment (Bell et al., 2018; Brown et al., 2023)

▶ What are the potential implications for innovation and growth?

   – Fewer new ideas (Atkin et al., 2022; Posch et al., 2024)

   – Lost productivity (Colonnelli et al., 2022; Evans et al., 2024)

Conclusions

Conclusions: Content and Diffusion of Innovation are Politically Polarized

▶ We link US inventors to their party affiliation

▶ Politically polarized issues: climate change, women's reproductive rights, gun control

▶ Republican and Democrat inventors are:
  – At least one-third differently likely to patent technologies mapping these issues
  – On average 20% differently likely to cite them

▶ New margin along which the political polarization of society reflects in the economy

▶ Implications for innovation & growth ⇒ Important avenue for future research

Additional Materials

Topics Covered in the CCES – Political Attitudes Module

- ▶ Abortion
- ▶ Environment
- ▶ Guns
- ▶ Health care
- ▶ Immigration
- ▶ Military
- ▶ Government spending
- ▶ Trade
- ▶ Gay marriage
- ▶ Affirmative action
- ▶ Income vs sales tax
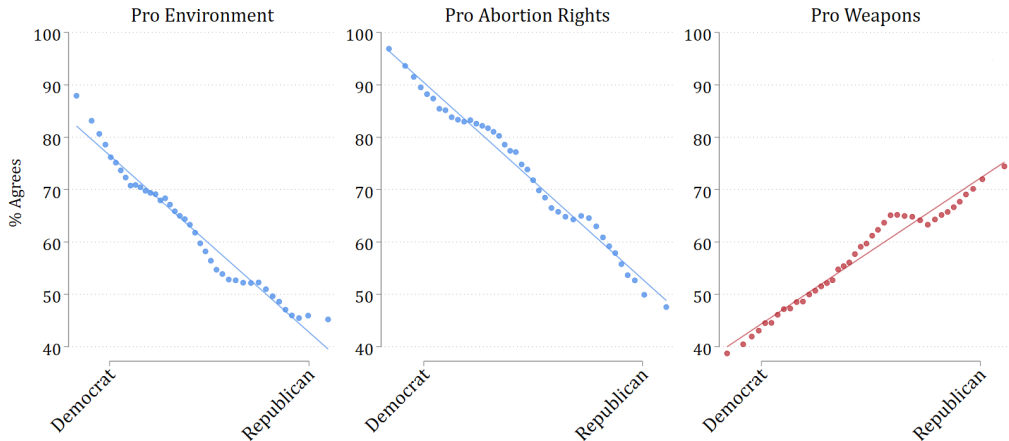
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Polarizing Issues: Individuals With Characteristics of Inventors ◂Back
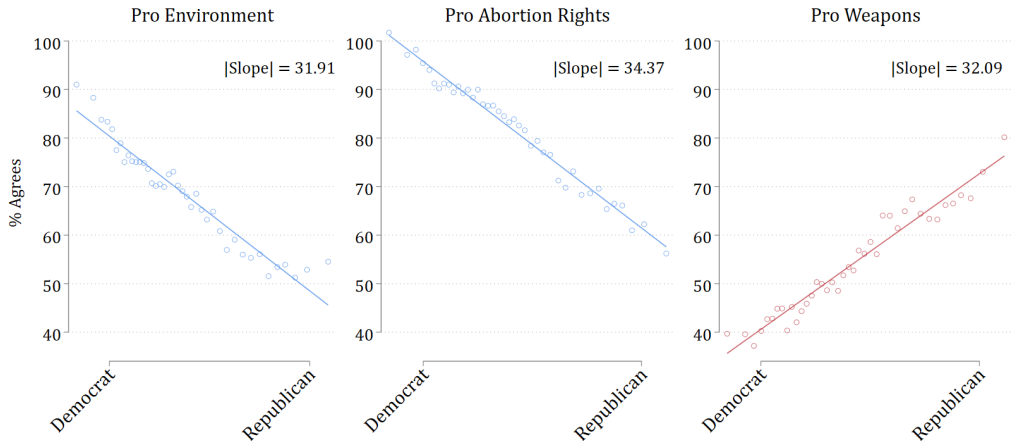
Notes. ≈ 500,000 US citizens from CCES (2006-2023). All plots control for age, sex, county FE, year FE, employment status FE, race FE, education FE, and income bracket FE. Sample: individuals with more than 150k in revenues per year and college graduates.

Notes. The figure plots the evolution of the yearly share of patents (by residence of inventors) for the top 10 US states in terms of innovation.

Merge Between Patent and Voters Data (◂ Back)

- NY 2020 (N. 19mln) + FL 2017 & 2022 (N. 16mln) + PA 2020 (N. 13mln) + NJ 2022 (N. 9 mln) voter data
- Drop those younger than 16 and older than 100 at registration + pre-clean strings in same way
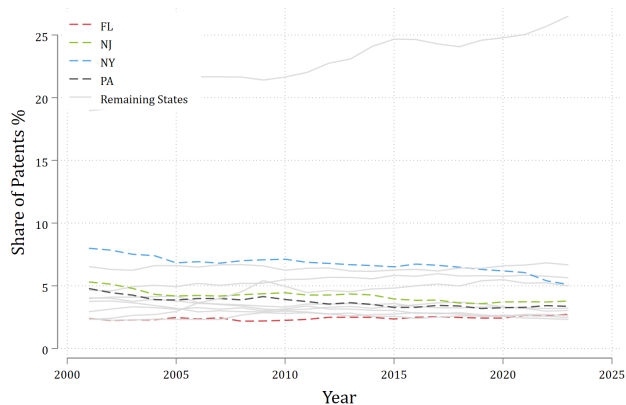- Conservative match algorithm (by state):
    1. Exact match last name, first name, and city of residence
    2. Middle initial matches exactly or missing in one of the two
    3. Remove those younger than 22 at the first or last patenting year
    4. Remove those older than 89 at the first or last patenting year
    5. Among duplicates:
        i. keep those with the same middle initials
        ii. keep those with same party (as Teso et al. (2023))
        iii. keep matches randomly
    6. Results unchanged if we keep only exact matches
- ≈ 53% of patents matched
- ≈ 8% of all US patents since 2001

Balance Table Matched-Unmatched Inventors ◀ Back

$H_0 = $ difference in characteristic X is larger than $10\% \times SD(X)$

	Matched		Unmatched		Matched-Unmatched	
	Mean (1)	Standard Deviation (2)	Mean (3)	Standard Deviation (4)	Standardized Difference (5)	P-value Equivalence Test (6)
Gender	0.134	0.341	0.151	0.358	-0.047	0.000
Num Consonants First Name	3.682	1.141	3.609	1.254	0.060	0.000
Num Consonants Middle Name	0.826	1.284	0.726	1.282	0.078	0.000
Num Consonants Last Name	4.138	1.400	4.032	1.575	0.070	0.000
Length First Name	5.842	1.516	5.820	1.754	0.013	0.000
Length Middle Name	1.201	1.976	1.078	1.998	0.062	0.000
Length Last Name	6.489	1.970	6.429	2.334	0.027	0.000

Difference between Republican & Democrat Inventors (Back)

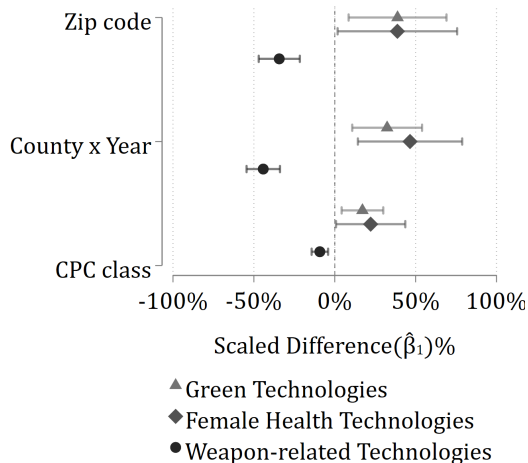|	Democrat		Republican		Democrat-Republican	
	Mean (1)	Standard Deviation (2)	Mean (3)	Standard Deviation (4)	Standardized Difference (5)	P-value Difference Test (6)
Female Dummy	0.183	0.386	0.088	0.283	0.277	0.000
Birth Year	1965	14.600	1962	13.120	0.215	0.000
Median Family Income (USD)	120,000	50,750	110,000	40,080	0.216	0.000
Section A	0.351	0.477	0.304	0.460	0.101	0.000
Section B	0.233	0.423	0.311	0.463	-0.174	0.000
Section C	0.235	0.424	0.155	0.361	0.203	0.000
Section D	0.015	0.120	0.016	0.124	-0.009	0.218
Section E	0.038	0.191	0.076	0.265	-0.164	0.000
Section F	0.104	0.306	0.173	0.378	-0.198	0.000
Section G	0.485	0.500	0.385	0.487	0.201	0.000
Section H	0.305	0.460	0.279	0.449	0.056	0.000
Section Y	0.235	0.424	0.263	0.440	-0.066	0.000

Inventors Patent Technologies Aligned With Views of Their Party

	Green Technologies			Female Health Technologies			Weapon-related Technologies		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Democrat ($\hat{\beta}_1$)	0.0024***	0.0036***	0.0034***	0.0037***	0.0023***	0.0019***	-0.0099***	-0.0067***	-0.0067***
	(0.0009)	(0.0008)	(0.0009)	(0.0008)	(0.0007)	(0.0007)	(0.0014)	(0.0010)	(0.0010)
Other ($\hat{\beta}_2$)	0.0016*	0.0019**	0.0019**	0.0020**	0.0012	0.0014*	-0.0057***	-0.0038***	-0.0040***
	(0.0009)	(0.0009)	(0.0009)	(0.0009)	(0.0008)	(0.0008)	(0.0010)	(0.0009)	(0.0009)
Female ($\hat{\beta}_3$)			0.0012			0.0069***			-0.0027***
			(0.0010)			(0.0011)			(0.0007)
N. of Inventors	95,595	95,595	95,302	95,595	95,595	95,302	95,595	95,595	95,302
% of Dem.	35.78	35.78	35.78	35.78	35.78	35.78	35.78	35.78	35.78
$\mathbb{E}(LHS)$ for Rep.	0.011	0.011	0.011	0.005	0.005	0.005	0.017	0.017	0.017
Scaled Difference %	21.61	32.49	31.48	68.12	41.63	34.72	-57.74	-39.05	-39.40
Patent Year FE	✓	✓	✓	✓	✓	✓	✓	✓	✓
County FE	✓	✓	✓	✓	✓	✓	✓	✓	✓
Section FE	✕	✓	✓	✕	✓	✓	✕	✓	✓
Birth Year FE	✕	✕	✓	✕	✕	✓	✕	✕	✓

Comparison With Match by Gender: Split by Male and Female ◂ Back

	Male Inventors			Female Inventors		
	(1)	(2)	(3)	(4)	(5)	(6)
Democrat	0.0026***	0.0015**	0.0015**	0.0053**	0.0048*	0.0047*
	(0.0008)	(0.0007)	(0.0007)	(0.0025)	(0.0025)	(0.0025)
N. of Inventors	82,547	82,547	82,547	12,738	12,738	12,738
Effect Size	55%	32%	32%	40%	36%	36%
Patent Year FE	✓	✓	✓	✓	✓	✓
County FE	✓	✓	✓	✓	✓	✓
Section FE	✗	✓	✓	✗	✓	✓
Age Controls	✗	✗	✓	✗	✗	✓

Scaled Difference($\hat{\beta}_1$)%

▲ Green Technologies
◆ Female Health Technologies
● Weapon-related Technologies

Scaled Difference($\hat{\beta}_1$)%

▲ Green Technologies
◆ Female Health Technologies
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Robustness Checks: Alternative Specification ◂Back

	Solo-Authored			Teams			Homogeneous		
	Green (1)	Female Health (2)	Weapon-related (3)	Green (4)	Female Health (5)	Weapon-related (6)	Green (7)	Female Health (8)	Weapon-related (9)
Democrat $\hat{\beta}_1$	0.0031**	0.0012	-0.0074***	0.0056***	0.0017	-0.0038***	0.0051***	0.0013*	-0.0029***
	(0.0016)	(0.0009)	(0.0019)	(0.0013)	(0.0012)	(0.0012)	(0.0012)	(0.0008)	(0.0011)
N. of Patents	53,189	53,189	53,189	122,026	122,026	122,026	122,026	122,026	122,026
% of Dem.	31.26	31.26	31.26	37.11	37.11	37.11	23.29	23.29	23.29
$\mathbb{E}(LHS)$ for Rep.	0.005	0.003	0.019	0.006	0.005	0.004	0.004	0.002	0.007
Scaled Difference (%)	60.44	42.44	-40.03	88.23	37.89	-88.85	134.73	53.40	-40.54

Scaled Difference($\hat{\beta}_1$)%

▲ Green Technologies
◆ Female Health Technologies
● Weapon-related Technologies
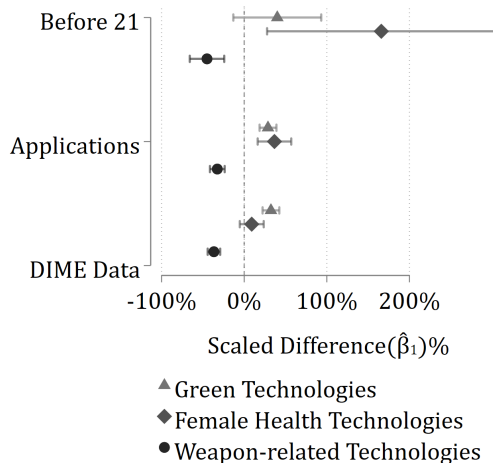
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